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Cross-cultural adaptation and psychometric properties of the Malay version of parenting and child tooth brushing assessment (M-PACTA)

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Abstract

Background Malaysian preschool children continue to exhibit a high prevalence of dental caries and poor oral hygiene. There is a need to gain an in-depth understanding of oral hygiene habits and design suitable interventions to improve oral hygiene in early childhood.

Objective To cross-culturally adapt and determine the psychometric properties of the Malay-translated Parenting and Child Tooth Brushing Assessment questionnaire (M-PACTA).

Methodology This cross-sectional study involved face and content validation, and forward and back-translation of PACTA. The M-PACTA was then tested for reliability and construct validity on 150 Malaysian parents of children aged 5 to 6 years old.

Results Face validity indicated that the M-PACTA items were clear and easy to understand. For content validity, some words had to be modified in accordance with the recommendations of the expert committees to make it more coherent to Malaysians. Some statements in the parental knowledge scales were modified according to the guidelines applicable in Malaysia. The content comparison of the back translation with the adapted PACTA revealed that all items were semantic and linguistically equivalent. Exploratory factor analyses of M-PACTA suggested a two-factor structure for three scales including child behaviour scale ('non-compliance' and 'avoidance behaviour'), parental attitudes ('lack of concern' and 'attitude of care'), and parental knowledge ('general tooth brushing knowledge' and 'awareness of tooth brushing care') while for the parental strategy scale, three-factor structure was extracted including 'routine positive methods', 'uncommon positive methods', and 'negative methods'. Internal consistencies for all scales were good ($\alpha > 0.9$).

Conclusion M-PACTA did not replicate the construct of the original PACTA. Nonetheless, M-PACTA demonstrated good construct validity, internal consistency reliability, and test-retest reliability within Malaysian context.

Keywords Children, Parenting, Tooth brushing, Validity, Malay

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Introduction

The global prevalence of Early Childhood Caries (ECC) continues to remain high with the highest prevalence in Asia [1, 2]. In Malaysia, the National Oral Health Survey of Preschool Children (NOHPS 2015) reports a caries prevalence of 71.3% and a mean decay, filling teeth (dft) of 4.8 in Malaysia [3]. Tooth brushing is an effective method for the removal of bacterial biofilm and consequently the most cost-effective preventive measure against dental caries [4]. Recommendations state that tooth brushing should start as soon as the first primary tooth erupts. As manual dexterity has not yet developed in young children, parents must assist brushing their children's teeth twice a day, in the morning and evening before bedtime [5].

Preschool children in Malaysia exhibited poor oral hygiene practices, with 43.5% of parents participating in their child's tooth brushing routine [6]. Malaysian school children had inadequate knowledge, attitudes, and practices regarding oral health [7]. Several studies demonstrated that tooth brushing habits among preschool children were insufficient since tooth brushing recommendations were not followed [8, 9]. Elsewhere, although parents were aware of proper child brushing techniques or had good oral health knowledge, they did not practice good tooth brushing habits on a daily basis for various reasons [10–12]. Varied challenges for parents of young children include difficult child behaviour, poor parenting skills around toothbrushing and lack of social support [10]. So far, no studies in Malaysia addressed specific parenting practices and child behaviours associated during toothbrushing to assess enablers and inhibitors of effective toothbrushing among preschool children.

Parenting and Child Tooth Brushing Assessment (PACTA) is a valid instrument to assess tooth brushing among Australian children and comprised of four scales; child behaviour, parenting strategies, attitudes, and knowledge [13]. Being economically and socio-culturally different from Australia, PACTA is unlikely to suitably capture the pertinent information from a multi-ethnic society such as Malaysia. A culturally adapted PACTA is essential to obtain more accurate information about tooth brushing behaviour of Malaysian children. Therefore, the aim of this study was to cross-culturally adapt and determine the psychometric properties of the Malay version of PACTA (M-PACTA) in assessing the child's behaviour, parents' strategy, knowledge, and attitude towards tooth brushing.

Materials and methods

Study design and ethical approval

This cross-sectional study focused on the cross-cultural adaptation of the PACTA, which included assessment of face and content validity followed by the translation into

Malay language and its psychometric testing for internal consistency, test-retest reliability, and construct validity. The study was approved by the Research and Ethics Committee of the Faculty of Dentistry, Universiti Malaya, Kuala Lumpur, Malaysia (DF CD2208/0028 P). The Department of Rural and Urban Development approved the list of participating preschools.

