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ORIGINAL RESEARCH

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Development and preliminary psychometric evaluation of a brief oral health knowledge, attitudes, and practices questionnaire for parents of primary schoolchildren

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Abstract

Background: What parents know, believe, and do at home has a direct bearing on their children's oral health. Yet, tools that enable clinicians to quickly assess parental knowledge, attitudes, and practices (KAP) during routine encounters remain scarce, particularly for parents of primary school-aged children. This study aimed to develop and conduct an initial psychometric validation of a brief parental oral health KAP questionnaire for potential use in pediatric dental practice in Malaysia. **Methods**: Questionnaire items were adapted from existing instruments and refined through content and face validation. The questionnaire was administered to 106 parents and guardians recruited from dental clinics, schools, and the general community across three regions in Malaysia, of whom 30 completed a two-week test–retest. Psychometric analyses included Item Response Theory for Knowledge, Exploratory Factor Analysis (EFA) for Attitudes and Practices, internal consistency (Cronbach's α), and intraclass correlation coefficients (ICC). **Results**: The final 11-item Knowledge domain demonstrated modest internal consistency (α = 0.62) and moderate test–retest reliability (ICC = 0.650). EFA supported a unidimensional 9-item Attitude domain (49.1% variance explained) with α = 0.70 and ICC = 0.558. EFA on 6 practice items yielded a two-factor structure comprising family dietary practices and family oral hygiene practices, explaining 65.1% of total variance; two additional fluoride items were retained descriptively, giving a final 8-item Practice domain. Internal consistency was strong for both practice subscales (α = 0.86 and 0.82), with moderate-to-good test–retest reliability (ICC = 0.729 and 0.786). The combined practice scale also demonstrated good temporal stability (ICC = 0.754). **Conclusions**: The parental oral health KAP questionnaire demonstrated modest psychometric properties. It may help identify parental knowledge gaps, unfavorable attitudes, and household behavioral risks that may not be captured through clinical examination alone. Further validation in larger, more diverse samples is needed before broader application.

Keywords

Children; Health knowledge; Attitudes; Practice; Parents; Surveys and questionnaires

1. Introduction

Despite being preventable, dental caries and gum disease in children remain common, with consequences that extend beyond pain and infection to affect eating, sleep, school participation, and quality of life [1, 2]. For children of primary school age, daily dietary patterns, toothbrushing routines, use of fluoride toothpaste, and attendance at preventive dental check-ups are all shaped by parents within the home environment [3]. Preventive approaches in pediatric dental practice that overlook this family context are therefore unlikely to achieve sustained improvements in clinical outcomes [4].

Existing evidence clearly reflects this. Studies consistently demonstrate wide variation in what parents know about oral disease, how they perceive its importance, and how this understanding translates into daily routines that either support or undermine their child's oral health [5–7]. Wherever gaps in knowledge and attitudes exist, they often manifest as poor oral health routines and contribute to inequalities in child oral health that are persistent and socially patterned.

In Malaysia, primary school education typically spans ages 7–12. During this period, children begin to assert greater independence but are not yet developmentally capable of removing plaque effectively without adult assistance. Continued parental supervision of toothbrushing is necessary until sufficient man-

ual dexterity and brushing competence are established [8]. This period also coincides with the mixed dentition phase, during which the eruption of permanent molars and incisors introduces new surfaces vulnerable to decay [9]. Parental involvement in daily oral hygiene routines and decisions is essential throughout the primary school age.

The Knowledge-Attitude-Practice (KAP) framework offers a well-established approach to examining health behaviors. It conceptualizes how knowledge informs attitudes, which in turn shape routine health practices [10]. Applied to oral health, the framework allows systematic assessment of whether gaps in preventive behaviors arise from limited knowledge, unfavorable beliefs, or practical constraints in daily routines [11]. In the context of child oral health, parental KAP provides an appropriate analytical lens for understanding modifiable behavioral determinants that may not be apparent through clinical examination alone.

Despite its utility, the application of the KAP framework to parents of primary schoolchildren has been constrained by a lack of appropriate measurement tools. Existing instruments have largely been developed for early childhood caries or preschool populations, limiting their applicability to parents of school-aged children. In Malaysia, where periodontal disease remains prevalent [12, 13] and oral cancer risk is shaped by tobacco use, alcohol consumption, and betel quid practices [14, 15], parental oral health-compromising behaviors are clinically relevant. These behaviors may shape parents' own attitudes toward oral health and, by extension, the home behaviors they model and enforce for their children. Locally adapted instruments such as the Malay-language version of the Oral Health Knowledge, Attitude and Practice Questionnaire (M-OHKAPQ) represent important progress; however, their validation has primarily focused on linguistic adaptation and test–retest reliability, with limited item-level psychometric evaluation [16]. More comprehensive evaluation tools exist, but their complexity and training requirements limit their applicability and feasibility in the local setting [17].

