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Socio-demographic factors associated with oral health knowledge, attitude, practice and frequency of cariogenic food consumption among 11- to 12-year-old primary schoolchildren in Pulau Pinang, Malaysia

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ABSTRACT

Introduction: This study determined socio-demographic factors associated with oral health knowledge, attitude, practice and frequency of cariogenic food consumption among 11- to 12-year-old primary schoolchildren in Pulau Pinang, Malaysia. **Methods:** A cross-sectional study using validated self-administered questionnaire was conducted among 11- to 12-year-old schoolchildren attending government national primary schools in Barat Daya and Seberang Perai Selatan districts of Pulau Pinang, excluding those with intellectual disabilities or visual impairments. A multi-stage sampling method was used. **Results:** A total of 218 schoolchildren participated in the study. The majority demonstrated good oral health knowledge (71.1%) and attitude (60.1%), but nearly half (44.5%) had never used dental floss. Cariogenic foods were mostly moderately consumed. Factors significantly associated with schoolchildren's oral health knowledge were ethnicity (p<0.001) and father's/male guardian's education level (p=0.029), whereas attitude was significantly associated with ethnicity (p<0.001), father's/male guardian's education level (p=0.046), mother's/female guardian's occupation (p=0.036) and monthly household income (p=0.016). Smoking habit was significantly associated with ethnicity (p=0.004) and mother's/female guardian's education level (p<0.001). Rural schoolchildren had significantly higher mean cariogenic food frequency score than urban schoolchildren (p=0.039). Oral health knowledge was positively correlated with attitude (r=0.554, p<0.001), while attitude was negatively correlated with frequency of cariogenic food consumption (r=-0.245, p<0.001). **Conclusion:** Ethnicity, parents'/guardians' education level, mother's/female guardian's occupation and monthly household income were associated with schoolchildren's oral health knowledge, attitude and practice. Rural schoolchildren consumed cariogenic foods more frequently compared to urban schoolchildren.

Keywords: child, health knowledge, attitudes, practice, oral health

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INTRODUCTION

Oral diseases, which affect nearly 3.5 billion people globally, according to the World Health Organization (WHO, 2022), are a significant public health concern and remain a pressing issue among Malaysian schoolchildren. The term 'oral health knowledge' refers to the possession of information required to understand oral diseases, their causes and the necessary preventive measures. Theoretically, this knowledge will lead to attitude changes, which in turn will prompt behavioural modifications in daily life (Smyth, Caamano & Fernández-Riveiro, 2007). These changes will ultimately impact the individual's oral health status (Gao *et al.*, 2014).

Foods and beverages that are cariogenic contain fermentable carbohydrates, which are metabolised by bacteria to produce acids that can demineralise tooth surfaces, leading to dental caries (Marya, 2011). Frequent between-meal consumption of processed sugar- and starch-containing foods has been found to increase the incidence of dental caries (Hancock, Zinn & Schofield, 2020).

According to the National Health and Morbidity Survey 2017: National Oral Health Survey of Schoolchildren 2017, the prevalence of dental caries among 12-year-old schoolchildren in Malaysia was 33.3%, while the prevalence of unhealthy periodontal conditions, as evidenced by the presence of gingival bleeding on probing, was 99.8% (Oral Health Division, 2017). Poor oral health has been shown to be associated with poor academic performance and low school attendance among schoolchildren (Ruff *et al.*, 2019). Based on the National Health and Morbidity Survey 2022: Adolescent Health Survey 2022, 10.8% of Malaysian adolescents had missed classes, both physical and online learning, due to toothache (IPH, 2022).

This study aimed to determine the socio-demographic factors associated with oral health knowledge, attitude, practice and frequency of cariogenic food consumption among 11- to 12-year-old primary schoolchildren in Pulau Pinang, Malaysia. Socio-demographic factors, such as sex, ethnicity, age, school location (urban or rural), parents'/guardians' education level, parents'/guardians' occupation and monthly household income, were considered. To the best of the researchers' knowledge, similar studies are limited in Malaysia. Understanding these factors is crucial for developing targeted oral health promotion programmes and educational tools that could ultimately improve schoolchildren's oral health status and quality of life, especially given that this is a critical period for shaping lifelong oral health behaviours, beliefs and attitudes (WHO, 2003).

