ORIGINAL ARTICLE

Knowledge, Attitude, and Behaviour Towards Fluoride Toothpaste Use and Toothbrushing Among 12-Year-Old School Children in Tawau District, Sabah

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ABSTRACT

Introduction: Toothbrushing with fluoride toothpaste is the most acceptable and cost-effective way to prevent caries. Knowledge, attitude, and behaviour towards fluoride toothpaste use and toothbrushing are crucial for proper oral hygiene care among children. This study aims to assess the factors associated with toothpaste use and toothbrushing behaviour among 12-year-old children. **Materials and methods:** This cross-sectional study was conducted among 317 respondents of 12-year-old children in the Tawau district, Sabah. Respondents were chosen in equal numbers of females and males from the urban and rural areas by a non-proportionate stratified multistage random sampling method. The tool used was a self-reported, validated Malay-translated questionnaire. A Chi-square and Fisher's exact tests assessed the association between variables of interest. **Results:** Most respondents had the misconception that fluoride's function was to make their teeth clean (n=147, 46.4%). Almost all respondents had a positive attitude towards the importance of brushing their teeth (n=314, 99.1%) and using toothpaste (n=311, 98.1%). 52.4% (n=166) of respondents brushed their teeth twice daily and 68.5% (n=217) used fluoridated toothpaste. For the post-toothbrushing behaviour, about 61.5% (n=195) of respondents very often rinse their mouth with water, but only 24.9% (n=79) used mouthwash products. Female (χ^2=5.18, p=0.023), Bumiputera Sabah ethnicity (χ^2=7.99, p=0.039), and urban school (χ^2=5.80, p=0.016) were significantly associated with good toothpaste behaviour.**Conclusion:** As there was an association between sex, school location, and ethnicity with the behaviour of toothbrushing and toothpaste use, implementing preventive strategies based on effective evidence-based oral health education and promotion is needed to tackle these issues.
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INTRODUCTION

Dental caries is a significant public oral health concern, affecting people of all ages in most countries. Although the caries prevalence for 12-year-old children in Malaysia was 33.3%, the prevalence in Sabah was twofold higher than in the whole country, 63.3% (1). This shows Sabahan children had a high burden of dental caries. According to the caries balance concept, the progression of caries occurs when pathological factors outweigh protective factors (2). Fluoride is one of the protective factors in the caries balance concept (2). Dental plaque, along with sugar and bacteria, plays a crucial role in the aetiology of caries (2,3). Plaque alters the oral cavity ecology by accumulating microbes that could lead to the progression or development of new carious lesions (3). Fluoride exposure from toothpaste and plaque removal via toothbrushing serve to reduce pathological factors and increase protective factors, thereby fostering a prosperous caries balance (2). Toothbrushing with fluoride toothpaste is close to an ideal public health method for preventing dental caries that is convenient, affordable, culturally acceptable, and widespread.

Maintaining good oral hygiene is essential for healthy oral health. Fostering correct knowledge, positive attitudes, and good behaviours related to fluoride toothpaste use and toothbrushing among children is necessary to ensure the implementation of an effective oral hygiene method and prevent oral diseases, especially dental caries (4). Once a certain level of belief is achieved, the information from which knowledge is generally derived

transforms into an attitude, and then, it is sustained as behaviour (5). Studies have shown that children with low knowledge, poor attitudes, and inadequate behaviour on toothpaste use and toothbrushing were prone to dental caries (6–8). In addition, dental personnel's primary concern is to impart correct oral health and oral hygiene knowledge, a positive attitude, and good behaviour to school children.

Brushing teeth using fluoride toothpaste with the correct concentration and amount of toothpaste is important in oral hygiene self-care, which helps in preventing dental caries. Assessing the knowledge, attitude, and behaviour towards using fluoride toothpaste and toothbrushing significantly could reflect how school children engage in oral hygiene self-care. Besides that, few studies have demonstrated an association of socio-demographic factors with school children's knowledge, attitude, and behaviour regarding toothpaste use and toothbrushing (9–11).

However, in Malaysia, most studies concentrated on general oral health, oral hygiene care, and water fluoridation, while limited studies focused solely on fluoride toothpaste usage and toothbrushing (7,12–14). This study further explores other factors associated with toothpaste use and toothbrushing behaviour among primary school children, thereby aiding in intervention planning to tackle the high prevalence of caries in Sabah. Additionally, this study also assessed the knowledge, attitude, and behaviour of primary school children in toothpaste use and toothbrushing. Most of the target population in oral health studies for primary school children are 12-year-old children, as well as in the national oral health survey (1,13–16). Therefore, this study targets 12-year-old children to ensure the findings are comparable to those of other studies. Targeting school children for preventive oral health strategies such as oral health promotion and education will help reduce caries prevalence in the future. This will raise children's awareness of good oral health in primary school, encouraging them to establish and maintain effective oral health routines until adulthood.

MATERIALS AND METHODS

Study design

This cross-sectional study was conducted among a respondent of 12-year-old children in the Tawau district, Sabah.

Sample

The inclusion criteria for this study were Malaysian citizens, children born in 2011 attending government primary schools, and children using adult toothpaste. This study did not involve children with intellectual disabilities or visual impairments. A total sample size of 348, including an additional 10% non-response rate, was needed based on a calculation comparing two proportions (power= 0.8, type I error= 0.05). A non-proportionate stratified multistage random sampling method was employed to capture three schools from 33 urban schools and three schools from 28 rural schools. The same sampling method captured an equal number of female and male respondents from each of the Standard 6 classes in the selected schools.