Routine pediatric dental care increasingly emphasizes risk-based prevention, in which clinicians integrate clinical findings with behavioral and environmental information obtained from parents to guide individualized preventive strategies and recall intervals [18]. Established caries risk assessment (CRA) frameworks capture observable clinical indicators and selected behaviors such as diet and fluoride exposure, but they provide limited insight into parental knowledge, beliefs, and household decision-making processes that shape these behaviors. However, practical tools that allow clinicians to systematically capture these parental determinants for this age group during routine pediatric encounters remain limited.

To address these gaps, this study aimed to develop and conduct an initial psychometric evaluation of a brief parental oral health KAP questionnaire for parents of primary schoolchildren. The instrument is designed for rapid administration in both pediatric clinical and community settings to identify parental knowledge gaps, unfavorable attitudes, and household behavioral risks that may not be captured through clinical examination alone. By providing structured insight into the parental and household factors shaping children's oral health behaviors, the tool aims to support targeted preventive counseling during routine pediatric dental encounters and to capture proxy-reported child home practices for preventive purposes, as these factors may influence a child's oral health risk and complement existing risk-based approaches to care. Given its brevity and the cultural and linguistic context in which it was developed, the instrument may also be adaptable to similar healthcare settings in the region, pending further validation.

2. Materials and methods

2.1 Phase 1: questionnaire development

2.1.1 Item generation

Questionnaire items were developed by adapting several established and psychometrically tested instruments to ensure a robust assessment of parental oral health determinants. The structure and validation of the knowledge and attitude domains were primarily informed by previous work using items measuring etiology, clinical manifestations, and preventive strategies. Specifically, the attitude domain was guided by the Health Belief Model (HBM) to evaluate beliefs regarding the importance of oral care and its impact on general health [19]. Parental literacy and behavioral items were further refined based on the Dental Health Literacy Assessment Instrument (DHLAI), which evaluates knowledge, comprehension, and motivation [20]. Additionally, items related to specific oral health practices and dietary behaviors were adapted from previously validated standardized instruments [21, 22], which have been successfully used to assess oral health awareness and practices in diverse populations. An initial pool of 14 knowledge items, 7 attitude items, and 8 practice items was drafted in English.

2.1.2 Translation procedure

As the intended respondents were Malaysian parents, the questionnaire was translated into Malay to ensure linguistic accessibility and cultural relevance. Forward translation was performed independently by two bilingual translators, namely the researcher and a schoolteacher experienced in communicating health information to parents, resulting in two separate Malay versions. The research team then compared the two versions and reconciled any discrepancies through discussion to produce a single consolidated Malay version. The questionnaire was subsequently back-translated into English by a certified translator blinded to the original English item pool. The back-translated version was compared with the original English draft to identify discrepancies and ensure conceptual equivalence. Any inconsistencies were discussed and resolved by consensus, and the wording was adjusted where necessary.

2.1.3 Content validity

Content validity was evaluated by a multidisciplinary panel of eight reviewers, consisting of three dental public health specialists, two pediatric dentists, one medical statistician, and two schoolteachers. Reviewers were provided with both Malay and English versions of the questionnaire to facilitate conceptual appraisal. Experts independently rated each item for relevance and clarity using a four-point ordinal scale:

• Relevance: 1 = not relevant; 2 = somewhat relevant (major

revision needed); 3 = quite relevant (minor revision needed); 4 = highly relevant.

• Clarity: 1 = not clear; 2 = somewhat clear (major revision needed); 3 = quite clear (minor revision needed); 4 = highly clear.

Experts were also invited to provide qualitative comments to justify their ratings and to suggest revisions to the wording. Item-level content validity indices (I-CVI) were calculated as the proportion of experts who assigned ratings of 3 or 4. Scale-level indices were computed using the average (S-CVI/Ave) and universal agreement (S-CVI/UA) methods for both relevance and clarity.

2.1.4 Face validity

Face validity was assessed among parents and clinic staff (n = 10) at a rural public dental clinic using a paper-based version of the questionnaire. Participants were encouraged to annotate the questionnaire directly by circling words that they did not understand, marking unclear phrases, and providing written comments on the wording and comprehension.

2.2 Phase 2: psychometric testing of the questionnaire

2.2.1 Study design and sample size

A cross-sectional study was conducted to evaluate the psychometric properties of the parental oral health KAP questionnaire. The study was conducted between January and December 2025 following institutional ethics approval. Parents or guardians aged $\geq$18 years who were the primary caregivers of primary school-aged children and were able to understand Malay were eligible to participate. Individuals who were not primary caregivers or were unable to complete the questionnaire independently were excluded.

Participants were recruited using convenience sampling from three geographical regions in Malaysia: the Klang Valley and Negeri Sembilan in Peninsular Malaysia, and Sabah in East Malaysia. Recruitment occurred across three settings: a dental clinic at a public university, a rural primary school, and the general community. These settings were selected to capture participants from both urban and rural populations.

