

Oral Health Literacy and Oral Health Status among Undergraduate University Students

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ABSTRACT

Introduction: To identify the prevalence of caries, plaque score, and periodontal disease and explore the correlations between oral health literacy scores and oral health status among undergraduate students. **Methods:** A cross-sectional study was conducted with a group of undergraduate students using the Malay version of the Oral Health Literacy (OHL) Index. A stratified random sampling technique was used to select the samples. Clinical oral examinations were conducted by a single trained examiner using a Community Periodontal Index (CPI) probe and a mouth mirror. Data analysis was conducted using statistical tests contained in SPSS version 26, and statistical significance was set at $p < 0.05$. **Results:** A total of 280 students were recruited into the study. The prevalence of caries and periodontal disease was 58.9 and 13.2%, respectively. There was a significant association between OHL and field of study ($p < 0.001$). There was also a significant negative but weak correlation between OHL and dental plaque scores ($r = -0.147$; $p = 0.014$). A significant positive but weak correlation was found between dental plaque scores and dental caries ($r = 0.135$; $p = 0.024$) and periodontal pocket depth ($r = 0.168$; $p = 0.005$). **Conclusion:** The prevalence of dental caries was high, while the prevalence of periodontal diseases was low in this study. OHL correlated significantly with dental plaque scores and field of the study. Thus, OHL assessment is essential to understand a person's OHL levels and can be considered a screening tool for early detection of poor oral hygiene.

KEYWORDS: Oral health literacy, dental plaque, dental caries, periodontal disease, undergraduate students

INTRODUCTION

Despite improved oral health, the prevalence of dental caries and periodontal problems is still high across the world [1]. The dental plaque or dental biofilm has a primary role in the development of periodontal diseases. The colonisation by bacteria and other micro-organisms that utilise sucrose to form glucan and dextran matrix, which can adsorb to the host surfaces, causes the development of a complex microbial community in the oral cavity. The interaction between micro-organisms in the dental biofilms produces an acidic environment, which causes enamel demineralisation, leading to the development of caries lesion and inflammatory reaction at the gingival margin [2].

Periodontal diseases are diseases involving the periodontium. It is a term used to describe the

supportive structures surrounding a tooth, including the gums (gingiva), alveolar bone, cementum, and periodontal ligaments [3]. There are two broad stages of periodontal diseases. The early or initial stage, called gingivitis, is described as the inflammation of the gingiva due to the accumulation of bacteria and debris between the gum line and tooth, also known as dental plaque. The later and more severe form is called periodontitis. This happens when the periodontal condition has progressed beyond gingivitis into a chronic, destructive, irreversible inflammatory disease state [3-4].

Recently, oral health literacy study has gained attention among researchers due to its relationship with oral health status [5]. Oral health literacy is known as the degree to which individuals can obtain, process and



understand basic health information and services needed to make appropriate oral health decisions [6]. Health literacy is a skill necessary for a person to understand health behaviour. On the other hand, misunderstanding of health instructions may result in individuals' inability to perform and adapt to healthy behaviour. Health literacy skills help patients communicate with healthcare workers, manage their medications, appointments, and prevent health problems [7]. Health literacy has also been considered a factor that determines a person's capability to stay healthy, recover from illness and improve health-related quality of life.

Previous research has demonstrated that a person with limited health literacy skills makes greater use of services designed to treat complications of the disease and less use of services designed to prevent complications [8]. Given the complexity of the healthcare system, it is not surprising that limited health literacy is associated with poor health. Moreover, low health literacy may also have negative psychological effects. Hence, those with limited health literacy skills report a sense of shame about their skill level. As a result, they may hide their reading or vocabulary difficulties to maintain their dignity [8]. Therefore, it is crucial to determine whether the public truly understands and benefits from the current oral health education material to achieve the National Oral Health Goals with improved oral health status among Malaysians [9].

It is also equally important to ensure that all health professionals have a high level of oral health literacy. They can promote oral health by supporting and spreading accurate oral health messages, showing exemplary oral health-related behaviour, and encouraging appropriate dental visits. As there are very few studies that had been conducted to assess the oral health literacy of undergraduates in local universities, this study is aimed to identify the prevalence of caries, plaque score, and periodontal disease and explore the possible correlation between oral health literacy and oral health status among undergraduate students.

