ORIGINAL ARTICLE

# ORAL HEALTH KNOWLEDGE AMONG FAMILY PHYSICIANS IN PUBLIC PRIMARY HEALTHCARE FACILITIES IN MALAYSIA

**Khuzaimah Kamarazaman[1], Norkhafizah Saddki[1], Zainab Mat Yudin@Badrin[1*], Noraini Mohamad[1], Zuliani Mahmood[1] and Norsiah Ali[2]**

*[1]School of Dental Sciences, Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kota Bharu, Kelantan, Malaysia*
*[2]Klinik Kesihatan Masjid Tanah, 78300, Melaka, Malaysia*

**Corresponding author: Zainab Mat Yudin@Badrin**
**Email: drzainab@usm.my**

## ABSTRACT

*Integration of oral healthcare into primary care is recommended to improve the oral health of patients. This study assessed oral health knowledge among family physicians in Malaysia. A postal survey was done on family physicians working at the Ministry of Health primary healthcare facilities. Structured questionnaires* containing *85 items assessing 5 sub-domains* were delivered to 350 family physicians. *A total of 138 responses were analysed. Most family physicians were able to identify the risk factors as well as signs and symptoms of dental caries, periodontal disease, and oral cancer, and recognize the link between oral diseases and general health, the oral side effects of medications, and the correct oral hygiene practices. However, misunderstandings were also common such as* not knowing that *dental caries is an infectious disease (56.5%) and a poorly fitting denture is a risk of oral cancer (60.1%) and having the misconception that the developing foetus draws calcium from the mothers' teeth (60.0%). The mean knowledge score was significantly higher in physicians who had attended an in-service training program on oral health than those who had not. In conclusion, most family physicians in this study had adequate basic knowledge about oral health although some common misunderstandings in several issues. A significant relationship was found between oral health knowledge and experience of attending in-service oral health education programs. A structured continuous professional development program to improve oral health knowledge of family physicians and other primary healthcare providers is recommended.*

***Keywords**: Family physician, oral health, knowledge*

## INTRODUCTION

The mouth is an integral part of the body. Besides having essential functions in the human digestive system, the mouth is part of the face that has unique roles in personal identity, body image, and interpersonal relationships[1]. Oral diseases refer to an array of craniofacial disorders, congenital anomalies, injuries, and infections that affect the soft and hard tissues of the mouth[2]. The personal impact of untreated oral diseases is often severe. It can include pain, discomfort, restriction in the functions normally expected, such as eating **and** speaking, and limitations in the ability to perform activities of daily living due to the physical, psychological, and social impact of the disease[2]. Additionally, treatment costs can pose a substantial economic burden on the family, society, and healthcare system[2].

Dental caries, periodontal disease, and oral cancers are significant public health problems of global magnitude[2]. Worldwide, the burden of untreated dental caries has remained relatively unchanged over the past 30 years despite the declining prevalence reported in many countries[3]. In Malaysia, caries prevalence is relatively high at 88.9% in adults, 33.3% in 12-year-old children, and 71.3% in 5-year-old children[4-6]. The prevalence of periodontal disease in adults is also high at 93.3% [4]. Oral cancer was reported at 0.8% among males and 0.9% among females in Malaysia between the year 2007 and 2011[7].

Oral health is associated with general health in several ways. Scientific evidence has linked oral diseases to various systemic diseases and conditions, including diabetes mellitus, cardiovascular disease, and adverse pregnancy outcomes[8]. The link can also be bidirectional[9]. Certain oral diseases are indicative of underlying systemic conditions, making the **mouth** an important diagnostic tool[10]. Some of the common medications used to treat chronic diseases are known to have oral side effects such as reducing salivary flow[11]. Oral diseases, some chronic diseases, and conditions share common risk factors, such as diet being the risk factor for dental caries, diabetes, obesity, and cardiovascular disease[12].

Given the link between oral health and systemic diseases and conditions, there is a growing interest in the roles of non-dental health professionals in preventive oral healthcare. Family physicians are medical specialists who provide continuing, comprehensive primary care for an individual and the family. Being the first

point of contact for most people seeking healthcare, family physicians are in an excellent position to help perform oral screening to detect signs and symptoms and refer patients to dentists accordingly[13,14]. This study examined the oral health knowledge of family physicians working at public healthcare facilities in Malaysia. We also assessed the influence of age, sex, length of service as a family physician, exposure to structured learning on oral health during undergraduate and postgraduate studies, and experience of attending in-service training on oral health.

## METHODS

### Study design, population, and sample

This was a cross-sectional study conducted from February to May 2018 among family physicians working at public healthcare facilities in Malaysia. The sample size was calculated using the single proportion formula with a 95% confidence interval (CI). The proportion was estimated at 25.0%, which was the proportion of medical physicians who knew that bacteria causing dental caries are transmitted from mother to child15. At a precision of 5%, a sample size of 288 was yielded. Anticipating a 30% non-response rate, a sample size of 374 was decided. The ethical approval to conduct this study was obtained from the Universiti Sains Malaysia Human Research and Ethics Committee (USM/JEPeM/16120583) and the Ministry of Health Malaysia Medical Research and Ethics Committee [NMRR-16-2639-33103(IIR)].