A target sample size of at least 100 participants was established for psychometric evaluation. This sample size is considered adequate for Item Response Theory (IRT) analyses and also satisfied the participant-to-item ratio recommended for exploratory factor analysis (EFA) in scale development, with ratios between 2:1 and 5:1 considered acceptable [23, 24].

2.2.2 Data collection procedure

Data were collected using a self-administered digital questionnaire (Google Forms) administered in Malay. Participants accessed the questionnaire via a web link and completed it independently. The Participant Information Sheet was embedded on the landing page, and participants had to provide digital informed consent prior to accessing the questions. Participants were also asked to indicate whether they consented to recontact for test–retest reliability analysis.

2.2.3 Statistical analysis

Statistical analyses were conducted using R (version 4.5.2) in the RStudio environment. Psychometric analyses were performed using the psych, GPArotation, and ltm packages. The level of statistical significance was set at 0.05.

Item responses were recoded prior to analysis to ensure consistent directionality across all domains, with higher scores indicating more favorable oral health knowledge, attitudes, or practices. Two Knowledge items (K2 and K11) and one Attitude item (A5) were reverse-scored accordingly. Knowledge items were dichotomized, with correct responses coded as 1 and incorrect or "don't know" responses coded as 0, while Attitude items were scored on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Practice items were ordinally scored, with higher values indicating healthier behaviors, including lower sugar consumption, more frequent toothbrushing, and the use of fluoridated toothpaste. All psychometric analyses were conducted using recoded item scores.

The Knowledge domain comprised dichotomous response options and was analyzed using IRT. Both the Rasch (one-parameter logistic (1-PL)) and two-parameter logistic (two-parameter logistic (2-PL)) models were initially estimated. Model fit was compared using likelihood ratio testing and Akaike Information Criterion (AIC). As the 2-PL model demonstrated a significantly better fit, it was selected for subsequent item-level analyses to estimate item discrimination (α) and difficulty (β). Unidimensionality was verified using Modified Parallel Analysis based on tetrachoric correlations. Items were flagged for removal if their difficulty parameters fell outside the range of -3 to $+3$ [25, 26], or if their discrimination values were less than 0.20 [19, 27]. Item-level goodness-of-fit was evaluated using the chi-square (χ^2) statistic.

EFA was conducted to assess the construct validity of the Attitude and Practice domains. For the 10-item Attitude domain, polychoric correlations were employed to account for the ordinal nature of the 5-point Likert scale [28]. Prior to extraction, data suitability was assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The sample was considered adequate if KMO $>$0.50 and Bartlett's test was significant ($p < 0.05$). Principal Axis Factoring (PAF) was used for extraction, followed by Promax oblique rotation to allow for correlated latent factors. The number of factors to retain was determined using parallel analysis and inspection of the scree plot. Items with factor loadings $>$0.30 were considered acceptable [29].

Internal consistency was assessed using Cronbach's alpha coefficients. A threshold of $>$0.60 was considered satisfactory [30], with a lower threshold permitted for the binary Knowledge domain, provided corrected item–total correlations (CITC) exceeded 0.20 [31, 32]. Temporal stability was evaluated by the test–retest procedure in which a subsample of participants completed the questionnaire again after a two-week interval. Test–retest reliability was assessed using Intraclass Correlation Coefficients (ICC) based on domain-level sum scores of retained items [33].

3. Results

3.1 Content and face validity of the questionnaire

Overall, expert agreement on item relevance was high. Most items achieved universal agreement, with one item showing slightly lower agreement; this item was subsequently removed as it was considered redundant. At the scale level, content validity indices indicated excellent relevance (S-CVI/Ave = 1.00; S-CVI/UA = 0.97). Clarity indices were lower at the initial review stage (S-CVI/Ave = 0.94; S-CVI/UA = 0.52).

Based on expert feedback, one knowledge item was removed due to redundancy, and three additional items were incorporated into the attitude domain to better align attitudinal constructs with knowledge concepts. Minor wording revisions were also made to improve clarity and readability.

Face validity assessment indicated that the questionnaire was generally well understood by participants. The average completion time was approximately 9 minutes. Several wording changes were made to the questionnaire, such as replacing minuman berkarbonat (carbonated drinks) with the colloquial equivalent of minuman bergas (gassy drinks). The word kordial (cordial), which was unfamiliar to many participants, was replaced with jus kotak (juice box). A "Don't Know" response option was added to all knowledge items to replace the initial binary True/False format. This change was made to reduce guessing amongst respondents.

Following content and face validation, the questionnaire administered for psychometric testing consisted of six sociodemographic items and four domains: (i) 13 oral health knowledge items, (ii) 10 oral health attitude items, (iii) four parental oral health practices items (self-reported), and (iv) four child oral health practices items (proxy-reported by parents).