Study instrument

The self-administered questionnaire by Jensen et al. (2012), originally in English, was adapted for this study (4). Permission for questionnaire adaptation was obtained from Jensen et al. (2012). Subsequently, the process of cross-cultural translation and adaptation of all items from the original questionnaire into the Malay version was conducted following the guidelines by Beaton et al. (2000) with modifications (17). A pre-test of the translated Malay-version questionnaire was done among ten respondents of 12-year-old children to assess the validity of the questionnaire. Following this, a pilot study was conducted among 30 respondents of 12- year-old children to assess the reliability of the questionnaire. The Cronbach's alpha of the reliability score for the knowledge domain was 0.814, the attitude domain was 0.749, and the behaviour domain was 0.729. Neither the participants in the pre-test nor the pilot study were involved in the actual study.

The socio-demographic profile form for the respondents was included with the consent form to be completed by the parents or caregivers. This part obtained information on sex, ethnicity, monthly household income, and parent's/ caregiver's education level. Additionally, an item inquiring about the type of toothpaste used by the child, either adult or child toothpaste, was included in the socio-demographic profile form that was used as additional screening to determine eligibility. The questionnaire consists of three parts that were answered by the 12- year-old children as the main respondents.

First part: The first part of the questionnaire contained three items to assess the knowledge of fluoride and toothpaste. Item 1 allows the respondents to choose multiple answer options, while the other items only permit one answer option.

Second part: In the second part, five items assessed attitudes towards using toothpaste and toothbrushing. Item 3 allows the respondents to choose multiple answer options, and other items only permit one answer option. Next, item 4 required the respondent to rate their oral health status on a Visual Analogue Scale (VAS) by putting a cross mark on a 100 mm line between "good" at the

left terminus and "bad" at the right terminus (Figure 1).

Figure 1: Visual Analogue Scale (VAS) for self-rated oral health status. Scoring is based on the distance of the cross-marking "X" made by the respondents on a 100 mm line between "good" at the left terminus and "bad" at the right terminus. The scoring is measured in millimetres (mm) using a ruler from the left "good" terminus to the cross-marking marker.

Third part: The third part of the questionnaire assessed behaviour regarding the use of toothpaste, toothbrushing, and other oral hygiene aids, which consisted of 16 items. Items 2 and 10 allow the respondents to choose multiple answer options, while other items only permit one answer option. Graphic illustrations to illustrate the answer options for the interdental brush, amount of toothpaste used, and amount of water used for rinsing were provided on the questionnaire to ease the respondents' understanding. Additionally, there were items in the questionnaire that required the respondents to state the brand name of the toothpaste used (item 5) and to choose from the listed mouthwash brands if respondents used any mouthwash (item 16).

Data collection

After receiving ethical approval for conducting research in April 2023, the principal investigator conducted data collection from April 2023 until May 2023 at the selected three urban schools (SK Tanjung Batu Keramat, SK St Patrick, and SK Muhibbah Raya) and three rural schools (SK Ranggu, SK Batu 22 Balung, and SK Umas Umas). Next, the principal investigator obtained the names of all 12-year-old children to determine eligibility based on school records and information. The names were listed according to their class, and the children's sex was also noted for the sampling, in accordance with the methods previously described in the sampling method.

The patient information sheet, the informed consent form, and the socio-demographic part of the questionnaire were distributed to the selected children from each school five days before the data collection day for the purpose of getting informed consent from the parents or caregivers. Further eligibility checks were done based on the responses obtained on the type of toothpaste used by the respondents from the socio-demographic profile form to ensure only children using adult toothpaste were included.

An appointment date for data collection was set with the school authority, and a reminder was sent to the teacher-in-charge from each selected school two days before the data collection day. Data collection was conducted in the children's respective classes, or the children from a few classes were grouped in one classroom or meeting room. The teacher-in-charge of each selected school was present during data collection sessions. During the data collection day, the principal investigator also brought several common brands of adult toothpaste and mouthwash to help the respondents identify and remember the brand name of the toothpaste and mouthwash used.

In addition to informed consent from the parents or caregivers, the children's assent was obtained. This was done immediately before the data collection by distributing an assent form to all eligible children to obtain their permission to participate in this study. The children were informed that their participation was purely voluntary and that the respondents had the right to withdraw from the study at any time with no penalty.

The principal investigator gave instructions for answering the questionnaire before the respondents started to answer it. The respondents took an average of 15 minutes to complete the questionnaire. The principal investigator collected the questionnaire immediately after the respondent completed answering all items in the questionnaire. For eligible respondents who were absent, another date for data collection was set with the teacher.

Data analysis

Data were entered and analysed using IBM Statistical Package of Social Science (SPSS) version 27.0. Prior to analysis, the data underwent thorough checking, exploration, and cleaning procedures. In descriptive statistics, continuous variables were described using the median and interquartile range (IQR) for non-normally distributed data. For the categorical variables, frequency and percentage were used. For items allowing multiple answers, each answer in that item was represented individually in frequencies and percentages. For the item in the attitude part that used a 100 mm VAS horizontal line, the perceived oral health status was categorised into three groups based on the distance of the marking measured in millimetres (mm) using a ruler from the left "good" terminus: either good (0–35 mm), fair (36–64 mm), or bad (65–100 mm). This category was adapted from Jensen et al. (2012), and modifications were made during the translation process with consensus from the expert review.