METHODOLOGY

Study design and sampling

This cross-sectional study was conducted at four government national primary schools in Pulau Pinang, Malaysia, from April to May 2024. A multi-stage sampling method was used to select schoolchildren for the study. Two districts, Barat Daya and Seberang Perai Selatan, were randomly chosen from five districts in Pulau Pinang. Proportionate stratified random sampling was used to select three urban schools and one rural school from these districts. Within these schools, non-proportionate stratified random sampling ensured equal representation of male and female schoolchildren aged 11 and 12 years. The inclusion criteria for the study were Malaysian citizens born between 2012 and 2013, enrolled in government national primary schools under the Ministry of Education Malaysia, and able to understand, read and write in

the Malay language. Schoolchildren with intellectual disabilities or visual impairments were excluded from the study.

The sample size for this study was determined based on the research objectives, selecting the largest required sample size. It was calculated by comparing two proportions using the Power and Sample Size Calculation (PS) software version 3.1.2. Based on the findings of the National Health and Morbidity Survey 2022: Adolescent Health Survey 2022 by the Institute for Public Health (IPH, 2022), the probability of females brushing their teeth at least twice daily was 0.88 (88%). If the true probability of males brushing their teeth at least twice daily was 0.73 (73%), the study needed to include 108 female and 108 male schoolchildren to reject the null hypothesis that the rates of brushing at least twice daily were equal between males and females, with a power of 0.8. The Type I error probability associated with this test of the null hypothesis was 0.05. To account for a 10% non-response rate, a final sample size of 240 was determined.

Research tool

The research tool used for data collection was an on-site, self-administered questionnaire divided into three sections. Section 1 of the questionnaire, covering the socio-demographic profile of the study participants, was distributed to the parents or guardians of the selected participants, along with an information sheet explaining the study and an informed consent form. This section was completed by parents or guardians, while the remaining sections of the questionnaire were answered by the selected schoolchildren. Information collected in Section 1 of the questionnaire included the participants' sex, ethnicity, age, school location (urban or rural), parents'/guardians' education level, parents'/guardians' occupation and monthly household income. Monthly household income was asked as an open-ended question and subsequently categorised into income groups based on Malaysia's Household Income Survey 2022 (Department of Statistics Malaysia, 2023).

Section 2 of the questionnaire was adopted from the Health Promotion Questionnaire Index (HPQI), a Malay language instrument that had been empirically validated for use among 11- to 12-year-old Malaysian schoolchildren by Yusof & Jaafar (2013). This section included three domains: oral health knowledge (11 items), oral health attitude (15 items) and oral health practice (7 items). The calculation of scores and categorisation was based on a study by Samosir *et al.* (2018), which adapted the HPQI for data collection. For the oral health knowledge domain, responses ranged from 'strongly agree' to 'strongly disagree', scored from 1 to 5, respectively. Since the questions were positive items, the scores were reversed, with 'strongly agree' scored as 5 and 'strongly disagree' as 1. The total score, ranging from 11 to 55, was converted to a percentage and categorised as 'poor' (less than 60%), 'moderate' (60% to 79%) or 'good' (80% to 100%). For the oral health attitude domain, responses ranged from 'strongly agree' to 'strongly disagree', scored from 1 to 4, respectively. For positive items (questions 1 to 12), the scores were reversed, whereby 'strongly disagree' was scored as 1 and 'strongly agree' as 4. Negative items (questions 13 to 15) were scored according to the original scale. The total score, ranging from 15 to 60, was converted to a percentage and categorised using the same criteria as for the knowledge domain. For the oral health practice domain, responses were rated from 1 ('more than two times daily')

to 7 ('never'). Each item was evaluated individually based on its frequency of oral health practice.

Section 3 of the questionnaire was adapted from the Malay language Cariogenic Food Frequency Questionnaire (M-CFFQ), which was originally validated by Rosnani, Ruhaya & Normastura (2019) for use among parents of children aged 6 to 11. The validity and reliability of the M-CFFQ were tested for self-administration by schoolchildren aged 11 to 12 years, using the same items. A pre-test was conducted with ten 11- to 12-year-old schoolchildren from a government national primary school in Pulau Pinang, who were not involved in the main study. The pre-test yielded a scale-level face validity index average of 0.91, indicating clarity and comprehensibility (Yusoff, 2019); therefore, no modifications were made to the original M-CFFQ by Rosnani *et al.* (2019).