3.2 Psychometric properties of the questionnaire

3.2.1 Participant characteristics

A total of 106 participants completed the questionnaire and were included in the psychometric analyses. Participants were recruited from the Klang Valley (n = 77), Negeri Sembilan (n = 15), and Sabah (n = 14) across three settings: a university dental clinic (n = 21), a rural primary school (n = 15, comprising 7 teachers who were parents of primary school-aged children and 8 parents whose children were enrolled in the school), and the general community (n = 70).

Half of the participants (50.0%) were aged 40–49 years, and mothers accounted for the majority (70.8%). The ethnic distribution was predominantly Malay (61.3%). Regarding education, 43.4% of participants had completed secondary education, while 29.3% held a university degree. Most households (60.4%) reported a monthly income of Malaysian Ringgit (MYR) 5250 or less, corresponding to the B40 income category (the lowest 40% of households in Malaysia) (Table 1).

TABLE 1. Characteristics of study participants (N = 106).

Characteristics	Category	n	%
Parent age			
	<30 yr	1	0.9
	30–39 yr	38	35.9
	40–49 yr	53	50.0
	≥50 yr	14	13.2
Relationship to child			
	Mother	75	70.8
	Father	24	22.6
	Guardian	7	6.6
Ethnicity			
	Malay	65	61.3
	Indian	22	20.8
	Indigenous persons of Sabah	14	13.2
	Chinese	4	3.8
	Indigenous Orang Asli	1	0.9
Education level			
	No formal education	2	1.9
	Primary school	7	6.6
	Secondary school	46	43.4
	Diploma/STPM/Matriculation	20	18.9
	University degree or higher	31	29.3
Monthly household income			
	MYR 5250 or less (B40)	64	60.4
	MYR 5251–11,819 (M40)	29	27.4
	MYR 11,820 and above (T20)	13	12.3
Child's age			
	7 yr	14	13.2
	8 yr	14	13.2
	9 yr	21	19.8
	10 yr	19	17.9
	11 yr	14	13.2
	12 yr	24	22.6

MYR: Malaysian Ringgit (1 MYR = 0.25 United States Dollar, USD); STPM: Sijil Tinggi Persekolahan Malaysia (Malaysian Higher School Certificate).

3.2.2 Oral health knowledge

3.2.2.1 Item response theory analysis

Prior to item-level evaluation, the fit of the Rasch (1-PL) and two-parameter logistic (2-PL) models was compared for the initial 13 items. The 2-PL model provided a better fit to the data ($\chi^2(12) = 30.50$, $p = 0.002$) and had a lower AIC. The 2-PL model was therefore retained, and initially identified two items (K2 and K11) that did not meet psychometric screening criteria. K2 showed an extreme difficulty parameter ($\beta = -50.40$), consistent with a floor effect, while K11 demonstrated negative discrimination ($\alpha = -0.11$) with an extreme difficulty estimate ($\beta = 93.65$). Following the removal of these 2 items, modified parallel analysis supported a unidimensional structure for the remaining 11 items.

Difficulty parameters for these items ranged from −0.46 to +2.78, indicating coverage from easy to more difficult knowledge items. Item K1 showed an unusually high discrimination estimate ($\alpha = 27.73$) but was retained due to its high relevance to the construct. Five items met the goodness-of-fit criterion ($p > 0.05$), and the remaining six items showed statistical misfit ($p < 0.05$). The scale captured 98.3% of the total test information within the range of $\theta = -4$ to +4. Given the instrument's intended use as a brief screening tool and the importance of maintaining content coverage, these items were retained with their limitations noted.

3.2.2.2 Internal consistency

The 11-item scale had a Cronbach's alpha of 0.62. Two items, K5 ($r = 0.179$) and K8 ($r = 0.190$), fell marginally below the 0.20 CITC threshold, but their removal would not have improved the scale's overall internal consistency. Both items were retained to preserve content validity and ensure the breadth of the screening tool (Table 2).

3.2.3 Oral health attitudes

3.2.3.1 Exploratory factor analysis

The Attitude domain yielded a KMO of 0.62 and a significant Bartlett's test ($\chi^2(45) = 740.22$, $p < 0.001$), which indicates suitability for factor analysis. Initial parallel analysis on all 10 items suggested more than one factor; however, item A5 failed to load on the factor (loading <0.30) and was removed from the scale. Re-running the parallel analysis on the remaining nine items led to a single-factor solution. There was a corresponding increase in total variance explained from 44.2% to 49.1%. Factor loadings for retained items ranged from 0.330 to 0.925.

TABLE 2. Item diagnostics for the oral health knowledge domain (N = 106).