### Research tool

We developed a new self-administered questionnaire to collect the variables of interest. This questionnaire was developed in English as the target population was health professionals who were fluent in English. Five content experts were involved in developing this questionnaire: one dental public health specialist, one paediatric dental specialist, two family physicians, and one medical public health specialist.

Following conceptualisation, questionnaire development started with item generation. This was done through a literature review and a series of discussions. A total of 94 knowledge items were generated. Then the sub-domains were defined, and the generated items were group into the sub-domains. A specification table was used to ensure that there were sufficient items to address each sub-domain and redundant items were eliminated.

The pre-final draft was tested on 28 medical doctors undertaking a postgraduate degree in Family Medicine at the School of Medical Sciences, Universiti Sains Malaysia. Feedbacks were favourable, only minor technical editing was required. The time required to complete the questionnaire was between 15 to 20 minutes. The questionnaire has a good internal consistency reliability coefficient with a Cronbach's alpha of 0.795.

The final questionnaire consists of the following sub-domains: 1) knowledge of common oral diseases and complications (8 items), 2) knowledge of risk factors of dental caries, gum disease, and oral cancer (18 items), 3) knowledge of signs and symptoms of dental caries, gum disease and oral cancer (14 items), 4) knowledge of the association between oral diseases and systemic diseases or conditions (27 items), and 5) knowledge of oral health and oral hygiene care (18 items). The response format for all items was closed-ended with the options of “true”, “false” and “do not know”. For each item, a score of one (1) was given for correct answers, and a score of zero (0) was given for incorrect and “do not know” answers. The total knowledge score may range from 0 to 85. A higher score indicates better oral health knowledge. An additional structured form was used to collect information on age, sex, ethnic group, length of service as a family physician, exposure to oral health-related subject/course/module in the undergraduate and postgraduate curriculum, and experience of attending in-service training programs such as continuous medical education, seminar, course, or workshop on oral health.

### Data collection

During the time of the study, data from the Family Health Development Division, Ministry of Health Malaysia showed that there was a total of 350 family physicians working at public healthcare facilities throughout Malaysia. No sampling was done, and all 350 physicians were invited to participate. The questionnaires were sent to their current work address via postal service. Each envelope contained the study information sheet, an informed consent form, and a sealable stamped envelope with the name and address of the main author for returning the completed questionnaire. A token of appreciation was also enclosed.

One week prior to sending the questionnaire, an e-poster was circulated via WhatsApp message to all physicians through the State representatives, informing and alerting them about this study, receiving the questionnaire in the mail, and inviting them to participate. One month after questionnaire distribution, a reminder WhatsApp message was circulated through the representatives, followed by the second and the third (final) reminder at one-month interval.

### Statistical analysis

Data processing and analysis were done using the IBM SPSS Version 26. We used descriptive statistics to obtain the frequency and percentage (%) of categorical variables and the mean or

median of continuous numerical variables. Simple linear regression was performed to investigate factors associated with oral health knowledge (mean knowledge score). The following independent variables were tested: age, sex, ethnic group, length of service as a family physician, exposure to oral health-related subject/course/module during undergraduate and postgraduate studies, and experience of attending in-service training on oral health. The significance level was set at 0.05. Multiple linear regression analysis was not performed as only one factor was found to be significantly associated with the mean knowledge score at the univariable level analysis.

**RESULTS**

A total of 140 family physicians returned the questionnaires. However, two responses were omitted due to having substantial missing data. The number of usable responses was 138, yielding a response rate of 39.4%. A new precision value was calculated. The precision of the study has changed from 5.0% to 7.2%, increasing the width of 95% CI from 10% to 14%. The new precision is deemed acceptable for the estimated proportion of outcomes.

Most of the 138 respondents were females (81.2%). Their age ranged from 30 to 58 years old, with a mean age of 43.2 years (SD=6.39). Most physicians were from Malay ethnicity (70.3%), followed by Chinese (17.4%), Indian (8.7%), and other ethnic groups (3.6%). The mean length of service as a family physician was 7.3 years (SD=6.10), and most have worked as a family physician less than 5 years (50.7%). Most physicians had not been exposed to any structured learning on oral health during their undergraduate (92.0%) and postgraduate training (97.1%). Similarly, most had never attended any in-service training program on oral healthcare (86.2%).

Table 1 shows knowledge of common oral diseases and their complications. More than half of the physicians did not know that dental caries is an infectious disease (56.5%). However, most of them could correctly answer questions about dental plaque. Additionally, most physicians could correctly identify most risk factors, signs, and symptoms of dental caries, gum disease, and oral cancer (Table 2).
Table 3 shows knowledge of the association between oral diseases and systemic diseases or conditions among the family physicians. Only approximately half of the physicians knew that gum diseases is an early sign of diabetes (54.0%) and is associated with premature birth (55.0%) and low birth weight babies (58.0%). Additionally, most physicians incorrectly thought that calcium would be absorbed from a pregnant woman's teeth by the developing foetus (60.0%). Most physicians could not identify reduced salivary flow as the side effect of muscle relaxants (55.1%), antiretrovirals (52.9%), analgesics (63.0%), calcium channel blockers (63.0%), antacids (63.8%), and angiotensin-converting enzyme inhibitors (64.5%).