A pilot study was then conducted among 30 schoolchildren aged 11 to 12 years, conveniently selected from another government national primary school in Pulau Pinang that was not involved in the main study. The questionnaire was administered twice, 7 to 14 days apart, to assess test-retest reliability using intraclass correlation coefficient (ICC) via IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, New York, United States). The total ICC value was 0.861, indicating excellent agreement (Cicchetti, 1994), with item-specific ICC values ranging from 0.462 (honey) to 0.956 (sugared cereals).

A total of 37 items from 15 different types of cariogenic food were assessed for consumption frequency, with responses ranging from 'never/rarely' to 'two to three times daily', scored from 1 to 7, respectively. The total cariogenic food frequency (CFF) score for each participant ranged from 37 to 259, with a higher score indicating more frequent consumption of cariogenic food. The cariogenic food frequency score for each cariogenic food item was also calculated using the following formula, adopted from Rosnani *et al.* (2019):

$$CFF\,score\,(\%) = \frac{(R_1S_1 + R_2S_2 + R_3S_3 + R_4S_4 + R_5S_5 + R_6S_6 + R_7S_7)}{Maximum\ scale\ rating\ (7)}$$

$$R = Percentage\ of\ subjects\ selecting\ a\ rating$$

$$S = Scale\ ratings$$

Based on the calculated CFF scores, the various cariogenic food items were categorised according to the study by Ahmad *et al.* (2020), as 'least consumed' (0% to 29.9%), 'moderately consumed' (30.0% to 79.9%) and 'highly consumed' (80.0% to 100%).

Data collection

Student name lists were obtained from school teachers to identify eligible participants. Participant information sheets, informed consent forms and the socio-demographic section of the questionnaire were distributed to parents or guardians two weeks before data collection. Only schoolchildren with written parental or guardian consent were included. On the day of data collection, assent was obtained from the schoolchildren; the study was explained to them, emphasising voluntary participation and the right to withdraw at any time. Participants were grouped, with a maximum of 30 per session, in rooms with adequate lighting and low noise levels. The principal investigator provided instructions for completing the self-administered questionnaire and was present to address any questions. Each questionnaire took approximately 20 minutes to complete and was collected at the end of the session.

Statistical analysis

Data from completed questionnaires were cleaned and analysed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, New York,

United States). Descriptive analysis was conducted, with categorical variables presented as frequencies and percentages, and numerical variables as means with standard deviations (*SD*) for normally distributed data, or medians with interquartile ranges (*IQR*) for skewed data. The Pearson's chi-square test assessed associations between socio-demographic characteristics and oral health knowledge, attitude and practice, with the Fisher-Freeman-Halton exact test used when assumptions were violated. Independent *t*-tests assessed differences in mean cariogenic food frequency score between socio-demographic groups. Pearson's correlation was used to determine the correlations between oral health knowledge, oral health attitude and frequency of cariogenic food consumption. Statistical significance was set at $p<0.05$.

Ethical consideration

Ethical approval for the study was obtained from the Human Research Ethics Committee of Universiti Sains Malaysia (USM/JEPeM/KK/24010076). Approvals were also obtained from the Ministry of Education Malaysia [KPM.600-3/2/3-eras(18695)], the Pulau Pinang State Education Department [JPNPP.500-8/9/2 Jld 6 (56)], as well as from the Barat Daya and Seberang Perai Selatan District Education Offices. The headmasters or headmistresses of the selected schools were also approached to request permission to conduct the study at their respective schools. The study was also registered in the National Medical Research Register of Malaysia (NMRR ID-24-00001-V7I). Written informed consent was obtained from the parents or guardians of the study participants.