Item	Question	Discrimination (α)	Difficulty (β)	χ^2 (df = 8)	p-value	Corrected item–total correlation	Cronbach's α if item deleted
K1	The risk of tooth decay increases if one consumes sweet foods more frequently.	27.73	0.07	1.09	0.998	0.324	0.61
K2	Bleeding gums are a sign of tooth decay.	0.21	−50.40	–	–	–	–
K3	Brushing with fluoride toothpaste helps prevent tooth decay.	2.90	0.50	12.22	0.142	0.392	0.58
K4	Fluoride toothpaste helps strengthen teeth.	1.57	0.77	11.25	0.188	0.321	0.59
K5	Bacteria in dental plaque can cause gum disease.	1.09	2.91	18.68	**0.017**	0.179†	0.61
K6	Bleeding gums are a sign of gum disease.	1.81	0.95	25.29	**0.001**	0.350	0.58
K7	Gum disease can cause bad breath.	1.32	1.88	10.29	0.246	0.225	0.61
K8	Dental plaque can be reduced by brushing teeth correctly.	1.74	1.28	7.76	0.457	0.190†	0.61
K9	Brushing teeth at least twice a day can prevent gum disease.	2.27	0.97	17.06	**0.030**	0.291	0.60
K10	Chewing betel quid can cause oral cancer.	0.85	0.24	20.10	**0.010**	0.301	0.60
K11	Smoking is not related to oral cancer.	−0.11	93.65	–	–	–	–
K12	Mouth ulcers that do not heal for more than 2 weeks may be a sign of oral cancer.	0.83	−0.45	36.44	<**0.001**	0.251	0.61
K13	The risk of oral cancer can be reduced by avoiding alcoholic drinks.	1.40	0.22	24.40	**0.002**	0.430	0.56

α: item discrimination parameter; β: item difficulty parameter; df: degrees of freedom.
Items with $p < 0.05$ are highlighted in bold to indicate statistical misfit in the item-level goodness-of-fit test.
†indicates corrected item–total correlation <0.20.
Items K2 and K11 were removed from subsequent analyses due to poor psychometric performance.

3.2.3.2 Internal consistency

The final 9-item scale demonstrated acceptable internal consistency (Cronbach's alpha = 0.70). Item A7 demonstrated a low CITC ($r = 0.13$); although removing A7 would have marginally increased the alpha to 0.72, the item was retained to ensure that parental preventive dental attendance beliefs were captured. Item A9 also demonstrated a lower loading (0.38) and CITC ($r = 0.31$) but met all inclusion criteria (Table 3).

3.2.4 Oral health practices

3.2.4.1 Exploratory factor analysis

Practice items were initially grouped by respondent (parent and child behaviors) for questionnaire administration. Two items measuring fluoride usage (D1D: "Does your toothpaste contain fluoride?" and D2D: "Does your child's toothpaste contain fluoride?") were categorical in nature (Yes/No/Don't Know) and showed substantial ceiling effects, with over 90% of participants reporting fluoride use for themselves and their children. Consequently, these two items were excluded from the EFA and are reported descriptively (Table 4).

The remaining 6 items measuring the frequency of sugar consumption and toothbrushing were subjected to EFA. The KMO was 0.66, and Bartlett's test was significant ($\chi^2(15) = 284.80$, $p < 0.001$). EFA yielded a two-factor solution explaining 65.1% of the total variance. Items were clustered by behavior type, yielding two interpretable factors: "family dietary practices" (41.3% variance explained) and "family oral hygiene practices" (23.9% variance explained). All items loaded at ≥ 0.60 on their assigned factor with no negligible cross-loadings observed.

3.2.4.2 Internal consistency

Internal consistency was strong for both subscales. Cronbach's alpha was 0.86 and 0.82 for "family dietary practices" and "family oral hygiene practices", respectively (Table 5). When all six items were considered together as a composite oral health practices scale, internal consistency remained acceptable (Cronbach's $\alpha = 0.72$), supporting its potential use as an overall practice index.

The two fluoride items were retained in the questionnaire for descriptive purposes and, together with the six EFA-validated items, defined the final 8-item Practice domain, organized into three functional groups:

- Family Dietary Practices (Items D1A, D1B, D2A, D2B).
- Family Oral Hygiene Practices (Items D1C, D2C).
- Fluoride Toothpaste Use in the Home (Items D1D, D2D).

3.2.5 Test–retest reliability

Thirty respondents completed the questionnaire after a two-week interval. ICC values indicated moderate to good temporal stability for the Knowledge scale (11 items), Attitude scale (9 items), Family Dietary Practices subscale (4 items), and

TABLE 3. Factor loadings and internal consistency for the oral health attitudes domain (N = 106).