**Table 1. Knowledge of the common oral diseases and their complications (n=138)**

| Variable | Frequency (%) | | |
|---|---|---|---|
| | Correct | Incorrect | Don't know |
| Dental caries is an infectious disease | 60 (43.5) | 70 (50.7) | 8 (5.8) |
| Dental plaque is a soft, sticky yellowish-white film that builds up on tooth surface | 123 (89.1) | 13 (9.4) | 2 (1.4) |
| Dental plaque contains bacteria | 105 (75.4) | 18 (13.0) | 16 (11.6) |
| Toxins from bacteria plaque can destroy the bones and connective tissues supporting the tooth | 128 (92.8) | 2 (1.4) | 8 (5.8) |
| Plaque that is not removed daily can eventually harden into calculus | 133 (96.4) | 3 (2.2) | 2 (1.4) |
| Prolonged bottle feeding with milk and fruit juice during bedtime and/or naptime can cause dental caries in children | 130 (94.2) | 2 (1.4) | 6 (4.3) |
| Cellulitis is a complication of untreated dental caries | 111 (80.4) | 14 (10.1) | 13 (9.4) |
| Oral cancer can be life threatening if not diagnosed and treated early | 135 (97.8) | 1 (0.7) | 2 (1.4) |

Table 2: Knowledge of the risk factors, signs and symptoms of dental caries, gum disease and oral cancer (n=138)

| Variable | Frequency (%) | | |
|---|---|---|---|
| | Correct | Incorrect | Don't know |
| Risk factors of dental caries include: | | | |
| High frequency of sugar intake | 137 (99.3) | 0 (0.0) | 1 (0.7) |
| Cigarette smoking | 122 (88.4) | 11 (8.0) | 5 (3.6) |
| Reduce saliva flow | 119 (86.2) | 7 (5.1) | 12 (8.7) |
| Genetic susceptibility | 27 (19.6) | 76 (55.1) | 35 (25.4) |
| Signs and symptoms of dental caries include: | | | |
| Brown or black spot on tooth surface | 123 (89.1) | 7 (5.1) | 8 (5.8) |
| Toothache | 122 (88.4) | 11 (8.0) | 45 (3.6) |
| White spot on tooth surface | 67 (48.6) | 38 (27.5) | 33 (23.9) |
| Risk factors of gum disease include: | | | |
| Cigarette smoking | 136 (98.6) | 0 (0.0) | 2 (1.4) |
| Poor oral hygience | 135 (97.8) | 0 (0.0) | 3 (2.2) |
| Having systemic diseases or conditions | 132 (95.7) | 2 (1.4) | 4 (2.9) |
| Malnutrition | 129 (93.5) | 4 (2.9) | 5 (3.6) |
| Genetic susceptibility | 87 (63.0) | 11 (8.0) | 40 (29.0) |
| Stress | 87 (63.0) | 22 (15.9) | 29 (21.0) |
| High frequency of sugar intake | 2 (1.4) | 127 (92.1) | 9 (6.5) |
| Signs and symptoms of gum disease include: | | | |
| Bleeding gums | 132 (95.1) | 3 (2.2) | 3 (2.2) |
| Bad breath | 128 (92.8) | 5 (3.6) | 5 (3.6) |
| Red gums | 127 (92.0) | 6 (4.3) | 5 (3.6) |
| Loose tooth | 126 (91.3) | 6 (4.3) | 6 (4.3) |
| Longer appearance tooth | 85 (61.6) | 21 (15.2) | 32 (23.2) |
| Risk factors of oral cancer include: | | | |
| Tobacco use of any kind | 136 (98.6) | 0 (0.0) | 2 (1.4) |
| Betel quid chewing habit | 133 (96.4) | 3 (2.2) | 2 (1.4) |
| Excessive alcohol consumption | 111 (80.4) | 19(13.8) | 8 (5.8) |
| HPV infection | 102 (73.9) | 15 (10.9) | 21 (15.2) |
| Excessive sun exposure to lips | 90 (65.2) | 27 (19.2) | 21 (15.2) |
| High frequency of sugar intake | 62 (44.8) | 59 (42.8) | 17 (12.3) |
| Poorly fitting denture | 55 (39.9) | 51 (37.0) | 32 (23.2) |
| Signs and symptoms of oral cancer include: | | | |
| Oral ulcer that doesn't heal after 2 weeks | 132 (95.7) | 0 (0.0) | 6 (4.3) |
| A growth or thickening of oral mucosa | 131 (94.9) | 1 (0.7) | 6 (4.3) |
| A lump in the neck or facial region | 121(87.7) | 9 (6.5) | 8 (5.8) |
| A red or white patch on oral mucosa | 115 (83.3) | 15 (10.9) | 8 (5.8) |
| Difficulty in chewing, swallowing, opening the mouth, or moving the tongue | 111 (80.4) | 19 (13.8) | 8 (5.8) |
| Numbness in the mouth and lips | 71 (51.4) | 30 (21.7) | 37 (26.8) |

Most respondents could correctly answer questions about oral health and oral hygiene care (Table 4). However, most incorrectly thought gum bleeding during tooth brushing and flossing is normal (61.6%). Additionally, while a few thought that fluoride in toothpaste is associated with human cancer (10.1%), almost half (43.5%) were not sure about it. The mean knowledge score was 62.7 (SD=10.13).