MATERIALS AND METHODS

A cross-sectional study was conducted among undergraduate students of the Faculty of Dentistry, Faculty of Leadership and Management, Faculty of Quranic and Sunnah Studies, Faculty of Syariah and Law, Faculty of Economics and Muamalat, Faculty of Science and Technology, Faculty of Health and Sciences, Faculty of Major languages Studies, and Faculty of Engineering and Built Sciences, Universiti Sains Islam Malaysia (USIM) from October 2019 to January 2020. This study design was approved by the University's Ethics Committee [Ref No: USIM/FPG-MEC/2016/No.(53)]. A stratified random sampling technique was used to select samples according to three main fields of study: i) health science, ii) science and technology, and iii) social science. Students were excluded if they were mute, blind, or deaf. Moreover, subjects with any communicable diseases or absence during the day of the clinical examination were also excluded. A consent form was given to the students prior to collecting data, which were only collected after receiving informed consents from all participants. The students were given a validated self-administered questionnaire and then underwent a clinical oral examination.

Sample size calculation

The sample size was calculated using PS software [10] of the t-test formula. The standard deviation (SD = 0.6) reported in a previous study was used [11], with $\alpha = 0.05$ and power = 0.80. The sample size required was 280.

Calibration

Intra and inter-examiner calibration was performed using Cohen's kappa test. Intra-examiner calibration showed a substantial agreement¹² between the examiners with a score of 0.75, 0.71, and 0.85 for plaque score, dental caries, and periodontal condition, respectively.

Questionnaire

A validated Oral Health Literacy Index questionnaire in Malay version (OHLI-M) [13] was distributed to the subjects via a google form. The questionnaire consisted of three sections: 1) Sociodemographic profiles, 2) Oral

health behaviour/practices, and 3) OHLI-M questions, including reading comprehension (38 items) and numeracy sections (19 items). Each correct answer was given one mark, whereas the incorrect answer obtained zero marks. The total weighted score for OHLI-M ranged from 0 to 100. The score was obtained from the reading comprehension (each item was multiplied by 1.316) and numeracy sections (each item was multiplied by 2.632), with each section weighted score ranging from 0 to 50 marks. The higher the OHLI-M score, the higher the functional oral health literacy level of an individual. In addition, the cut-off point for inadequate oral health literacy was set at 59 and below. The data were tabulated into a Microsoft excel sheet before importing it to SPSS for data analysis.

Clinical examination

Upon completion of the self-administered questionnaire, students underwent oral examination. The clinical examination data were recorded into a standard pro forma recommended by WHO [12]. The clinical examinations were conducted in an open area within the university facilities at the main campus of Universiti Sains Islam Malaysia (USIM). A portable dental chair and a portable dental light were used to enhance the lighting for the oral examination. Clinical examinations were conducted by a single trained examiner using a disposable community periodontal index (CPI) probe and a disposable mouth mirror. Standard infection control precautions were implemented during the whole procedure. The oral examinations for oral health status were dental plaque scores using Silness and Løe [14], dental caries using DMFT [12] index, and periodontitis using Community Periodontal Index (CPI) [12].

In this study, the measurement of Silness-Løe plaque index was according to the recording of both soft debris and mineralised deposits on every four surfaces (buccal, lingual, mesial, and distal) of six index teeth: Maxillary right first molar(16), maxillary lateral incisor(12), maxillary left second premolar(24), mandibular left lateral incisor(32), mandibular right central incisor(41) and mandibular right first premolar(44). A score range of 0 (no plaque) to 3 (abundance of soft matter) was given for each tooth.

A total score of plaque index for a patient was obtained by summing the indices for all six teeth divided by six [14]. The DMFT was recorded according to the criteria recommended by WHO, defining dental caries when a lesion in a pit or fissure or on a smooth tooth surface had an unmistakable cavity, undermined enamel, or a detectably softened floor or wall. It also includes missing teeth due to caries and filled teeth. Periodontitis was assessed based on the periodontal pocket criteria defined by WHO [12] as the absence of conditions, pocket 4-5mm, and pocket more than 6mm at six index teeth: 17/16, 11, 26/27, 36/37, 31, 46/47. All teeth present in that sextant were examined, and the highest score was recorded as the score for the sextant. For further analysis of data, we categorised the periodontitis as the absence or presence of a periodontal pocket of 4mm and more.

Data analysis

Descriptive statistical analysis was performed using frequency and percentage for categorical variables. Mean and standard deviation or median and interquartile range were used for continuous variables or ranked data. A parametric analysis of independent t-test and one-way ANOVA was used for normally distributed data. Whereas for non-parametric analysis, the Mann-Whitney U test and Kruskal-Wallis were used for skewed DMFT data. Chi-square analysis was performed for categorical data variables. Pearson's correlation coefficient was performed between oral health literacy (OHL) and oral health status (OHS). In comparison, Spearman's correlation coefficient was performed for other non-parametric data with a significant level set at $p < 0.05$.