Item	Question	Factor loadings	Corrected item–total correlations	Cronbach's α if deleted
A1	I believe brushing teeth twice a day improves my oral health.	0.797	0.550	0.65
A2	I believe brushing with fluoride toothpaste prevents tooth decay.	0.714	0.470	0.65
A3	I believe limiting sugary food and drinks protects my teeth from decay.	0.639	0.320	0.68
A4	I believe that having healthy teeth is important.	0.925	0.500	0.67
A6	I believe it is important for me to take care of my child's teeth.	0.899	0.530	0.67
A8	I believe smoking harms oral health.	0.759	0.510	0.65
A10	I believe excessive alcohol consumption harms oral health.	0.612	0.520	0.63
A5	I believe there is no link between dental health and general health.	-	-	-
A7	I believe my child needs a dental check-up at least once a year.	0.330	0.130	0.72
A9	I believe chewing betel quid can cause oral cancer.	0.379	0.310	0.71

Item A5 did not load on the factor (loading <0.30) and was removed from the final scale.

TABLE 4. Descriptive frequencies for fluoride toothpaste use items excluded from EFA (N = 106).

Item	Question	Yes n (%)	No n (%)	Don't Know n (%)
D1D	Does your toothpaste contain fluoride?	100 (94.3%)	4 (3.8%)	2 (1.9%)
D2D	Does your child's toothpaste contain fluoride?	98 (92.5%)	5 (4.7%)	3 (2.8%)

TABLE 5. Factor loadings and internal consistency for the oral health practices domain (N = 106).

Item	Question	Factor loadings		Corrected item–total correlations	Cronbach's α if deleted
		Factor 1: Family dietary practices	Factor 2: Family oral hygiene practices		
D2A	In the past month, how often did your child eat sugary foods (candies, chocolates, ice cream, sweet bread, cakes, traditional sweet pastries)?	0.832	–	0.759	0.82
D2B	In the past month, how often did your child have sugary drinks (carbonated drinks, juice boxes, syrup drinks, drinks with sweetened condensed milk)?	0.824	–	0.709	0.82
D1B	In the past month, how often did you have sugary drinks (carbonated drinks, juice boxes, syrup drinks, drinks with sweetened condensed milk)?	0.799	–	0.733	0.83
D1A	In the past month, how often did you eat sugary foods (candies, chocolates, ice cream, sweet bread, cakes, traditional sweet pastries)?	0.683	–	0.641	0.86
D1C	In the past 7 days, how often did you brush your teeth using toothpaste?	–	0.839	0.691	–
D2C	In the past 7 days, how often did your child brush their teeth using toothpaste?	–	0.819	0.691	–

"–" indicates that the item did not load on the corresponding factor.

Family Oral Hygiene Practices subscale (2 items). The ICC values indicated moderate to good temporal stability across all domains: Knowledge (ICC = 0.650), Attitudes (ICC = 0.558), Family Dietary Practices (ICC = 0.729), and Family Oral Hygiene Practices (ICC = 0.786). When the six retained practice items were combined as an overall practice scale, reliability remained good (ICC = 0.754). All values were statistically significant ($p < 0.001$).

4. Discussion

This study developed and conducted an initial psychometric validation of a brief parental KAP questionnaire for parents of primary schoolchildren, intended for use in both clinical and community settings. To evaluate the instrument across a range of parental backgrounds, participants were recruited from dental clinics, schools, and the general community to capture parents with varying levels of health-seeking behavior and socioeconomic circumstances. Oral healthcare utilization is known to be socially patterned, with higher-income groups more likely to attend dental services even in settings with publicly subsidized universal healthcare [34–36]. Including parents who both routinely access dental care and those who do not, therefore supports the applicability of the instrument across both clinical and community contexts. Although the sample was predominantly lower income, participants from middle- and higher-income households were also represented. Most participants were mothers, consistent with caregiving norms and parental decision-making in child health [37].

Global evidence indicates that parental KAP regarding oral health are often strong predictors of children's clinical dental status, including caries prevalence and plaque accumulation [38–40]. Studies have also consistently found that while many parents possess adequate foundational knowledge, such as recognizing the role of sugar in caries or the importance of twice-daily brushing, this does not reliably translate into optimal home practices for their children [41, 42]. The tendency to seek dental care for their child only when symptoms arise rather than as a preventive routine, further reflects the gap between parental awareness and behavior [43]. For children of primary school age, these parental behaviors remain highly influential through primary socialization and observational learning [44, 45].

The Knowledge domain in this study demonstrated modest internal consistency as scales measuring heterogeneous constructs typically yield lower alpha values compared with more homogeneous measures [46]. A Cronbach's alpha of 0.62 reflects the domain's deliberate design: by spanning dental caries, periodontal disease, and oral cancer, the scale prioritizes breadth over item inter-correlations. Individual-level scores should therefore not be used to classify parents. Rather, the domain score is best interpreted as a broad indicator of knowledge patterns, guiding more targeted advice and health

education.