RESULTS

Socio-demographic characteristics of schoolchildren

A total of 218 schoolchildren participated in the study. Table 1 shows the socio-demographic characteristics of the schoolchildren. The participants included 104 males (47.7%) and 114 females (52.3%), with 112 (51.4%) being 12 years old and 106 (48.6%) being 11 years old. Most participants were of Malay ethnicity (*n*=169, 77.5%) and attended urban schools (*n*=162, 74.3%). The majority of fathers/male guardians, amounting to 107 (49.1%), had secondary education, as did 121 (55.5%) mothers/female guardians. Predominantly, 126 (57.8%) fathers/male guardians worked in the private sector, while 98 (45.0%) mothers/female guardians were unemployed. The monthly household income of participants ranged from MYR400 to MYR25,000, with a median of MYR3,500 (*IQR*=MYR2,735). When categorised by income groups, the majority of participants came from low-income households (*n*=164, 75.2%).

Oral health knowledge, attitude and practice among schoolchildren

Mean total oral health knowledge score among the schoolchildren was 45.60 (*SD*=5.08). A majority of 155 schoolchildren (71.1%) demonstrated good oral health knowledge, while 60 (27.5%) had moderate knowledge and only three (1.4%) had poor knowledge. For oral health attitude, the mean total score was 48.54 (*SD*=5.65). More than half of the participating schoolchildren (*n*=131, 60.1%) exhibited a good oral health attitude, 83 (38.1%) had a moderate attitude and only four (1.8%) displayed a poor attitude.

Table 2 presents the oral health practices of the schoolchildren. Most schoolchildren brushed their teeth twice

Table 1. Socio-demographic characteristics of schoolchildren (*N*=218)

Variables	*Median (IQR)*	*n (%)*
Sex		
Male		104 (47.7)
Female		114 (52.3)
Ethnicity		
Malay		169 (77.5)
Chinese		11 (5.0)
Indian		34 (15.6)
Others		4 (1.8)
Age		
11 years old		106 (48.6)
12 years old		112 (51.4)
Location of school		
Urban		162 (74.3)
Rural		56 (25.7)
Father's/Male guardian's education level		
No formal education		2 (0.9)
Primary education (Standards 1-6 or equivalent)		14 (6.4)
Secondary education (Forms 1-5 or equivalent)		107 (49.1)
Post-secondary education (*Sijil Tinggi Persekolahan Malaysia*/Vocational certificate/Matriculation certificate/ Diploma or equivalent)		56 (25.7)
Tertiary education (Degree or higher)		39 (17.9)
Mother's/Female guardian's education level		
No formal education		1 (0.5)
Primary education (Standards 1-6 or equivalent)		7 (3.2)
Secondary education (Forms 1-5 or equivalent)		121 (55.5)
Post-secondary education (*Sijil Tinggi Persekolahan Malaysia*/Vocational certificate/Matriculation certificate/ Diploma or equivalent)		53 (24.3)
Tertiary education (Degree or higher)		36 (16.5)
Father's/Male guardian's occupation		
Government sector		28 (12.8)
Private sector		126 (57.8)
Self-employed		48 (22.0)
Unemployed		10 (4.6)
Others		6 (2.8)
Mother's/Female guardian's occupation		
Government sector		35 (16.1)
Private sector		69 (31.7)
Self-employed		15 (6.9)
Unemployed		98 (45.0)
Others		1 (0.5)
Monthly household income (MYR)	3,500 (2,735)	
Low income (≤5,249)		164 (75.2)
Middle income (5,250-11,819)		45 (20.6)
High income (≥11,820)		9 (4.1)

Table 2. Oral health practices of schoolchildren (*N*=218)

Items	*n (%)*						
	>2 times a day	*2 times a day*	*Once a day*	*2-3 times a week*	*Once a week*	*Once a month*	*Never*
Q1. How often do you brush your teeth?	77 (35.3)	119 (54.6)	18 (8.3)	4 (1.8)	0 (0.0)	0 (0.0)	0 (0.0)
Q2. How often do you use toothpaste when brushing your teeth?	67 (30.7)	120 (55.0)	24 (11.0)	6 (2.8)	1 (0.5)	0 (0.0)	0 (0.0)
Q3. How often do you rinse your mouth after meal?	113 (51.8)	56 (25.7)	33 (15.1)	5 (2.3)	5 (2.3)	1 (0.5)	5 (2.3)
Q4. How often do you use dental floss to clean the areas between your teeth?	22 (10.1)	33 (15.1)	32 (14.7)	13 (6.0)	13 (6.0)	8 (3.7)	97 (44.5)
Q5. How often do you drink Coca-Cola or carbonated drinks with sugars?	5 (2.3)	6 (2.8)	18 (8.3)	28 (12.8)	55 (25.2)	73 (33.5)	33 (15.1)
Q6. How often do you eat sweets/chocolate/ ice cream?	17 (7.8)	13 (6.0)	30 (13.8)	65 (29.8)	59 (27.1)	33 (15.1)	1 (0.5)
Q7. Do you smoke?	0 (0.0)	2 (0.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	216 (99.1)