Simple linear regression showed a significant relationship between mean knowledge score and experience of attending in-service training programs (p=0.002) (Table 5). Physicians who had attended an in-service training program on oral health had a higher mean knowledge score than those who had not.

Table 3: Knowledge of the association between oral diseases and systemic diseases or conditions (n=138)

| Variable | Frequency (%) | | |
|---|---|---|---|
| | Correct | Incorrect | Don't know |
| Gum disease is an early sign of diabetes | 75 (54.0) | 38 (27.3) | 26 (18.7) |
| Severe gum disease may make it more difficult for diabetic patients to control their blood sugar | 111 (79.9) | 14 (10.1) | 14 (10.1) |
| Treatment for gum disease in diabetic patients is associated with improved glycemic control | 110 (79.1) | 7 (5.0) | 22 (15.8) |
| Uncontrolled diabetes can decrease saliva flow leading to xerostomia (dry mouth) | 107 (77.0) | 8 (5.8) | 24 (17.3) |
| Pregnant women are susceptible to gum diseases due to hormonal changes associated with pregnancy | 122 (88.4) | 1 (0.7) | 15 (10.9) |
| Calcium will be absorbed out of a pregnant woman's teeth by the developing fetus | 23 (16.7) | 84 (60.0) | 31 (22.5) |
| Dental treatment during pregnancy may harm the fetus | 124 (89.9) | 7 (5.1) | 7 (5.1) |
| Adverse pregnancy outcome associated with gum diseases include: | | | |
| Low birth weight babies | 80 (58.0) | 19 (13.8) | 39 (28.3) |
| Premature birth | 76 (55.0) | 19 (13.8) | 43 (31.2) |
| Women who take oral contraceptive are at risk for gum inflammation | 64 (46.4) | 34 (24.6) | 40 (29.0) |
| Menopausal women are at increased risk for loss of alveolar (jaw) bone density due to decline in estrogen | 114 (82.6) | 1 (0.7) | 23 (16.7) |
| Medications that can reduce salivary flow include: | | | |
| Antihistamines | 113 (81.9) | 13 (9.4) | 12 (8.7) |
| Diuretics | 112 (81.2) | 14 (10.1) | 12 (8.7) |
| Antidepression | 112 (81.2) | 8 (5.8) | 18 (13.0) |
| Muscle relaxants | 62 (44.9) | 37 (26.8) | 39 (28.3) |
| Antiretrovirals | 65 (47.1) | 30 (21.6) | 43 (31.2) |
| Analgesics | 51 (37.0) | 54 (39.1) | 33 (23.9) |
| Calcium channel blockers | 51 (37.0) | 42 (30.4) | 45 (32.6) |
| Antacids | 50 (36.2) | 43 (31.3) | 45 (32.6) |
| Angiotensin converting enzyme inhibitors | 49 (35.5) | 44 (31.9) | 45 (32.6) |
| Medications that can cause gum overgrowth include: | | | |
| Phenytoin | 125 (90.6) | 6 (4.3) | 7 (5.1) |
| Calcium channel blockers | 81 (58.7) | 28 (20.3) | 29 (21.0) |
| HIV-related oral lesions include: | | | |
| Oral candidiasis | 136 (97.8) | 0 (0.0) | 3 (2.2) |
| Oral hairy leukoplakia | 136 (97.8) | 0 (0.0) | 3 (2.2) |
| Kaposi's sarcoma | 124 (90.5) | 6 (4.4) | 7 (5.1) |
| Oral non-Hodgkin's lymphoma | 114 (82.0) | 6 (4.3) | 19 (13.7) |
| Severe form of gum diseases | 113 (81.3) | 8 (5.8) | 18 (12.9) |

Table 4: Knowledge of oral health and oral hygiene care (n=138)