The Chi-square and Fisher's exact tests were used to assess the association between socio- demographic variables and the respondents' toothpaste use and toothbrushing behaviour. The independent variables were socio-demographic, which included sex, ethnicity, parents' or caregiver's education level, school location, and monthly household income. The dependent variable was toothpaste use and toothbrushing behaviour, which were presented as "good toothpaste behaviour". The "good toothpaste behaviour" marker is based on Jensen et al. (2012), which consider the effective use

of toothpaste with toothbrushing (4). Respondents who showed the following behaviour were considered to have "good toothpaste behaviour" (4): (1) brushed teeth at least twice daily; (2) used at least 1 cm of toothpaste on a regular toothbrush or put toothpaste twice on an electric toothbrush; (3) brushed teeth for at least 2 minutes; and (4) used no more than a handful of water for the post-brushing rinse. The level of significance was set at 0.05 (two-tailed).

Ethical consideration

Ethical approval for this study was obtained from the Human Research and Ethics Committee, Universiti Sains Malaysia (Reference. no: USM/JEPeM/KK/23010090). This study was also approved by the Malaysian Ministry of Education (Reference. no: KPM.600-3/2/3-eras (15066)) and the Sabah Education Department (Reference number: JPNSBH.SPS.600-1/1/1 JLD. 15 (02)).

RESULTS

Response rate

The total number of respondents who participated in this study was 317 (91.9%). Another 31 children were refused to participate in the study. The total number of respondents who refused to join this study did not exceed the additional 10% non-response rate from the initial sample size (n= 310).

Socio-demographic profile

The socio-demographic profile of the respondents is presented in Table I. Due to stratification during sampling, the distribution of respondents' sex (male and female) and school location (urban and rural) were almost equal. One-third of respondents were Malay (37.5%) and Sabah Bumiputera (37.2%). All respondents (100.0%) in this study were under the care of their biological parents. The highest percentage of education level for most fathers and mothers was secondary education, 52.0% and 54.9%, respectively. The median monthly household income of the parents was MYR2800 (IQR= 3425).

Table I: Socio-demographic characteristics of the respondents (n= 317)

Variables	Frequency (%)
Sex	
Male	158 (49.8)
Female	159 (50.2)
Ethnicity	
Malay	119 (37.5)
Chinese	4 (1.3)
Indian	0 (0.0)
Sabah Bumiputera	118 (37.2)
Others	76 (24.0)
Father education level	
No formal education	14 (4.4)
Primary education	56 (17.7)
Secondary education	165 (52.0)
Post-secondary education	51 (16.1)
Tertiary education	31 (9.8)
Mother education level	
No formal education	18 (5.7)
Primary education	42 (13.2)
Secondary education	174 (54.9)
Post-secondary education	43 (13.6)
Tertiary education	40 (12.6)
Monthly household income (MYR)	2800 (3425)[a]
School location	
Urban	155 (48.9)
Rural	162 (51.1)

[a]Median (IQR)

Knowledge of fluoride and toothpaste

Table II shows respondents' knowledge of fluoride and toothpaste. Concerning the respondents' knowledge on the effect of fluoride in toothpaste, only less than half correctly knew that fluoride could strengthen the teeth (40.4%), and a quarter (25.9%) did not know about it. Most respondents knew toothbrushes and toothpaste were equally important (42.9%) in preventing dental caries. About 43.8% of respondents received toothpaste instructions from their parents or family members, and only 30.3% received instructions from dental clinic personnel.

Table II: Knowledge of fluoride and toothpaste (n= 317)

Variable	Frequency (%)
What is the effect of fluoride on toothpaste?[a]	
Whiten teeth	135 (42.6)
Strengthens teeth	128 (40.4)
Makes teeth cleaner	147 (46.4)
Makes your mouth feel fresh	113 (35.6)
Do not know	82 (25.9)
Which do you think is the most important to prevent tooth decay?	
Cleaning with the toothbrush	103 (32.5)
Fluoride content in the toothpaste	78 (24.6)
Toothbrush and toothpaste equally important	136 (42.9)
Have you had any toothpaste instructions before?	
No instruction	47 (14.8)
From parents or family members	139 (43.8)
From dental clinic personnel	96 (30.3)
From advertisement and brochure (flyer)	13 (4.1)
From school personnel	21 (6.6)
Other	1 (0.3)

[a]Respondents can choose more than one answer option.

Attitude toward the use of toothpaste and toothbrushing

The attitude of the respondents regarding the use of toothpaste and toothbrushing was generally favourable. Most respondents believed toothbrushing (83.3%) and

brushing their teeth using toothpaste (78.9%) were very important. Regarding the reason(s) that determine the toothpaste to be used, nearly half of them used what is available at home (49.5%), and taste (48.9%) was another common reason given. Furthermore, more than half of the respondents rated their oral health as fair (58.0%), and most believed that having healthy teeth was the most important for them (75.7%). The data obtained are tabulated in Table III.