daily (*n*=119, 54.6%), while 77 (35.3%) brushed more than twice a day. A majority of 120 schoolchildren (55.0%) used toothpaste twice daily, while 67 (30.7%) used it more than twice a day. Most schoolchildren rinsed their mouths after meals more than twice a day (*n*=113, 51.8%), while 56 (25.7%) rinsed twice daily. However, nearly half of the schoolchildren had never used dental floss (*n*=97, 44.5%). Regarding sugary food and beverage consumption, most schoolchildren drank carbonated drinks once a month (*n*=73, 33.5%), while 65 (29.8%) consumed sweets, chocolate or ice cream two to three times a week. Out of the total 218 schoolchildren, only two (0.9%) reported being smokers; both smoked twice a day.

Frequency of cariogenic food consumption among schoolchildren

Table 3 shows the frequency of cariogenic food consumption among schoolchildren. Mean total CFF score among the 218 schoolchildren in this study was 107.52 (*SD*=31.89). Among the various cariogenic foods assessed, three items were found to be the least frequently consumed (CFF score between 0% and 29.9%): herbal drinks (23.2%), coffee with added sugar or condensed milk (27.3%) and honey (28.6%). The other food items were all moderately consumed (CFF score between 30.0% and 79.9%). Comparatively, bread had the highest consumption frequency, followed by packet drinks and flavoured snacks.

Table 3. Frequency of cariogenic food consumption among schoolchildren (*N*=218)

Variables	*Mean±SD*	*CFF score (%)*
Total CFF score of the schoolchildren	107.52±31.89	
Cakes/pastries/bread		
Cakes†		35.4
Pastries†		49.0
Bread†		59.9
Biscuits†		55.6
Traditional delicacies†		42.1
Chocolates†		53.8
Crisps		
All types of crisps†		46.5
Flavoured snacks†		57.4
Sweets		
Chewable candies†		48.1
Hard candies†		37.1
Lollipops†		39.4
Sugared cereals†		38.1
Fruits		
Dried fruits†		38.8
Pickled fruits†		36.6
Candied fruits†		31.4
Sugared fresh/ultra-high temperature (UHT) milk		
Fresh/UHT milk with added sugar†		49.3
Fresh/UHT milk with added honey†		30.7
Formula milk with added sugar†		30.9
Soya milk†		37.4
Sugared/Sweetened drinks		
Chocolate drinks†		51.5
Fruit-flavoured drinks/Cordials†		56.7
Packet drinks†		57.9
Carbonated drinks†		36.8
Tea with added sugar or condensed milk†		43.4
Coffee with added sugar or condensed milk‡		27.3
Herbal drinks‡		23.2
Fruit juices		
Fruit juices with no added sugar†		49.9
Fruit juices with added sugar†		37.4
Fruit juices with added condensed milk†		32.9
Desserts		
All types of desserts†		41.6
Yoghurt with added sugar†		36.6
Curd with added sugar†		32.2
All types of ice-cream, *cendol*, *air batu campur*†		48.8
Other cariogenic foods		
Honey‡		28.6
All types of jam†		30.4
Coconut spread (*kaya*)†		37.5
Sweet sauces†		46.2

CFF score: Cariogenic food frequency score
†Moderately consumed cariogenic food (CFF score between 30.0% to 79.9%)
‡Least consumed cariogenic food (CFF score between 0% to 29.9%)

Table 4. Factors associated with oral health knowledge, attitude, practice and frequency of cariogenic food consumption among schoolchildren