RESULTS

A total of 280 students were recruited in this study. The mean age was 22.3 years (SD= 1.17), ranging from 20 to 26 years. Most of them were female (82.1%), coming from urban areas (57.1%). Table 1 describes the OHL scores and OHS of the students. The mean score of plaque was 0.55 (95% CI= 0.50, 0.59). The prevalence of caries among the students was 58.9% (95% CI= 53.2, 64.6), whereas the prevalence of periodontitis was 13.2% (95% CI= 9.3, 17.5).

Table 1 Descriptive data of OHL and OHS of the students

Variables	Mean (SD)	% (95% CI)
OHL score	79.97 (10.18)	
Dental plaque	0.55 (0.37)	
Caries severity		
D(T)	1.54 (1.96)	
M(T)	0.26 (0.83)	
F(T)	1.41 (2.52)	
DMF(T)	3.22 (3.67)	
Dental caries		
No		41.1 (35.4, 47.1)
Yes		58.9 (53.2, 64.6)
Periodontal disease		
No		86.8 (82.5, 90.7)
Yes		13.2 (9.3, 17.5)

Table 2 depicts the comparison of OHL and OHS according to the student's demographic profiles. There was a significant difference between OHL and the field of study ($p < 0.001$). Post-hoc analysis of ANOVA indicated that students of social sciences had lower OHL compared to students of health sciences (mean difference = -10.90; 95% CI= -14.96, -6.83; $p < 0.001$). Moreover, Post-hoc analysis of ANOVA also indicated that students of social sciences had lower OHL compared to science and technology students (mean difference = -6.62; 95% CI= -9.88, -3.36; $p < 0.001$). For dental plaque scores, a significant difference was found between gender and the field of study (mean different= 0.29; 95% CI= 0.18, 0.40; $p < 0.001$). Male students had higher dental plaque scores compared to female students. The post-hoc test of ANOVA indicated that health science students had lower dental plaque scores than science and technology students (mean different= -0.21, 95% CI= -0.39, -0.02; $p = 0.020$) and social science students (mean different= -0.21; 95% CI= -0.37, -0.05; $p = 0.004$).

Table 3 depicts the differences between OHL and OHS on the oral health behaviour of the students. The dental plaque scores were significantly higher among students who brush their teeth less than twice a day (mean different= 0.23; 95% CI= 0.11, 0.34; $p < 0.001$). Students who had visited a dentist within the last 1 to 2 years had lower dental plaque scores than students who had visited a dentist more than 2 years ago (mean different= -0.10; 95% CI= -0.19, -0.01; $p = 0.038$). Students who perceived good oral health had lower dental plaque scores than students who perceived it as poor (mean different= -0.21; 95% CI= -0.36, -0.07;

$p = 0.001$) and fair (mean different= -0.15; 95% CI= -0.28, -0.02; $p = 0.020$) OHS. On the other hand, dental caries was found to be significantly higher among students who sought health information from a dentist than other resources ($p = 0.007$).

Table 4 depicts the correlation test between OHL and OHS. There was a significant negative, weak correlation between OHL and dental plaque scores ($r = -0.147$; $p = 0.014$). A significant positive, weak correlation was found between dental plaque scores and dental caries ($r = 0.135$; $p = 0.024$) and periodontitis ($r = 0.168$; $p = 0.005$).

DISCUSSION

Oral health is an essential part of general health. Thus, oral healthcare has been given considerable importance in Malaysia during the last decade. However, very few studies have been performed to assess the oral health of those who have had at least one year of basic science foundation. As future healthcare providers and representatives of the young adult population, the results of this study could be a baseline to expand further and develop appropriate oral health education materials, further improving oral health awareness and practice among young adults. Literature also suggests that higher oral health literacy is associated with better oral health status [13]. The lack of dental knowledge and poor oral health behaviour could be overcome by incorporating an oral health module in undergraduate training programs.

Based on our findings, the prevalence of periodontitis and dental caries among undergraduate USIM students was 13.2 and 58.9%, respectively. According to a survey conducted in Malaysia in 2010 among the same age group, the prevalence of periodontitis with the pocket of 4-5mm and ≥ 6 mm was 25.3 and 4.7%, respectively. The caries prevalence, on the other hand, was 69.7% [15]. Worldwide data showed a higher prevalence of periodontitis in adults aged 30 years and above, whereas the prevalence for adults aged 15 to 19 years was below 20% [16-17]. The prevalence of dental caries among adults worldwide was high as the disease affects nearly 100% of the population in the majority of countries [17].