Table III: Attitude toward the use of toothpaste and toothbrushing (n= 317)

Variable	Frequency (%)
Do you think brushing your teeth is important?	
Yes, very important	264 (83.3)
Yes, quite important	50 (15.8)
Not important	1 (0.3)
Do not know	2 (0.6)
Do you think it is important to brush your teeth with toothpaste?	
Yes, very important	250 (78.9)
Yes, quite important	61 (19.2)
Not important	2 (0.6)
Do not know	4 (1.3)
What determines which toothpaste you use?[a]	
The price	108 (34.1)
The taste	155 (48.9)
Advertisements	71 (22.4)
Use what's at home	157 (49.5)
Do not know	10 (3.2)
How do you rate your oral health?	
Good	108 (34.1)
Fair	184 (58.0)
Bad	25 (7.9)
What is most important to you?	
Healthy teeth	240 (75.7)
White teeth	37 (11.7)
No holes	37 (11.7)
Other	3 (0.9)

[a]Respondents can choose more than one answer option

Behaviour regarding the use of toothpaste, toothbrushing, and other oral hygiene aids

Table IV displays the result of respondents' behaviour regarding the use of toothpaste, toothbrushing, and other oral hygiene aids. The majority (94.0%) of respondents brushed their teeth at least twice daily. Although about three-quarters (76.0%) of respondents brushed their teeth before bed, about half (50.5%) claimed that there were times when they did not brush their teeth in the morning or evening. In addition, most respondents did not consume any food or drink after brushing their teeth in the evening (77.0%).

Table IV: Behaviour regarding the use of toothpaste, toothbrushing and use of other oral hygiene aids (n= 317)

Variable	Frequency (%)
How many times do you brush your teeth per day?	
Never	0 (0.0)
1 time	19 (6.0)
2 times	166 (52.4)
3 times or more	132 (41.6)
When do you brush your teeth?[a]	
Before breakfast	140 (44.2)
After breakfast	184 (58)
Do not brush in the morning	10 (3.2)
Before dinner	64 (20.2)
After dinner	139 (43.8)
Before I go to bed	241 (76.0)
Do not brush in the evening	14 (4.4)
Does it happen that you don't brush your teeth in the morning or the evening?	
Yes	160 (50.5)
No	157 (49.5)
Do you drink or eat anything after you brush your teeth in the evening?	
Yes	73 (23.0)
No	244 (77.0)
Do you use toothpaste with or without fluoride?	
With fluoride	217 (68.5)
Without fluoride	38 (12.0)
Do not know	62 (19.6)
Do you always brush your teeth with toothpaste?	
Often	245 (77.3)
Not often	72 (22.7)
How often do you brush your teeth without using toothpaste?	
Once a day	32 (10.1)
More than 2 times a week	16 (5.0)
Once a week	21 (6.6)
Several times a month	21 (6.6)
Never	227 (71.6)
Do you often use the same brand of toothpaste?	
Often	220 (69.4)
Not often	97 (30.6)
Do you use a regular toothbrush or an electric toothbrush?	
Regular toothbrush	297 (93.7)
Electric toothbrush	7 (2.2)
Both	13 (4.1)
How do you clean between your teeth?[a]	
Toothbrush	228 (71.9)
Dental floss	52 (16.4)
Toothpicks	103 (32.5)
Interdental brush	2 (0.6)

CONTINUE

Table IV: Behaviour regarding the use of toothpaste, toothbrushing and use of other oral hygiene aids (n= 317). (CONT.)

Variable	Frequency (%)
How do you clean between your teeth?[a]	
Other	0 (0.0)
Not using anything other than a toothbrush	172 (54.3)
How much toothpaste do you put on your toothbrush?	
Pea size	33 (10.4)
1cm	172 (54.3)
2 cm	103 (32.5)
Put toothpaste once on my electric tooth-brush	8 (2.5)
Puts toothpaste twice on my electric toothbrush	1 (0.3)
How long do you brush your teeth?	
Less than half a minute	16 (5.0)
Half a minute	63 (19.9)
1 minute	110 (34.7)
Less than 2 minutes	38 (12.0)
2 minutes	51 (16.1)
More than 2 minutes	39 (12.3)
How many times do you dip your toothbrush under running water when you brush your teeth?	
Never dip	6 (1.9)
1 to 2 times	145 (45.7)
3 times or more	166 (52.4)
Do you rinse your mouth with water after brushing your teeth?	
No, never	0 (0.0)
Yes, occasionally	28 (8.8)
Yes, often	94 (29.7)
Yes, very often	195 (61.5)
Haven't thought about it	0 (0.0)
If you rinse your mouth after brushing your teeth, how much water do you use?	
A handful	49 (15.5)
Two handfuls	163 (51.4)
Half a glass of water	38 (12.0)
A full glass or water	67 (21.1)
Do you rinse your mouth with any solution (mouthwash) after brushing your teeth?	
Yes	79 (24.9)
No	238 (75.1)

[a]Respondents can choose more than one answer option

Most respondents used fluoride toothpaste (68.5%). Respondents in this study often brushed their teeth with toothpaste (77.3%), and most of them never brushed their teeth without toothpaste (71.6%). Most respondents often used the same brand of toothpaste (69.4%), and the most common brand used was Colgate®. Almost all respondents in this study used regular toothbrushes (93.7%), and most of them used a toothbrush to clean between their teeth (71.9%).