| Variable | Frequency (%) | | |
|---|---|---|---|
| | Correct | Incorrect | Don't know |
| Toothbrushing at least twice daily is recommended | 131 (94.9) | 5 (3.6) | 2 (1.4) |
| A soft-bristled toothbrush is best for removing plaque and debris from teeth | 109 (79.0) | 14 (10.1) | 15 (10.9) |
| Firm-bristled toothbrush is more likely to traumatized gum | 120 (87.0) | 16 (11.6) | 2 (1.4) |
| Firm-bristled toothbrush is more likely to wear away tooth surface | 108 (78.3) | 20( 14.5) | 10 (7.2) |
| A toothbrush can be shared among family members | 129 (93.5) | 6 (4.3) | 3 (2.2) |
| A toothbrush needs to be replaced when the bristles are worn and splayed | 112 (81.2) | 25 (18.1) | 1 (0.7) |
| Brushing teeth with fluoridated toothpaste can help prevent dental caries | 129 (93.5) | 8 (5.8) | 1 (0.7) |
| Children's teeth should be brushed with fluoridated toothpaste as soon as they appear | 50 (36.2) | 73 (52.9) | 15 (10.9) |
| For children younger than 3 years, fluoridated toothpaste in an amount of a smear layer should be used | 79 (57.2) | 35 (25.4) | 24 (17.4) |
| Children's toothbrushing should be supervised | 132 (95.7) | 1 (0.7) | 5 (3.6) |
| There is an association between fluoride in toothpaste and human cancer | 64 (46.4) | 14 (10.1) | 60 (43.5) |
| Dental floss is used to remove dental plaque between teeth where toothbrush bristles can't reach | 125 (90.6) | 12 (8.7) | 1 (0.7) |
| Gum bleeding during toothbrushing or flossing is normal | 43 (31.2) | 85 (61.6) | 10 (7.2) |
| Toothbrushing and flossing should be stopped if the gum bleeds | 81 (58.7) | 45 (32.6) | 12 (8.7) |
| Flossing at least once a day is recommended | 118 (85.5) | 8 (5.8) | 12 (8.7) |
| Mouth rinses can help to control or reduce oral diseases | 115 (83.3) | 13 (9.4) | 10 (7.2) |
| Consumption of sugar-containing foods and drinks should be limited to mealtimes only | 104 (75.4) | 26 (18.8) | 8 (5.8) |
| Regular dental check-up at least once a year is recommended | 106 (76.8) | 29 (21.0) | 3 (2.2) |

Table 5: Factors associated with mean knowledge score among respondents (n=138)

| Variable | SLR[a] | | | |
|---|---|---|---|---|
| | b[#] | (95% CI) | *t*-statistic | P value |
| Age (years) | 0.17 | -0.09, 0.44 | 1.26 | 0.209 |
| Sex | | | | |
| Male* | | | | |
| Female | 4.12 | -0.20, 8.44 | 1.88 | 0.062 |
| Length of service as a family physician (years) | 0.14 | -0.14, 0.42 | 0.98 | 0.328 |
| Exposure to structured learning on oral health during undergraduate training | | | | |
| No* | | | | |
| Yes | -1.87 | -8.18, 4.44 | -0.59 | 0.558 |
| Exposure to structured learning on oral health during postgraduate training | | | | |
| No* | | | | |
| Yes | 3.89 | -6.29, 14.07 | 0.76 | 0.451 |
| Experience of attending in-service training program | | | | |
| No* | | | | |
| Yes | 7.83 | 3.04, 12.61 | 3.23 | 0.002 |

[a] Simple Linear Regression
* Reference category
[#] Crude Regression coefficient

## DISCUSSION

Oral diseases are mainly preventable and can be treated in their early stages. Prevention of oral diseases requires identification and reduction of risk factors or by enhancing resistance to the disease. Early diagnosis and prompt treatment can **prevent** disease **complication**s and improve the prognosis of treatment, including the potential for complete recovery. The relationship between oral health and systemic diseases and conditions highlights the important roles of family physicians as oral health advocates[13,14]. Recognition of signs and symptoms by family physicians is the key to early diagnosis and immediate referral to dentists for prompt **treatment that can improve patient outcomes**.

Dental caries is an infectious and transmissible disease. Mother-child transmission is the major route for early-infancy acquisition of mutans streptococci (MS), acid-producing bacteria that play a central role in the aetiology of **dental caries**[16]. Saliva is the main vehicle in MS transfer through kissing the child on the mouth, blowing on and tasting food before giving it to the child, or sharing utensils. A study by Sakai *et al.*[17] in Brazil found that most parents and caretakers had the habit of blowing and tasting food or sharing utensils with the child (58.6%) and kissing the child on the mouth (36.4%). Similarly, most parents in Italy (61.0%) taste the food before giving it to their child[18]. Besides dental caries, other infectious diseases can spread through saliva, including the common colds and flu, and more severe viral infections[19]. Toothbrush sharing among family members can also lead to bacterial transmission[20]. More than half of family physicians in this study did not know that dental caries is an infectious disease, although most of them knew that toothbrushes could not be shared among family members. Other **studies elsewhere** also reported that most physicians were not aware that bacteria could be transmitted from mother to child[15,21,22].

It is good to note that most respondents in this study knew that a high frequency of sugar intake increases the risk for dental caries. Besides caries, excessive sugar consumption has been associated with an increased risk of diabetes, obesity, cardiovascular disease, and non-alcoholic fatty liver disease[23]. Controlling the amount and frequency of sugar intake can reduce the risk of both oral diseases and general diseases[24].

About half of respondents could not identify the presence of white spots as a sign of caries. This finding concurs with other **studies elsewhere**[15,22,25]. White spot lesion indicates the loss of minerals from the tooth surface. Topical fluoride application by dental professionals along with good oral hygiene can reverse the caries formation process by promoting remineralization of enamel surface[26]. Early detection of the lesion by family physicians followed by dental referral can help to stop caries progression and prevent unnecessary complications[27].