Table 2 Comparison of OHL and OHS among the undergraduate students

Variables	OHL	<i>p</i> -value	Plaque	<i>p</i> -value	Caries	<i>p</i> -value	Periodontal pocket depth	<i>p</i> -value
	Mean (SD)		Mean (SD)		Median (IQR)		N (%)	
Gender								
Male	77.34 (13.26)	0.109	0.79 (0.44)	<0.001	2.50 (5.0)	0.515	5 (10.0)	0.459
Female	80.56 (9.30)		0.50 (0.33)		2.00 (5.0)		32 (13.9)	
Residency								
Urban	80.25 (9.97)	0.600	0.57 (0.35)	0.186	2.00 (4.0)	0.057	23 (14.4)	0.508
Rural	79.60 (10.48)		0.51 (0.40)		2.50 (4.0)		14 (11.7)	
Field of study								
Health	87.86 (7.64)	<0.001*	0.36 (0.21)	0.005 [#]	1.00 (6.0)	0.891	7 (18.9)	0.115
Science & technology	83.58 (7.52)		0.57 (0.41)		2.00 (6.0)		4 (6.1)	
Social science	76.97 (10.18)		0.58 (0.37)		2.00 (4.0)		26 (14.7)	

*One-way ANOVA

Post-hoc with Bonferroni test showed significant between Health science vs Social Science ($p<0.001$) and Science & Technology vs Social science ($p<0.001$).[#]One-way ANOVAPost-hoc with Bonferroni test showed significant between Health science vs Science & Technology ($p=0.020$) and Health science vs Science & Technology ($p=0.004$).**Table 3** Comparison between OHL and OHS with oral health behaviour among the undergraduate students.

Variables	OHL	<i>p</i> -value	Plaque	<i>p</i> -value	Dental caries	<i>p</i> -value	Periodontal pocket	<i>p</i> -value
	Mean (SD)		Mean (SD)		Median (IQR)		N (%)	
Frequency of tooth brushing per day								
Less than twice								
Twice or more	78.44 (10.76)	0.271	0.74 (0.41)	<0.001	2.00 (4.0)	0.350	5 (10.9)	0.607
	80.27 (10.06)		0.51 (0.35)		2.00 (5.0)		32 (13.7)	
Fluoridated toothpaste								
No	80.96 (6.44)	0.440	0.56 (0.38)	0.795	2.00 (4.0)	0.265	3 (11.1)	0.734
Yes	79.87 (10.50)		0.54 (0.37)		2.00 (5.0)		34 (13.4)	

Last dental visit								
No/When necessary	79.06 (10.74)	0.274	0.61 (0.42)	0.038	2.50 (5.0)	0.944	15 (15.5)	0.448
Within 1 to 2 years	80.47 (9.85)		0.51 (0.34)		2.00 (5.0)		22 (12.5)	
Perceived oral health								
Poor	79.79 (9.44)	0.410	0.63 (0.43)	0.002*	3.00 (5.0)	0.183	13 (16.7)	0.509
Fair	79.37 (10.03)		0.56 (0.36)		2.00 (5.0)		17 (12.7)	
Good	81.39 (11.25)		0.42 (0.29)		1.50 (4.0)		7 (10.3)	
Source of health-information								
Dentist	80.00 (11.04)	0.974	0.55 (0.43)	0.948	4.00 (6.0)	0.007	7 (12.3)	0.807
Others	79.95 (9.98)		0.55 (0.35)		2.00 (4.0)		30 (13.5)	

*One-way ANOVA

Post-hoc with Bonferroni test showed significant between Good vs Poor (p=0.001) and Good vs Fair (p=0.020)

Table 4 Correlation coefficient test between OHL and OHS

Variables	OHL	Plaque	Caries
Plaque	-0.147*	-	-
Caries	-0.45	0.135*	-
Periodontal pocketing	0.070	0.168**	0.070

*p<0.05, ** p<0.01

In general, females were reported to have lower dental plaque scores than male students. Moreover, females were found to practice better oral hygiene care than males, including frequent toothbrushing, flossing at least once a day, and visiting the dentist regularly [18-19]. Females also reportedly have more significant oral health knowledge, a more positive attitude, a healthier lifestyle, and a higher level of oral health behaviours than males [19]. However, if males can practice the same oral hygiene care as females, they also can obtain lower dental plaque [20].