Furthermore, about half of the respondents (54.3%) reported using a 1 cm amount of toothpaste during toothbrushing, while only 10.4% used a pea size. Only 28.4% of respondents in this study brushed their teeth for at least 2 minutes. About half of the respondents (52.4%) dipped their toothbrush under running water at least three times during brushing, while only 1.9% did not dip their toothbrush. Further, for the post-toothbrushing behaviour, all respondents rinsed their mouths with water after brushing their teeth, mainly using two handfuls of water (51.4%). Finally, most respondents did not use mouthwash after brushing their teeth (75.1%).

Factors associated with toothpaste use and toothbrushing behaviour among school children

As in Table V, a total of 25 respondents had good toothpaste behaviour (7.9%). Toothpaste used and toothbrushing behaviour of the respondents was significantly associated with their sex (χ^2= 5.18, p= 0.023), ethnicity (χ^2= 7.99, p= 0.039), and location of school (χ^2= 5.80, p= 0.016). However, the influence of other factors, such as the father's education level (χ^2= 0.80, p= 0.959), the mother's education level (χ^2= 1.88, p= 0.768), and the monthly household income of the parents (χ^2= 1.353, p= 0.453) was not significant.

Table V: Association between socio-demographic characteristics variables with behaviour on fluoride toothpaste use and toothbrushing (n= 317)

	Good toothpaste behaviour		χ^2 value (df)	p value
	Yes (%)	No (%)		
Sex				
Male	7 (28.0)	151(51.7)	5.18 (1)	0.02*
Female	18 (72.0)	141(48.3)		
Ethnicity				
Malay	10 (40.0)	109(37.3)	7.99[a]	0.04*
Chinese	0 (0.0)	4 (1.4)		
Indian	0 (0.0)	0 (0.0)		
Bumiputera Sabah	14 (56.0)	104(35.6)		
Others	1 (4.0)	75 (25.7)		
Father education level				
No formal education	1 (4.0)	13 (4.5)	0.80[a]	0.96
Primary education	5 (20.0)	51 (17.5)		
Secondary education	12 (48.0)	153(52.4)		
Post-secondary education	5 (20.0)	46 (15.8)		
Tertiary education	2 (8.0)	29 (9.9)		
Mother education level				
No formal education	2 (8.0)	16 (5.5)	1.88[a]	0.77
Primary education	3 (12.0)	39 (13.4)		
Secondary education	12 (48.0)	162(55.5)		
Post-secondary education	5 (20.0)	38 (13.0)		
Tertiary education	3 (12.0)	37 (12.7)		
School location				
Urban	18 (72.0)	137(46.9)	5.80 (1)	0.02*
Rural	7 (28.0)	155(53.1)		
Monthly household income				
B40 (≤ RM4849)	17 (68.0)	220(75.3)	1.35[a]	0.45

CONTINUE

Table V: Association between socio-demographic characteristics variables with behaviour on fluoride toothpaste use and toothbrushing (n= 317). (CONT.)

	Good toothpaste behaviour		χ^2 value (df)	p value
	Yes (%)	No (%)		
Monthly household income				
M40 (RM4850 to RM10959)	6 (24.0)	58 (19.9)		
T40 (≥RM10960)	2 (8.0)	14 (4.8)		

[a]Fisher's Exact test, *Significant level at p<0.05

DISCUSSION

Knowledge of fluoride and toothpaste

In Malaysia, children have been exposed to fluoride toothpaste information since preschool and continued throughout their school life. Due to it, more school children have developed an understanding of the importance of toothbrushing and fluoride toothpaste for caries prevention. This explains why only 25.9% did not know the effect of fluoride and more respondents had correct knowledge of fluoride to strengthen teeth in this study. However, a study by Al- Darwish. (2016) reported that more school children had incorrect knowledge of fluoride function, with more than half not knowing the effect of fluoride (57.9%) (16). Children with no knowledge of fluoride function in preventing caries suffer from higher caries experiences compared to children with knowledge of the benefits of fluoride (18). Fluoride's function is to strengthen teeth by promoting enamel remineralisation, reducing the demineralisation of enamel, and inhibiting the metabolism of bacteria (2,19).

However, a high percentage of respondents in this study (42.6%) held misunderstandings about the effect of fluoride to whiten teeth, which aligns with the results reported by Al-Qahtani et al. (2020) (34.8%) (20). As there was increasing whitening toothpaste promotion on social media by non-dental professionals, this could lead to misunderstandings about the function of toothpaste, as such information was unregulated (21). Social media easily manipulate children (22), and more of them use it nowadays. This explains why almost half of the respondents thought fluoride functions in toothpaste to whiten teeth. In addition, a higher percentage of respondents in this study considered cleaning with a toothbrush (32.5%) to be more important in caries prevention than fluoride content in toothpaste (24.6%), which agrees with the finding from a study by Verma and Jain. (2018) (toothbrushing (33.5%) and fluoride content in toothpaste (12.5%)) (23). This is because people thought toothbrushing was more important than fluoride in toothpaste (4,23). People were more concerned about brushing their teeth to prevent dental caries, but people were uncertain about the fluoride function in toothpaste (4,23).