Common risk factors as well as signs and symptoms of oral cancer were correctly identified by most respondents except poorly fitting dentures. The risk of developing oral cancer increases with age[28,29], and older age is associated with edentulism and subsequent use of dentures[30]. Family physicians are in an advantageous position to advise elderly patients who wear dentures to visit the dentist for regular mouth examinations due to the associated risk[31].

A high number of respondents thought that gum bleeding during toothbrushing is normal, and toothbrushing and flossing should be stopped if the gum bleeds. Bleeding gums is a sign of gingivitis or **inflammation** of the gingival tissue, and it can be reversed with good oral hygiene. However, if toothbrushing and flossing are discontinued, the inflammation may worsen. If left untreated, gingivitis can progress to periodontitis, characterised by irreversible destruction of tooth-supporting structures and ultimately tooth loss.

Only about half of our respondents knew that gum disease is a sign of diabetes. Periodontal disease and diabetes mellitus are major public health problems in Malaysia and have a bidirectional relationship[4,32]. Both dentists and family physicians have important roles to play in ensuring patient referrals are done accordingly.

Most family physicians in this study knew that pregnant women are susceptible to gum disease, but only about half knew of the risk for adverse pregnancy outcomes. This finding agrees with reports from studies among physicians in other countries[21,33,34]. Utilisation of primary oral healthcare services among antenatal mothers in Malaysia is fairly low at 44.1%[35]. Given the potential link between maternal periodontal health and pregnancy outcomes, this low dental visit should be a cause for concern.

Most respondents incorrectly thought that calcium would be absorbed from a pregnant woman's teeth by the developing foetus. A similar finding was reported in a local study among primary care nurses involved in antenatal care[36]. A foetus absorbs calcium from the mother's diet or from the mother's bone if the calcium intake is inadequate, but not from the mother's teeth[37]. This myth must be corrected. Not only because family physicians are responsible to deliver accurate health information to patients, but also because the myth may lead to another erroneous belief that because of the calcium loss, it is normal for mothers' teeth to become brittle during pregnancy.

Most respondents in this study knew that toothbrushing with fluoridated toothpaste at least twice daily is recommended in caries prevention. However, only about one-third knew about fluoride toothpaste recommendations in children. Additionally, some erroneously thought that fluoride in toothpaste could cause cancer, and almost half were not sure. The **effectiveness** of fluoride in caries prevention is well established, and the claim that fluoride can cause cancer is unfounded[38]. Owing to the high caries prevalence in young children, fluoride toothpaste should be used as soon as the first deciduous tooth erupts[39-41]. Nevertheless, special care should be taken during the application, and parents must continue to assist or supervise tooth brushing until at least 7 years of age to avoid accidental or habitual ingestion of fluoride toothpaste[39].

Most respondents were not aware that analgesics, muscle relaxants, antacids, calcium channel blockers, angiotensin-converting enzyme inhibitors, and antiretrovirals could reduce salivary flow. Reduced saliva may result in oral health problems such as dental caries and oral infections, in addition to issues related to oral functions, including eating, swallowing, and speaking[42]. Another common oral side effect of the medication is gingival enlargement, and only a bit more than half of the respondents knew that calcium channel blockers can cause such side effect.

Only a few physicians in this study claimed that they had been exposed to oral health subjects during undergraduate or postgraduate training. While the incorporation of oral health subject into undergraduate curricular has resulted in favourable outcomes on oral health knowledge of students[43], our study failed to demonstrate the relationship. Nevertheless, our study concurs with the findings that demonstrated favourable effects of continuous medical education on oral health knowledge of health professionals, including primary care physicians[44-46].

To our understanding, this is the first study on oral health knowledge of family physicians in Malaysia. However, a low response rate is the main limitation, although we had taken the recommended measures to encourage participation[47]. The non-response rate was set at 30%, but this is perhaps inadequate. While Web-based surveys are becoming popular nowadays, current evidence failed to show any significant improvement in response rate compared to other administration modes, including mail surveys[48,49].

## CONCLUSION

Most family physicians in Malaysia who participated in this study had adequate basic knowledge about oral health. However, misunderstandings about oral disease and its link with general health, the risk factors, signs and symptoms, oral side effects of medications, and oral hygiene practice were also common. This **lack of knowledge** can have serious

implications on patient outcomes due to delayed disease diagnosis and treatment. In line with our findings that respondents who attended in-service training programs on oral health have a higher mean knowledge score, continuing education on relevant oral health issues in primary care is therefore warranted. We recommend the development of a structured in-service continuous professional development program to improve oral health knowledge of not only the family physicians but also other primary healthcare providers, including the paramedics. It is hoped that by integrating oral healthcare into the mainstream of primary care, the health of people can be holistically improved.

**Acknowledgements**
The authors would like to thank the Family Health Development Division, Ministry of Health Malaysia, and all Family Physicians who have taken the time to complete and return the questionnaire. Special thanks as well to Dr. Ninin Sukminingrum Masudi, who has contributed to the study.