The present study indicated that both participants from health and science and technology disciplines (the science stream) had higher oral health literacy than those from the social science discipline. There is no study, to our knowledge, that has observed similar findings. Most of the studies compared between health and non-health disciplines [21-22]. Science and technology discipline and health science discipline students had a background of basic science knowledge, which they learned in high school. Ploomipuu and colleagues [23] explained that people who had studied science during high school might have acquired the skills regarding information seeking, evaluating, and applying the evidence related to science. Hence, this group may have acquired the capability to make a better oral health decision than those who had not been exposed to science during high school.

Although the outcome of oral health literacy was almost similar between participants from the health and science and technology disciplines, the oral hygiene practices between the participants from the two disciplines were different. Health students were more acquainted with oral health knowledge than their counterparts in science and technology. Thus, they adopted better oral health behaviour, such as brushing their teeth twice or more a day, flossing their teeth, and visiting a dentist regularly [19, 21]. Brushing teeth at least twice a day is crucial for the removal of dental plaque [24-25]. The aim of toothbrushing is to prevent two major dental problems, namely dental caries and periodontal diseases. Kumar and colleagues [26] revealed that infrequent brushing, less than two times daily, can cause plaque-induced diseases such as gingivitis and dental caries. Hence, professional advice from a dentist and self-efficacy from the individuals is the key to better oral health.

Besides self-removal of plaque by brushing the teeth every day, a routine dental check-up at the dental clinic has been proven to reduce dental plaque [18-19]. Most individuals who routinely visit a dentist seek preventive dental care rather than operative care [27]. The preventive oral health care obtained during the visits is related to oral hygiene instruction, oral prophylaxis, dental sealant, and diet counselling [28-29].

Perceived oral health status has been reported to be a useful outcome measure in dentistry [30]. The present study found that perceived good oral health had lower dental plaque scores than a fair and poor perception of oral health. Martinez-Beneyto and colleagues [31] found that people who perceived better oral health had lower dental plaque scores. The probable explanation for low dental plaque and those with perceived good self-rated oral health is the frequency of toothbrushing a day. When someone believes to have good oral health, they are more motivated to practice good oral hygiene care, resulting in lower dental plaque scores [32-33].

Based on our knowledge, there is a lack of information on the association between the type of health information resources and the occurrence of dental caries. Patients would prefer to discuss their oral health problems face-to-face with the dentist [34]. Although the dentist had explained associated-oral health conditions and future management, patients tend to forget about the information [35]. On the other hand, seeking information from other resources such as the internet or pamphlet before confirming with the dentist increases the self-reported oral health status [36]. Thus, seeking information from multiple sources might strengthen the health motivation and oral health care behaviour of a person.

There is a positive correlation between dental plaque with dental caries and periodontitis. The microorganisms adhere to the tooth surface as a biofilm. This subject is the main attributable factor to caries formation and periodontal diseases. The recommended method to prevent and control the extension of both diseases is by frequent brushing of the teeth, at least twice daily for 2 to 3 minutes each time [24-25].

Studies have shown that health-literate people have the understanding and confidence that enable them

to manage their health daily. According to Hjertstedt and colleagues, a significant increase in oral health literacy over time has a significant impact on the level of dental plaque scores [37]. The finding agrees with the present study, which found that a high OHL was negatively associated with the level of dental plaque scores among undergraduate students. Ueno and colleagues [38] also found that individuals with a high literacy rate have better oral hygiene status. They adopt good oral hygiene practice by brushing their teeth frequently, self-checking their oral condition with a mirror, and having regular dental check-ups.

However, this study has some limitations. The CPI criteria recommended by the WHO include the measure of both gingival bleeding and periodontal pocket in determining periodontal disease. Moreover, in this study, gingival bleeding was dropped, and the status of periodontal disease was merely based on the measure of the overall periodontal pocket of ≥ 4 mm. Therefore, the data presented must be carefully interpreted.

Despite the limitation, this study provides additional information for potential application in research, emphasising further the need to improve oral health literacy in oral health promotion. For research purposes, this study can be extended to other institutions to examine whether differences in the field of study influence oral health literacy. In oral health promotion, there is a need to re-evaluate the health-related information given to ensure it enhances the oral health knowledge of the population.

CONCLUSION

The prevalence of dental caries among undergraduate students was high, while the prevalence of periodontal diseases was low. OHL was significantly correlated with dental plaque scores and the field of study. Lower OHL was associated with higher dental plaque scores. Thus, indicating that oral health promotion and programmes could be tailored to the non-science disciplines students to enhance their OHL skills.

Authors' Contribution

Dr Azlan Jaafar, Dr Normaliza Ab Malik and Dr Aws Hashim Ali were equally involved and contributed to the conduction this study, and all were actively involved in writing up and critical revision for this manuscript.

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Conflict of Interest

Authors declare none.

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