Further, in this study, most respondents received toothpaste instruction from parents or family members, which aligns with other studies (16,24). Children spend most of their time with families compared to others. Children are believed to imitate the oral care habits of their parents due to the role of parents since childhood, who brush and supervise their children to brush their teeth and determine the toothpaste they use (25). This explains why parents are among their children's main sources of oral health information. Additionally, as most schools have been provided with school dental services, dental health personnel are the other source for children receiving toothpaste instruction and other information on oral health.

Attitude toward the use of toothpaste and toothbrushing

Although few respondents had insufficient knowledge concerning fluoride toothpaste, most respondents in this study displayed a positive attitude towards the importance of toothbrushing (99.1%) and brushing teeth with toothpaste (98.1%), in line with previous studies (4,26,27). Individuals with a positive attitude towards the importance of toothbrushing and brushing teeth with toothpaste tend to engage in good practices related to it, resulting in less risk of caries (6,15). Furthermore, in agreement with other studies, factors such as using what is available at home (49.5%) and taste (48.9%) were important factors for the children in the present study to determine which toothpaste was being used (4,23). Since most children's daily needs, including oral care products, are supported and responsible by their parents, children tend to use whatever their parents have chosen and are available in their homes. A study among children aged 5 to 12-year-old reported that 50.0% of children prefer sweet flavour toothpaste to mint flavour (20.0%), and most children did not prefer the bitter taste or medicated smell of toothpaste (28). This supports why respondents in this study consider taste to be one of the factors influencing their choice of toothpaste to use.

However, most respondents rated their oral health as fair in this study, contradicting the finding from Jensen et al. (2012), in which most respondents of the 15- to 16-year-old age group rated their oral health attitude as good (50%) (4). An individual's oral health apprehension is reflected in a person's attitude (9). The attitude towards good oral health will be influenced by one's experiences, cultural and familial practice, religious beliefs, and other life situations, reflecting an individual's oral health behaviour (9). As there were different socio-demographic backgrounds and cultures, it suggested contradicting results in this study. Other than that, children's self-perceived oral health attitude is also associated with their oral health status (29). A study showed that primary school children with a bad self-perceived oral health attitude had a more moderate and high DMFT (decayed, missing, and filled permanent

teeth) category compared to those with a good attitude (29). However, because this study did not involve any clinical oral examination, the association cannot be concluded.

Further, most respondents in this study believed having healthy teeth (75.7%) was the most important for them, reflecting most of their positive attitudes towards the importance of toothbrushing and brushing teeth with toothpaste. This finding aligns with previous studies (23,27). Children with a positive attitude towards having healthy teeth are more concerned about their oral health, well-being, and general health (30).

Behaviour regarding the use of toothpaste, toothbrushing, and other oral hygiene aids

School dental services in Malaysia provide dental education and demonstrate toothbrushing drilled yearly to all government primary schools, emphasising the importance of effective toothbrushing among school children (31). This explains why most findings regarding toothbrushing frequency among school children in Malaysia, including this study, reported that most school children brushed their teeth at least twice daily (7,12,14,32). However, 6.0% of respondents only brushed their teeth once a day. A study by Jasmine et al. (2019) shows the reason for children not regularly brushing their teeth due to laziness (45.2%) and dislike brushing their teeth (40.5%) (26). This suggests possible causes for a small percentage of respondents in the present study brushing their teeth once daily.

The school dental service emphasises the importance of brushing teeth in the morning and before bed during health talks and chairside education, which is repeated annually (31). This explains the small percentage of respondents who did not brush their teeth in the morning (3.2%) or evening (4.4%) in the current study. Few studies reported similar findings to this study, with most children brushing their teeth in the morning and evening (4,20,23). This suggests that children understand the importance of brushing their teeth in the morning and evening, especially before bed. A high percentage of the respondents in this study admitted not drinking or eating after brushing their teeth in the evening (77.0%), indicating their understanding of the detrimental effect of such behaviour on oral health. In this context, evening refers to before bedtime in the present study. Bedtime is a critical time for both diet and preventive behaviours regarding oral health (33). Consuming food or drinks containing sugar before bedtime is a substantial risk factor for caries due to lower salivary flow, which shifts the balance towards demineralisation rather than remineralisation (33).

Studies reported that most of the school children in Malaysia were using fluoridated toothpaste, which agrees with this study (68.5%) (13,32). Since the role of fluoride in caries prevention has been proven, most dental professionals support the use of fluoride toothpaste by the public, and school dental services in Malaysia also promote fluoride toothpaste for children (31). However, the availability of non-fluoridated toothpaste was almost similar to fluoridated toothpaste, and the price for certain non-fluoridated toothpaste was lower in the Malaysian market than fluoridated toothpaste (34). For this reason, it was unsurprising that some school children in Malaysia use non-fluoridated toothpaste, including those in this study (12.0%).

In addition, in line with a few studies in Malaysia, most school children often brushed their teeth using toothpaste in this study (77.3%) (14,32). Toothbrushing alone may not be effective, as combining fluoridated toothpaste and toothbrushing is more effective in caries prevention (2,19). In Malaysia, school dental services provide repetitive oral health education and toothbrushing demonstrations to primary school children, fostering a positive attitude and promoting good toothbrushing habits using toothpaste. However, 30.6% of respondents in the present study often used a different toothpaste brand. The presence of multiple brands of toothpaste at home due to different family preferences and just using whatever toothpaste is available at home explains the reason for not often using the same brand of toothpaste in this study (4,35).