Variables	*n (%)*		*x^2 value/ t-statistic (df)*	*p-value*
	Yes	*No*		
	Good oral health knowledge			
Ethnicity			15.685	<0.001‡
Malay	131 (77.5)	38 (22.5)		
Chinese	5 (45.5)	6 (54.5)		
Indian	16 (47.1)	18 (52.9)		
Others	3 (75.0)	1 (25.0)		
Father's/Male guardian's education level			10.026	0.029‡
No formal education	0 (0.0)	2 (100.0)		
Primary education	10 (71.4)	4 (28.6)		
Secondary education	71 (66.4)	36 (33.6)		
Post-secondary education	47 (83.9)	9 (16.1)		
Tertiary education	27 (69.2)	12 (30.8)		
	Good oral health attitude			
Ethnicity			17.271	<0.001‡
Malay	114 (67.5)	55 (32.5)		
Chinese	4 (36.4)	7 (63.6)		
Indian	11 (32.4)	23 (67.6)		
Others	2 (50.0)	2 (50.0)		
Father's/Male guardian's education level			9.046	0.046‡
No formal education	0 (0.0)	2 (100.0)		
Primary education	8 (57.1)	6 (42.9)		
Secondary education	57 (53.3)	50 (46.7)		
Post-secondary education	41 (73.2)	15 (26.8)		
Tertiary education	25 (64.1)	14 (35.9)		
Mother's/Female guardian's occupation			9.465	0.036‡
Government sector	26 (74.3)	9 (35.7)		
Private sector	37 (53.6)	32 (46.4)		
Self-employed	5 (33.3)	10 (66.7)		
Unemployed	62 (63.3)	36 (36.7)		
Others	1 (100.0)	0 (0.0)		
Monthly household income			8.261 (2)	0.016†
Low income	90 (54.9)	74 (45.1)		
Middle income	33 (73.3)	12 (26.7)		
High income	8 (88.9)	1 (11.1)		
	Smoking habit			
Ethnicity			13.660	0.004‡
Malay	0 (0.0)	169 (100.0)		
Chinese	2 (18.2)	9 (81.8)		
Indian	0 (0.0)	34 (100.0)		
Others	0 (0.0)	4 (100.0)		
Mother's/Female guardian's education level			18.790	<0.001‡
No formal education	1 (100.0)	0 (0.0)		
Primary education	1 (14.3)	6 (85.7)		
Secondary education	0 (0.0)	121 (100.0)		
Post-secondary education	0 (0.0)	53 (100.0)		
Tertiary education	0 (0.0)	36 (100.0)		
	Cariogenic food frequency score			
	Mean±SD			
Location of school			-2.081 (216)	0.039§
Urban	104.90±30.99			
Rural	115.11±33.49			

†Pearson's chi-square test (significant at $p<0.05$)
‡Fisher-Freeman-Halton exact test (significant at $p<0.05$)
§Independent *t*-test with equal variances assumed (significant at $p<0.05$)

Table 5. Correlation between oral health knowledge, oral health attitude and frequency of cariogenic food consumption among schoolchildren

Variables	*Pearson correlation coefficient, r*	*p-value*
Oral health knowledge – Oral health attitude	0.554	<0.001*
Oral health knowledge – Frequency of cariogenic food consumption	-0.109	0.110
Oral health attitude – Frequency of cariogenic food consumption	-0.245	<0.001*

*Significant at $p<0.05$

Factors associated with oral health knowledge, attitude, practice and frequency of cariogenic food consumption among schoolchildren

Table 4 presents the factors associated with oral health knowledge, attitude, practice and frequency of cariogenic food consumption among schoolchildren. Oral health knowledge was significantly associated with ethnicity ($p<0.001$) and father's/male guardian's education level ($p=0.029$), whereas oral health attitude showed statistically significant associations with ethnicity ($p<0.001$), father's/male guardian's education level ($p=0.046$), mother's/female guardian's occupation ($p=0.036$) and monthly household income ($p=0.016$). No statistically significant associations were found between socio-demographic factors and oral health practices such as toothbrushing habits, toothpaste usage, mouth rinsing after meals or dental floss usage. However, smoking habit was significantly associated with ethnicity ($p=0.004$) and mother's/female guardian's education level ($p<0.001$). A statistically significant difference in mean cariogenic food frequency score was observed between rural and urban schoolchildren ($p=0.039$); mean cariogenic food frequency score of schoolchildren from rural schools [115.11 (SD=33.49)] was significantly higher than that of schoolchildren from urban schools [104.90 (SD=30.99)].