Assessment tool

The PACTA comprised of 77 items with four independent scales: child behaviour, parental strategies, parental attitude, and parental knowledge. The child behaviour scale consisted of 21 items that incorporated (i) a 5-response likert scale to assess the frequency of the occurrence of problematic behaviour in the past 1 week (ii) a 2-way response of 1 (*yes*) or 0 (*no*) to evaluate if the behaviour is a problem for the parent and (iii) a 10-point score to assess the parents' confidence in handling the behaviour. Parental strategies during tooth brushing sessions were assessed using 27 items with a 5-point scale. The parental attitude scale involved 18 items assessed using a 5-point scale whereas the parental knowledge scale comprised 11 items measured with a 5-point scale.

Description of the face and content validity

Face validity of the original questionnaire was carried out by two experts: one paediatric dentist and one public health dentist. Face validity required critical observation of each item in the questionnaire to establish a valid measure of concept using a 5-point rating scale (1- very insufficient, 2- insufficient, 3- sufficient, 4- good, 5- outstanding). The feasibility, readability, consistency of style and formatting, and the language of the questionnaire were also assessed. Face validity index (FVI) was utilized to assess agreement regarding face validity. An FVI above 0.4 (80%) is considered an acceptable cutoff score for face validity [14].

Content validity was carried out to determine the appropriateness and validity of items, and involved four experts: two paediatric dentists, two public health dentists; and two parents of preschool children who attended the Paediatric Dental Clinic at the Faculty of Dentistry, Universiti Malaya. They were tasked to rate each item in the PACTA using a 4-point rating scale (1- not relevant, 2- item needs some revision, 3- relevant but needs some minor revision, 4- very relevant) which considered the item's relevance, clarity, and essentiality. Scale content validity index (S-CVI) was employed to evaluate the degree of agreement for content validity. A S-CVI value exceeding 0.9, indicated excellent content validity [17].

The revised items and the comments on the face and content validity were then assessed and discussed among an expert panel consisting of two paediatric dentists and one public health dentist. The revision of the

questionnaire was done based on the experts' final decision. The final version of the questionnaire was then subjected to the next phase of the study. There was a distinct and non-overlapping set of experts engaged in face validity, content validity, and finalising of the questionnaire.

Cross-cultural adaptation

The process of cross-cultural adaptation followed published guideline [15] involved several steps, including forward-translation from English to Malay, evaluation by an expert committee, back-translation from Malay to English, re-evaluation by the expert committee, and cognitive debriefing with a group of parents. The PACTA forward-translation was done by two native Malay-speaking translators: one professionally trained linguistic translator from the Faculty of Language and Linguistics and one layperson. The expert committee, which included three paediatric dentists and one public health dentist, evaluated these two forward-translated PACTA versions before deciding on the consensus version. The Malay consensus version of PACTA was then back-translated into English by two independent English-speaking translators who were also proficient in the Malay language: one professionally trained linguistic translator and one experienced high school English teacher. Back-translated English versions of PACTA were then compared to the original English language PACTA to achieve conceptual and semantic equivalency. Following the expert committee's recommendations (three paediatric dentists and one public health dentist), the Malay version of PACTA (M-PACTA) was finalised.

The M-PACTA was pre-tested on five parents of preschool children who attended the Paediatric Dental Clinic in the Faculty of Dentistry, Universiti Malaya. Participants were required to score each question in the M-PACTA using a 5-point scale (1- very insufficient, 2- insufficient, 3- sufficient, 4- good, 5- outstanding) based on the items' clarity, comprehension, and language understanding.

Reliability and validation of M-PACTA

A pilot study was done to evaluate the reliability and validity of the M-PACTA. Malaysian parents or caregivers of fit and healthy preschool children aged 5 years 1-month old to 6 years 11 months old who could speak and read in the Malay language were included in this study. The study was conducted in four randomly selected preschools in Petaling Jaya district, Selangor, Malaysia and the Paediatric Dental Clinic at the Faculty of Dentistry, Universiti Malaya. The M-PACTA was administered to 180 parents of preschool children, and 150 completed questionnaires were collected. Written informed consent was obtained from parents who participated in this study. The data collected was then

tested for validity and reliability. For test and retest reliability measurements, a sample of 15 preschool parents, selected randomly, using SPSS software were tested after two weeks of the pilot study.