The removal of K2 and K11 was appropriate, given their extreme and uninterpretable parameter estimates. Although the correct response for K2 ("Bleeding gums are a sign of tooth decay") was False, nearly all parents answered True. This suggests that many parents may have incorrectly associated bleeding gums with tooth decay, rather than as a sign of gum disease. On the other hand, the performance of item K11 ("Smoking is not related to oral cancer") indicated that parents with higher overall knowledge scores were paradoxically less likely to answer correctly. Neither item could contribute reliable measurement information, and their removal did not compromise content coverage. Item K1 ("The risk of tooth decay increases if one consumes sweet foods more frequently") warrants separate consideration. Although it had a high discrimination estimate due to only two incorrect responses in this sample, with near-zero response variance, the item demonstrated good model fit. Retention is justified on clinical grounds: population-level data indicate that sugar consumption in Malaysia has remained substantial over the past two decades [47, 48], highlighting a persistent disconnect between knowledge and behavior. K1 is therefore retained to identify parents who correctly recognize the sugar–caries link and compare this against their responses to the practice domain item on sugar consumption frequency. This allows clinicians to identify families where knowledge does not translate into behavior, which is precisely the profile that requires targeted counseling.

Retention of the six misfitting items ($p < 0.05$) was justified on both psychometric and content-related grounds. Within the 2-PL framework, statistical misfit does not necessarily translate into practically significant consequences for scoring decisions, as proficiency classifications and group-level estimates have been shown to remain robust under realistic levels of model deviation [49]. For items K5, K6, and K9, the misfit most plausibly reflects a ceiling effect, whereby high correct response rates compress variance and provide minimal information at the targeted proficiency range, as the standard error of the estimates becomes relatively large when nearly all respondents answer correctly. The oral cancer items (K10, K12, K13), by contrast, demonstrated wider variation in difficulty, discrimination, and item–total correlations, a pattern inconsistent with redundancy or artificially inflated reliability. The variability here could reflect participants' heterogeneity, as parents recruited from dental clinic settings may have had prior exposure to oral cancer screening messages that community-recruited parents had not, producing divergent response patterns across the sample. Consistent with previous studies, which have reported lower levels of awareness among younger adults and a lack of recognition of oral cancer risk factors [50], this response variability is precisely what makes these items clinically informative. Parents who do not recognize oral cancer risk factors are less likely to be able to identify risky behaviors in themselves or their children—a gap that existing parental KAP instruments, which almost exclusively address dental caries and periodontal diseases do not capture.

A unidimensional structure emerged in the Attitude domain indicating that a single summed score can characterize a parent's overall oral health attitude profile. Reverse-worded item A5 failed to load onto the factor and was removed, which is a pattern consistent with known method effects of negatively worded items in self-administered questionnaires [51, 52]. Clinically, the item was designed to gauge whether parents perceive oral health as an integral part of general health, and its poor psychometric performance suggests that participants may have misinterpreted the phrasing rather than rejected the underlying concept. Item A7 ("I believe my child needs a dental check-up at least once a year") was retained despite low factor loading and weaker corrected item–total correlation. Its weaker psychometric performance suggests that beliefs about routine dental attendance for children may be less tightly integrated with other preventive oral health attitudes in the domain. Structural and social determinants of health are also likely to mediate the relationship between preventive attitudes and actual service utilization, such that positive beliefs about routine attendance do not always translate into regular dental visits [53]. Test–retest reliability for the Attitude domain was moderate (ICC = 0.558) and lower than that observed for the Knowledge and Practice domains. Attitudes are also inherently more susceptible to contextual influences than factual knowledge or habitual practices. A two-week interval is sufficient for incidental experiences like a child's toothache, which results in a dental visit with subsequent exposure to health information, which could genuinely produce an attitude shift.

The Practice domain yielded a two-factor structure of "family dietary practices" and "family oral hygiene practices" that cut across parent and child items rather than clustering by respondent. This finding is conceptually significant: oral health practices appear to be organized at the household level, with parent and child dietary habits and hygiene routines co-varying as shared family behaviors, consistent with evidence that such practices are fundamentally derived from family norms and values rather than isolated individual behaviors. Evidence consistently demonstrates significant correlations between parent and child oral health behaviors across developmental stages and geographic settings, from preschool, where children's oral care is almost entirely steered by caregiving routines, through adolescence, where toothbrushing and dietary habits remain strongly associated with household norms established in early childhood [54–56]. Parental behavior has been shown to predict children's oral health practices more strongly than parental knowledge or attitudes alone [45]. Mothers with irregular brushing habits report the same for their children [55], and children are considerably more likely to brush regularly when parents model this behavior themselves [57]. Oral health intervention strategies targeting the household unit are likely to be more effective than those directed at parents or children in isolation.

This framing also has direct implications for how the instrument should be interpreted clinically. Since parent and child items load onto shared factors, higher scores within each subscale indicate more favorable household-level practices rather than individual behavior. This could be considered a strength in the context of family-centered preventive counseling, where a clinician reviewing the family dietary practices subscale can identify households with collectively elevated sugar consumption and target dietary advice accordingly. At the same time, within-factor comparisons between parent and

child item responses can lead to the discovery of clinically meaningful discrepancies: a parent who reports infrequent sugar consumption alongside a child reported to consume sugar frequently may signal a lack of parental supervision rather than a shared household dietary pattern, warranting a different counseling approach entirely.