Correlations between oral health knowledge, oral health attitude and frequency of cariogenic food consumption among schoolchildren

Table 5 shows the correlations between oral health knowledge, oral health attitude and frequency of cariogenic food consumption among schoolchildren. There was a statistically significant moderate positive linear correlation between oral health knowledge and oral health attitude ($r=0.554$, $p<0.001$), while a statistically significant negative linear correlation was observed between oral health attitude and frequency of cariogenic food consumption ($r=-0.245$, $p<0.001$), although this correlation was weak (Schober, Boer & Schwarte, 2018). In contrast, the correlation between oral health knowledge and frequency of cariogenic food consumption was not statistically significant ($p=0.110$).

DISCUSSION

This study found that the majority of schoolchildren had good oral health knowledge, which can be attributed in part to the oral health educational activities provided in schools through the school dental service in Malaysia, which include oral health talks, toothbrushing demonstrations, exhibitions and other educational activities (Oral Health Programme, 2022). Overall, most schoolchildren in this study displayed a good oral health attitude, in contrast

to another Malaysian study conducted in Cameron Highlands, where the majority of indigenous children showed a moderate oral health attitude. Cultural and socio-economic differences in indigenous communities may account for the variation in oral health attitude levels (Samosir *et al.*, 2018).

Although recommended oral health practices were adhered to by most schoolchildren, nearly half had never used dental floss, reflecting a low utilisation rate similar to findings from a previous Malaysian study by Ahmad *et al.* (2019) and the National Health and Morbidity Survey 2022: Adolescent Health Survey 2022 (IPH, 2022). Despite annual oral health education provided to schoolchildren through the school dental service (Oral Health Programme, 2022), most cariogenic foods were consumed at moderate rather than low frequencies, possibly due to media exposure, such as food advertisements on television, which contribute to poorer diet quality and a higher risk of developing dental caries (Somasundaram *et al.*, 2014). Furthermore, peer pressure can influence dietary choices, as seen in a study conducted in Saudi Arabia by El Tantawi *et al.* (2017), where adolescents' practices of snacking on sugary foods and drinks were significantly associated with those of their close friends.

Among the factors assessed for associations with oral health knowledge, attitude, practice and frequency of cariogenic food consumption among schoolchildren, ethnicity was significantly associated with schoolchildren's oral health knowledge, attitude and smoking habit. Different ethnic groups often have distinct cultural beliefs, values and practices related to health, including oral health (Butani, Weintraub & Barker, 2008). The education level of fathers or male guardians was also significantly associated with the oral health knowledge and attitude of schoolchildren in this study. While schoolchildren whose fathers or male guardians had post-secondary education exhibited the highest proportion of good oral health knowledge, it is noteworthy that those whose fathers or male guardians had only primary education demonstrated a higher proportion of good oral health knowledge than those with fathers or male guardians who had secondary or tertiary education. Thus, the findings of this study did not fully align with those of another study, which suggested that higher parental education levels were associated with better oral health knowledge (Wahengbam *et al.*, 2016). This discrepancy could be attributed to the provision of oral health education to all schoolchildren, regardless of family background, through the school dental service initiated by the Malaysian government (Oral Health Programme, 2022). However, schoolchildren whose fathers or male guardians had higher levels of education exhibited a higher proportion of good oral health attitude, consistent with findings from a study conducted in India (Wahengbam *et al.*, 2016).

This study also found a significant association between schoolchildren's smoking habits and the education level of their mothers or female guardians. Similarly, another study conducted in Poland demonstrated that adolescents with lower maternal education were more likely to smoke (Polańska *et al.*, 2016). Moreover, the occupation of mothers or female guardians was associated with the schoolchildren's oral health attitude. In this study, the proportion of schoolchildren with a good oral health attitude was higher among those with unemployed mothers compared to those with self-employed mothers or mothers working in the private sector. Mothers play a crucial role in fostering good oral health care habits in their children, but employed mothers often have less

time to focus on their children's dietary habits and oral health care (Baiju *et al.*, 2018). However, a high proportion of schoolchildren with mothers employed in the government sector exhibited a good oral health attitude, which may be attributed to a better work-life balance, as shown in a study conducted in Pulau Pinang (Hassan, Abdullah & Akmal Ismail, 2017).