Moreover, in agreement with another study, most respondents in the present study used regular toothbrushes (93.7%) (4). The main reason most people use regular toothbrushes is that regular toothbrushes are considerably cheaper compared to electric toothbrushes. Toothbrushes alone are inadequate for cleaning interdental surfaces, and hence, it has been recommended to use dental floss and an interdental brush to further prevent dental caries (36). However, most school children rely only on toothbrushes to clean their teeth and the interdental area (36). This is further supported by the present study's findings, in which most respondents used toothbrushes to clean between teeth (71.9%), only 16.4% used floss, and 0.6% used interdental brushes. The reason for not flossing among children was negligence with daily flossing, which was associated with laziness and lack of motivation (37). Cost barriers and low awareness among children also contribute to not using floss and interdental brushes (37).

This study reported that most respondents used a 1 cm amount of toothpaste on their toothbrushes while brushing their teeth (54.3%), aligning with other studies (4,23). The current recommendations on the amount size of fluoride toothpaste for children were the smear-sized amount for those aged below 3-year-old, the pea-sized amount for those aged 3 to 6-year-old, and no minimum amount was stated for those above 6-year-old (38). As more children and adults use different amounts of toothpaste, the significance of the amount of toothpaste used has been disputed (4,23,39). However, few studies

support the view that a larger amount of toothpaste increases saliva's fluoride content, thus creating a longer caries preventive effect (39,40). Therefore, this study supports the study by Jensen et al. (2012) regarding the amount of 1 cm or more of fluoride toothpaste that indicated good toothpaste behaviour for school children (4).

Evidence has shown brushing for two minutes achieves clinically significant plaque removal, and increased brushing duration will increase fluoride retention in the mouth and provide more fluoride benefits (39). However, the result of the present study shows more respondents brushed their teeth in less than 2 minutes (71.6%), which contradicts other studies conducted in Malaysia (7,12). Studies by Whye Lian et al. (2010) and Kaur et al. (2015) showed more than half of their respondents brushed their teeth for 2 minutes or longer (7,12). The possible contributing factor for more positive results in the two studies is that both study respondents only involved school children in urban areas. In contrast, the present studies equally involve children from urban and rural schools. Evidence showed that toothbrushing behaviour differed between children residing in urban and rural areas (41). Further, children tend to ignore brushing the inner tooth surface rather than a recommendation to brush all tooth surfaces, resulting in them only brushing their teeth for a shorter period (42). Other than that, children may encounter difficulties performing the required movements, especially brushing the tooth's inner surface, having incomplete visual control of the toothbrushing, and taking for granted brushing teeth, which impairs their motivation towards brushing for longer periods (42).

Furthermore, findings from this study show that most respondents dip their toothbrushes three times or more under running water while brushing their teeth (52.4%); meanwhile, only 1.9% had the behaviour of never dipping their toothbrush. However, another study shows more positive toothbrush dipping behaviour, with 28.0% of the respondents never dipping their toothbrush while brushing their teeth and only 15% dipping their toothbrush at least three times (4). Dipping a toothbrush under running water is more like a habit of wetting the toothbrush bristle before toothbrushing (4). Therefore, the difference between the findings in this study and a study by Jensen et al. (2012) is more related to the habit difference between the two groups based on the demographic background (4). As for the current evidence, the behaviour of dipping the brush in water has not been thoroughly investigated, indicating a need for further research to explore this aspect of behaviour.

Additionally, post-toothbrushing behaviour plays a significant role in toothpaste function and toothbrushing effectiveness in caries prevention. The finding in this study was in line with other studies, as most of the respondents often rinsed with water after brushing their teeth, mostly with one or two handfuls of water (4,27). Thus, post-brushing rinsing can be considered common behaviour among children. Evidence from randomised control trials showed that post- toothbrushing rinsing with water reduced the fluoride concentration in the mouth due to the dilution effect (43). The post-toothbrushing rinsing frequency and water amount used are inversely associated with the fluoride concentration (39). A study by Creeth et al. (2013) reported that rinsing three times instead of once reduced the total fluoride retained by 42.5% and the bound fluoride by 18.7% (39). Individuals have the behaviour of rinsing with water after brushing their teeth to remove excess and residual toothpaste, to make their teeth feel cleaner, to avoid swallowing toothpaste, and to reduce the taste effect of toothpaste (27).

Next, the use of mouthwash was considered low among school children, as shown in the present study and in concurrence with other studies (4,20,44). The present study reported that less than a quarter (24.9%) of respondents used mouthwash after brushing their teeth. Despite recommendations for the use of mouthwash after toothbrushing, the use of mouthwash among school children is still low due to poor motivation, poor awareness of the mouthwash used, and the cost barrier to using an additional oral care aid other than a toothbrush and toothpaste (44).

Factors associated with toothpaste use and toothbrushing behaviour among school children

The present study shows that good toothpaste and toothbrushing behaviour, identified as brushing at least twice daily, using at least 1 cm of toothpaste, brushing at least for 2 minutes, and using no more than a handful of water when rinsing, were reported by only 7.9% of the respondents, that agrees with the study by Jensen et al. (2012) (4). The socio-demographic background of children influences their oral hygiene awareness and behaviour (12,45,46). As for the present study, toothpaste used and toothbrushing behaviour of the respondents was significantly associated with their sex (χ^2= 5.18, p= 0.023), ethnicity (χ^2= 7.99, p= 0.039), and location of school (χ^2= 5.80, p= 0.016).