The reported use of fluoridated toothpaste by parents for themselves and their children in the sample was near-universal, consistent with high rates of reported fluoride use documented in other studies [42]. While this likely reflects long-standing public health messaging and the widespread availability of these products, it is also plausible that these responses reflect habitual household purchasing rather than active awareness of fluoride content, as demonstrated in Libya, where high reported use coexisted with limited parental understanding of fluoride concentration requirements [41]. Although unsuitable for inclusion in EFA, these items remain useful for identifying subgroups that may not be using fluoridated products and for guiding more targeted follow-up.

The pragmatic utility of this instrument lies in its fit within the Malaysian public healthcare system. High patient volumes and long waiting times at government dental clinics [35] often constrain opportunities for tailored oral health education, and no brief psychometrically evaluated parental KAP tool currently exists for use in these settings. This questionnaire could potentially be administered in the waiting area via paper-based forms or digital platforms (*e.g.*, Google Forms accessed via a Quick Response (QR) code), to help clinicians identify parental knowledge gaps and household behavioral determinants that may not be systematically captured during standard CRA assessments. The tool also addresses an important engagement gap in the School Dental Service, where parental involvement has historically been limited to the provision of signed consent [58]. Disseminating the questionnaire via the school provides an opportunity to involve parents in their child's oral health beyond this passive role. Given its performance in test–retest, the instrument also shows potential for repeated administration in longitudinal studies or evaluation of oral health promotion programs.

As this was an early-stage validation study, the questionnaire should be regarded as a preliminary instrument rather than a finalized measure. While its current form offers immediate practical value, our findings highlight several areas for refinement. Given the inferior performance of reverse-worded items, future iterations should prioritize straightforward, positively-worded phrasing throughout, with more extensive cognitive interviewing to ensure the items are interpreted as intended. Future work should examine whether expanding the Knowledge domain and organizing items into condition-specific subdomains improves internal consistency. This could also yield a more detailed picture of what parents know. Future iterations of the instrument could explore relocating item A7 to a behavioral intentions' subscale, or pairing it with items that probe the underlying barriers to preventive attendance. Reporting separate sub-scores for parent and child behaviours alongside the composite practice score would allow clinicians to identify families where a gap exists between parents' and children's behaviors.

This study has several limitations that should be considered when interpreting the findings. The sample size of 106, while adequate for the psychometric procedures employed and consistent with precedents for early-stage instrument development [59], remains relatively small for stable IRT parameter estimation. For example, the high discrimination estimate observed for item K1 may reflect sample-specific characteristics rather than the true property of the item, and parameter estimates across the knowledge domain should be interpreted with caution until confirmed in larger samples. Confirmatory factor analysis, which was beyond the scope of this preliminary study, will be necessary to verify the factor structures identified through EFA before the instrument can be recommended for broader use. Participants were recruited using convenience sampling, which may limit the generalizability of the findings to the broader population of Malaysian parents. The sample was also demographically skewed towards mothers and households within the B40 income category—this means the instrument's psychometric properties have not been adequately tested among fathers and higher-income households. There may be meaningful differences in these groups' oral health KAP, and the items' performance could vary accordingly. As data were collected via a digital questionnaire, parents without access to smartphones or reliable internet connectivity may have been underrepresented despite efforts to recruit across multiple settings.

5. Conclusions

This study presents a brief parental oral health KAP questionnaire that has undergone initial psychometric evaluation among parents of primary schoolchildren in Malaysia. The findings provide preliminary support for the instrument, but it should be regarded as an early-stage measure. Further validation is required before it can be recommended for broader application. Before broader use is recommended, validation in larger, more diverse samples is needed to yield stable IRT parameter estimates, confirmatory factor analysis is required to verify the factor structures identified through EFA, and cross-cultural adaptation studies will be necessary to assess transferability beyond the Malaysian context. Subject to the above, the instrument shows promise for chairside use during pediatric dental visits to support the identification of parental KAP, and may have future utility in recall visits, school-based programs, and the evaluation of oral health promotion interventions. With continued development, this questionnaire could contribute to a more systematic and family-centered approach to preventive oral healthcare for primary schoolchildren.

AVAILABILITY OF DATA AND MATERIALS

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

PP—performed the research; analyzed the data and wrote the manuscript. ZYMY—provided help and advice on study methodology and interpretation of findings. Both authors

designed the research study. Both authors contributed to editorial changes in the manuscript. Both authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval for this study was granted by the Medical Ethics Committee, Faculty of Dentistry, Universiti Malaya, Malaysia (Ref: DF CO2504/0019 (P)). The study was registered with the National Medical Research Register (NMRR ID-25-01008-MRH). Participants provided informed consent before participation, and data collection was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. All reasonable measures were taken to ensure the confidentiality and privacy of participants.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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