Additionally, monthly household income was associated with schoolchildren's oral health attitude, with the highest proportion of schoolchildren with a good attitude in the high-income group, followed by the middle- and low-income groups. Family environment and socio-economic conditions influence oral health outcomes among schoolchildren, with underprivileged families often facing limited access to oral health information and resources, making it difficult to adopt recommended dietary and oral hygiene practices (Lisboa *et al.*, 2013). Schoolchildren in rural schools also had higher frequency of cariogenic food consumption compared to those in urban schools, echoing findings from a national survey showing that Malaysian adolescents living in rural areas consumed carbonated drinks more frequently than those residing in urban areas (IPH, 2018).

In this study, oral health knowledge was found to have moderate positive linear correlation with oral health attitude, indicating that increase in oral health knowledge correlated with more positive oral health attitude. A statistically significant correlation was also observed between oral health attitude and frequency of cariogenic food consumption, although the negative correlation was weak. Hence, more positive oral health attitude was correlated with better oral health practice in terms of lower frequency of cariogenic food consumption. These findings supported the established theory that gaining knowledge would change attitudes and lead to behavioural changes (Daly *et al.*, 2013). However, this study did not find a correlation between oral health knowledge and frequency of cariogenic food consumption, demonstrating that while knowledge is essential, it is generally not enough to change an individual's behaviour. Motivation often needs to stem from sources beyond just factual knowledge or be supplemented by it (WHO, 2012). The absence of a correlation between oral health knowledge and frequency of cariogenic food consumption, along with the weak correlation between oral health attitude and frequency of cariogenic food consumption, underscores the limitations of the knowledge, attitude and practice (KAP) theory in health behaviour interventions.

Several limitations of this study were acknowledged. The focus on socio-demographic factors, due to resource constraints, potentially overlooked other important factors, such as the impact of peers, family, media exposure, access to oral health care services and the availability of cariogenic foods. The cross-sectional design restricted clarity on temporal relationships, making it difficult to infer causality between socio-demographic characteristics and oral health outcomes. Data collection via self-administered questionnaire introduced a limitation due to its reliance on subjective assessments instead of objective evaluations. This approach may result in respondent bias, as participants might be inclined to provide favourable answers. Additionally, there was potential for measurement errors stemming from misinterpretation of questions and memory lapses. However, the use of a valid and reliable questionnaire, along with the presence of the principal investigator during questionnaire completion, allowed schoolchildren to seek clarification

whenever necessary, which minimised potential issues.

CONCLUSION

Most schoolchildren in this study demonstrated good oral health knowledge and attitude. While most of them followed recommended oral health practices, nearly half had never used dental floss. Additionally, the schoolchildren moderately consumed most cariogenic foods. Socio-demographic factors, including ethnicity, parents'/guardians' education level, mother's/female guardian's occupation and monthly household income, were associated with schoolchildren's oral health knowledge, attitude and practice. Moreover, rural schoolchildren consumed cariogenic foods more frequently than urban schoolchildren. A moderate positive correlation was found between oral health knowledge and oral health attitude, while a weak negative correlation was observed between oral health attitude and frequency of cariogenic food consumption.

These findings suggest the need for comprehensive and tailored oral health promotion programmes that address the socio-demographic factors influencing oral health knowledge, attitude, practice and frequency of cariogenic food consumption among schoolchildren. This study's results can guide improvements in oral health educational interventions delivered to schoolchildren through the school dental service, ensuring that interventions are more targeted and effective. Future research should explore the effectiveness of tailored oral health promotion programmes on the oral health status of schoolchildren through clinical assessments, such as evaluations of dental caries and periodontal status.

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Authors' contributions

Oung SKY, principal investigator, conceptualised and designed the study, conducted data collection, data analysis and interpretation, and prepared the draft of the manuscript; Ruhaya H, conceptualised and designed the study, conducted data analysis and interpretation, and reviewed the manuscript; Norkhafizah S, conceptualised and designed the study, conducted data analysis and interpretation, and reviewed the manuscript; Kueh YC, conceptualised and designed the study, conducted data analysis and interpretation, and reviewed the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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