Female (72.0%) respondents had a statistically significant greater percentage of good toothpaste behaviour than males (28.0%) (p= 0.023). Other studies in Malaysia also show female children demonstrate more positive toothbrushing behaviour in terms of frequency and duration than males (11,12). The difference in oral care behaviour was more attributed to females who cared more about their bodies and appearance, causing females to be more concerned about adopting behaviours that promote good oral health (47,48). In addition, compared to males, females have lower oral health self-assessments, making them more ready to adopt better oral health behaviour as they grow or learn oral health information (48).

Ethnicity is related to individual oral health behaviour, as certain ethnicities have their own culture, values, and beliefs pertaining to oral health, which directly or indirectly influence their oral health behaviour (46,48). Respondents from the Bumiputera Sabah ethnicity (56.0%) in this study significantly had the highest proportion of good toothpaste behaviour compared to other ethnicities (p= 0.039). A multivariable analysis by Che Salleh et al. (2019) among school children in Malaysia also reported that Bumiputera Sarawak had more positive behaviour regarding toothbrushing frequency than other ethnicities (11). The relation between ethnicity and brushing teeth behaviour in Malaysia could be explained by additional factors involving culture, belief, and religion, as limited studies explore this issue (11) . Future research may be necessary to ascertain whether there may be further explanations for these variations in oral hygiene behaviours between ethnic groups.

Besides that, the present study shows the respondents from urban school areas (72.0%) had significantly more positive behaviour towards toothpaste and toothbrushing than in rural school areas (28.0%) (p= 0.016), which was in line with previous studies (46,49). Lower oral health-related behaviours in rural areas are more attributed to the difference in socioeconomic status, lifestyle, and poorer coverage of oral healthcare programmes (46,49). Moreover, there is an unequal distribution of dental facilities in Malaysia, which are more available in urban areas (50). Due to this, children residing in rural areas have difficulty accessing dental facilities and oral health activities (50). The school dental services provided for children in rural areas are not adequate in terms of the availability of oral health services because the services are only provided once a year in rural schools.
Meanwhile, parents' education level and monthly household income differences had no significant association with toothpaste use and toothbrushing behaviour among the respondents in this study. The main reason is that most parents in the present study had secondary education levels and were from lower-income groups. Parents with low education levels are more associated with low socioeconomic status, poor oral health awareness, and attitudes that will negatively influence their children's oral care behaviour (45). Therefore, parents with a low level of education and low income have a negative attitude towards their children's oral care, making them less concerned about their children's oral hygiene routines (10,45).

Limitations and recommendations

There were some limitations to the current study. As this study was a cross-sectional study, no causal relationship could be interpreted. Secondly, this study was only conducted in a government primary school in the Tawau district. Few private primary schools are available in Tawau, but the school was not included in this study. Further, this study also did not include school children using children's toothpaste, as there are possibilities that there are reference populations still using children's toothpaste. Next, this research was evaluated based on questionnaire responses and self-reported data. Measurement errors due to misinterpretation of questions and memory errors are subject to occurring. The ability to accurately recall and report behaviour influences the reliability of answers (5). Responding to the self-reported questionnaire also led respondents to consider behaviour-relevant issues they had not considered before responding (5).

Another limitation was that the minimum age group from the original questionnaire by Jensen et al. (2012) was 15-year-old, which is a bit older than the current research. However, this age group is still within the school age group in the Swedish education system. This questionnaire was selected because it mainly focuses on the use of toothpaste and toothbrushing, which fulfils the main purpose of the current study. Up to date, there are no available tools solely focusing on toothpaste and toothbrushing. Further, a pre-test and pilot study were done for the research tool to ensure it was suitable for the 12-year-old children as the targeted population. The research tool achieves an adequate validity and reliability score to be used with 12-year-old children.

There are a few recommendations that are beneficial for future research. First, incorporating clinical assessments such as dental plaque and caries assessments is strongly recommended for future research. The association with clinical assessment will provide more concrete evidence of the impact of oral care knowledge, attitudes, and behaviours on oral health. Secondly, diet analysis is recommended to be included in future research, as diet is strongly associated with oral health. Unhealthy eating habits are a significant threat to the oral health of children. Therefore, implementing diet analysis in future research will benefit a better understanding of the association of routine diet with oral care and oral health.

CONCLUSION

Overall, even though most respondents had a misconception about fluoride toothpaste's effect and poor post-toothbrushing behaviour, most respondents displayed a positive attitude towards toothpaste use and toothbrushing. There was also an association between sex, school location, and ethnicity factors with the behaviour of toothbrushing and toothpaste use. Therefore, there is a need to implement preventive strategies based on effective evidence-based oral health education and promotion to tackle these issues. Focusing on strengthening health education interventions is needed for school dental services, as effective oral health education will increase children's oral health awareness, especially oral health care. Additionally, given the crucial role parents play in their children's oral

health, it is imperative to provide accurate information to parents and increase the provision of oral health knowledge. With the advancement of technology and widespread use of the internet and social media, utilising this medium as a platform for delivering oral health education and promotion will be more effective and beneficial. Therefore, oral health information is readily available and accessible to everyone through online platforms and various digital resources.

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