**Competing interests**
The authors declare that they have no competing interests.

**Funding**
This research was funded by the Universiti Sains Malaysia Short Term Grant (304/PPSG/6315039).

**REFERENCES**

1. Zebrowitz LA, Montepare JM. Social psychological face perception: Why appearance matters. *Soc Personal Psychol Compass* 2008; **2**(3):1497. doi: 10.111/j.751-9004.2008.00109.x.

2. Peres MA, Macpherson LMD, Weyant RJ, et al. Oral diseases: a global public health challenge. *Lancet* 2019; **394**(10194):249-60.

3. Kassebaum NJ, Smith AGC, Bernabé E, et al. Global, Regional, and National Prevalence, Incidence, and Disability-Adjusted Life Years for Oral Conditions for 195 Countries, 1990-2015: A Systematic Analysis for the Global Burden of Diseases, Injuries, and Risk Factors. *J Dent Res* 2017; **96**(4):380-7.

4. Ministry of Health Malaysia. National Oral Health Survey of Adults 2010 (NOHSA 2010). Putrajaya: Oral Health Division, Ministry of Health Malaysia; 2013.

5. Ministry of Health Malaysia. National Oral Health Survey of Preschool Children 2015 (NOHPS 2015), Vol. 1: Oral Health Status and Caries Treatment Needs of 5-Year-Old Children. Piutrajaya: Oral Health Division, Ministry of Health Malaysia; 2017.

6. Ministry of Health Malaysia. National Health and Morbidity Survey 2017: National Oral Health Survey of Schoolchildren 2017 (NHMS 2017: NOHSS 2017). Vol. II: Oral Health Status of 12-Year-Old Schoolchildren. Putrajaya: Oral Health Division, Ministry of Health Malaysia; 2017.

7. Azizah Ab M, Nor Saleha IT, Noor Hashimah A, et al. Malaysian National Cancer Registry Report 2007-2011. Putrajaya: National Cancer Institute, Ministry of Health; 2016.

8. Casamassimo PS, Flaitz CM, Hammersmith K, et al. Recognizing the relationship between disorders in the oral cavity and systemic disease. *Pediatr Clin North Am* 2018; **65**(5):1007-32.

9. Genco RJ, Borgnakke WS. Diabetes as a potential risk for periodontitis: association studies. *Periodontol 2000* 2020; **83**(1):40-5.

10. Bhalla N, Nudell Y, Thakkar J, et al. Oral manifestation of systemic diseases. *Dent Clin North Am* 2020; **64**(1):191-207.

11. Yuan A, Woo SB. Adverse drug events in the oral cavity. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2015; **119**(1):35-47.

12. Sheiham A, Watt RG. The common risk factor approach: a rational basis for promoting oral health. *Community Dent Oral Epidemiol* 2000; **28**(6):399-406.

13. Ramirez JH, Arce R, Contreras A. Why must physicians know about oral diseases? *Teach Learn Med* 2010; **22**(2):148-55.

14. Stephens MB, Wiedemer JP, Kushner GM. Dental problems in primary care. *Am Fam Physician* 2018; **98**(11):654-60.

15. Rabiei S, Mohebbi SZ, Patja K, et al. Physicians' knowledge of and adherence to improving oral health.

*BMC Public Health* 2012; **12**:855. doi: 10.1186/471-2458-12-855.

16. Berkowitz RJ. Mutans streptococci: acquisition and transmission. *Pediatr Dent* 2006; **28**(2):106-9.

17. Sakai VT, Oliveira T, Silva TC, et al. Knowledge and attitude of parents or caretakers regarding transmissibility of caries disease. *J Appl Oral Sci* 2008; **16**(2):150-4.

18. Calcagnile F, Pietrunti D, Pranno N, et al. Oral health knowledge in pre-school children: A survey among parents in central Italy. *J Clin Exp Dent* 2019; **11**(4):e327-e33.

19. Slots J, Slots H. Bacterial and viral pathogens in saliva: disease relationship and infectious risk. *Periodontol 2000* 2011; **55**(1):48-69.

20. Contreras A, Arce R, Botero JE, et al. Toothbrush contamination in family members. *Revista Clínica de Periodoncia, Implantología y Rehabilitación Oral* 2010; **3**(1):24-6.

21. Gambhir RS, Batth JS, Arora G, et al. Family physicians' knowledge and awareness regarding oral health: A survey. *J Educ Health Promot* 2019; **8**:45. doi: 10.4103/jehp.jehp_252_18.

22. Prakash P, Lawrence HP, Harvey BJ, et al. Early childhood caries and infant oral health: Paediatricians' and family physicians' knowledge, practices and training. *Paediatr Child Health* 2006; **11**(3):151-7.

23. Rippe JM, Angelopoulos TJ. Relationship between added sugars consumption and chronic disease risk factors: Current understanding. *Nutrients* 2016; **8**(11):697. doi: 10.3390/nu8110697.

24. Maltz M, Jardim JJ, Alves LS. Health promotion and dental caries. *Braz Oral Res* 2010; **24 Suppl 1**:18-25.

25. Singhal S, Figueiredo R, Dupuis S, et al. Knowledge, attitude, willingness and readiness of primary health care providers to provide oral health services to children in Niagara, Ontario: a cross-sectional survey. *CMAJ Open* 2017; **5**(1):E249-E54.

26. Gao SS, Zhang S, Mei ML, et al. Caries remineralisation and arresting effect in children by professionally applied fluoride treatment - a systematic review. *BMC Oral Health* 2016; **16**:12. doi: 0.1186/s12903-016-0171-6.

27. Tinanoff N, Baez RJ, Diaz Guillory C, et al. Early childhood caries epidemiology, aetiology, risk assessment, societal burden, management, education, and policy: Global perspective. *Int J Paediatr Dent* 2019; **29**(3):238-48.

28. White MC, Holman DM, Boehm JE, et al. Age and cancer risk: a potentially modifiable relationship. *Am J Prev Med* 2014; **46**(3 Suppl 1):S7-15.

29. Irani S. New insights into oral cancer-risk factors and prevention: A review of literature. *Int J Prev Med* 2020; **11**:202. doi: 10.4103/ijpvm.IJPVM_403_18.

30. Peltzer K, Hewlett S, Yawson AE, et al. Prevalence of loss of all teeth (edentulism) and associated factors in older adults in China, Ghana, India, Mexico, Russia and South Africa. *Int J Environ Res Public Health* 2014; **11**(11):11308-24. doi: 10.3390/ijerph111111308.

31. Manoharan S, Nagaraja V, Eslick GD. Ill-fitting dentures and oral cancer: A meta-analysis. *Oral Oncol* 2014; **50**(11):1058-61.

32. Ministry of Health Malaysia. National Health and Morbidity Survey 2015 (NHMS 2015). Vol. II: Non-Communicable Diseases, Risk Factors & Other Health Problems. Kuala Lumpur: Institute for Public Health, National Institutes of Health, Ministry of Health Malaysia 2015.

33. Al-Habashneh R, Aljundi SH, Alwaeli HA. Survey of medical doctors' attitudes and knowledge of the association between oral health and pregnancy outcomes. *Int J Dent Hyg* 2008; **6**(3):214-20.

34. Hoerler SB, Jenkins S, Assad D. Evaluating oral health in pregnant women: Knowledge, attitudes and practices of health professionals. *J Dent Hyg* 2019; **93**(1):16-22.

35. Ministry of Health Malaysia. Annual Report Ministry of Health Malaysia 2017. Putrajaya: Ministry of Health Malaysia; 2018.

36. Sharif S, Saddki N, Yusoff A. Knowledge and attitude of medical nurses toward oral health and oral health care of pregnant women. *Malays J Med Sci* 2016; **23**(1):63-71.

37. Kovacs CS. Calcium and bone metabolism disorders during pregnancy and lactation. *Endocrinol Metab Clin North Am* 2011; **40**(4):795-826.

38. O'Mullane DM, Baez RJ, Jones S, et al. Fluoride and oral health. *Community Dent Health* 2016; **33**(2):69-99.

39. Clark MB, Keels MA, Slayton RL. Fluoride use in caries prevention in the primary care setting. *Pediatrics* 2020; **146**(6):e2020034637. doi: 10.1542/peds.2020-034637.

40. Toumba KJ, Twetman S, Splieth C, et al. Guidelines on the use of fluoride for caries prevention in children: an updated EAPD policy document. *Eur Arch Paediatr Dent* 2019; **20**(6):507-16.

41. American Dental Association Council on Scientific Affairs. Fluoride toothpaste use for young children. *J Am Dent Assoc* 2014; **145**(2):190-1.

42. Llena-Puy C. The rôle of saliva in maintaining oral health and as an aid to diagnosis. *Med Oral Patol Oral Cir Bucal* 2006; **11**(5):E449-55.

43. Berkowitz O, Brisotti MF, Gascon L, et al. The impact of an interprofessional oral health curriculum on trainees. *J Physician Assist Educ* 2017; **28**(1):2-9.

44. Wee AG, Zimmerman LM, Anderson JR, et al. Promoting oral cancer examinations to medical primary care providers: a cluster randomized trial. *J Public Health Dent* 2016; **76**(4):340-9.

45. Blaylock P, Lish R, Smith M. Oral health training for general practitioners and general practice teams. *Educ Prim Care* 2020; **31**(4):240-3.

46. Mohebbi SZ, Rabiei S, Yazdani R, et al. Evaluation of an educational intervention in oral health for primary care physicians: a cluster randomized controlled study. *BMC Oral Health* 2018; **18**(1):218. doi: 10.1186/s12903-018-0676-2.

47. Edwards P, Roberts I, Clarke M, et al. Increasing response rates to postal questionnaires: systematic review. *BMJ* 2002; **324**(7347):1183. doi: 10.36/bmj.324.7347.1183.

48. Weaver L, Beebe TJ, Rockwood T. The impact of survey mode on the response rate in a survey of the factors that influence Minnesota physicians' disclosure practices. *BMC Med Res Methodol* 2019; **19**(1):73. doi: 10.1186/s12874-019-0719-7.

49. Phillips AW, Friedman BT, Utrankar A, et al. Surveys of health professions trainees: Prevalence, response rates, and predictive factors to guide researchers. *Acad Med* 2017; **92**(2):222-8.