Statistical analysis

The data collected were entered and analysed using the Statistical Package for the Social Sciences for Windows version 27.0 (SPSS, Chicago, IL, USA). Descriptive statistics were used to assess the distribution of demographic parameters of the respondents in the pilot study. Mean scoring for face validity was calculated by using the sum of the scores divided by the number of respondents. For each item, the content validity index (I-CVI) was computed by summing the scores of responses and dividing them by the total number of experts. The mean of all I-CVIs was utilised to determine the scale content validity index (S-CVI) for each scale of the PACTA questionnaire. Interrater agreement was measured using the Feiss' kappa coefficient [16].

Since the variables were categorical, exploratory factor analysis was employed using a polychoric correlation matrix using FACTOR version 12.04.04 [17]. Tetrachoric correlation is a special case of the polychoric correlation applicable when both observed variables are dichotomous. The factor structure of the dichotomous questionnaire items was examined using Principal Components Analysis (PCA) and with Promax rotation which enabled analysis based on a polychoric correlation matrix [17]. To determine the number of factors to retain in the scale, parallel analysis was used. The dimensionality of each of the four scales of PACTA was evaluated independently, acknowledging the conceptual distinctions inherent in each scale. The Kaiser-Meyer-Olkin (KMO) sampling adequacy measure and Bartlett's test of sphericity were used to establish the factorability of these scales. Items that had a loading of 0.3 or higher on multiple factors were allocated to the factor with the highest loading. The internal consistency of the subscales was determined based on the factor located.

The internal consistency of scales and subscales was assessed using Cronbach's alpha, with a score of 0.5–0.7 and 0.7–0.9 considered moderate and high reliability respectively [18]. Intraclass correlation coefficients (ICC) were used to calculate the test-retest reliability on the repeated administration; ICCs greater than 0.75 indicated good reliability [19].

Results

Face validation

Both experts agreed that all the items in all four scales of the PACTA (child's behaviour, parental strategies, parental attitudes, and parental knowledge) were clear, easy to understand, with appropriate layout and style,

and appropriate language was used. All the items had an impact score of more than 4.0. One expert pointed out that in *item 12*, the behaviour of swallowing toothpaste is not an indication of avoiding tooth brushing. Thus, a new item, 'swallowed the toothpaste during tooth brushing' was developed in the scale of child behaviour.

Content validation

For the child's behaviour scale, the experts suggested the review and modification of *item 1* and *item 11*. Thus, 'Refused to brush their teeth in the evening' and 'Complained or whinged during tooth brushing, e.g. didn't like toothpaste or toothbrush, or how long it takes to brush' were changed to 'Refused to brush their teeth before bedtime' and 'Complained or grumbled during tooth brushing, e.g. didn't like toothpaste or toothbrush, or how long it takes to brush' respectively. For all items in this scale, I-CVI ranged between 0.86 and 1. The S-CVI for this scale was 0.97. Significant consensus among experts was observed with the Feiss' kappa coefficient reaching 0.79 (p -value < 0.01).

In the parental strategies scale, *item 2*, *item 19*, and *item 22* were modified based on feedback. The changes were as follows; *Item 2*: 'Had an evening routine for your child that included tooth brushing' to 'Had a routine before bedtime for your child that included tooth brushing'; *item 19*: 'Used a logical sequence when a problem behaviour occurred (e.g. missing out story time for running away during tooth brushing)' to 'Used a logical sequence when a problem behaviour occurred (e.g. missing out TV/ play time for running away during tooth brushing)'; and *item 22*: 'Used physical punishment (e.g. smacking) if your child didn't cooperate with tooth brushing' to 'Used physical punishment (e.g. smacking/ pinching) if your child didn't cooperate with tooth brushing'. The I-CVI ranged from 0.83 to 1.0 with the S-CVI of 0.9. There was no revision required for the parental attitude scale. Its I-CVI ranged between 0.92 and 1.0 with the S-CVI of 0.96.

According to the experts' opinion, *item 3* and *item 4* in the parental knowledge scale needed revision and modification based on local guidelines in Malaysia. These statements were modified as such; *item 3*: 'Brushing with fluoridated toothpaste from 18 months of age are important for preventing tooth decay' to 'Brushing with fluoridated toothpaste from 6 months of age is important for preventing tooth decay' and *item 4*: 'Children are only supposed to use a pea-size amount of toothpaste' to 'Children are only supposed to use a smear layer/ pea-size amount of toothpaste'. The I-CVI for parental knowledge ranged from 0.86 to 1.0 with the S-CVI of 0.97.

Semantic equivalence

Some words had to be modified according to the expert committees' recommendations to achieve the optimal cross-cultural adaptation of the M-PACTA. The content of PACTA was not altered; rather, it was modified to make it more comprehensible to Malaysians. In the pre-testing phase of M-PACTA, all participants agreed that all items in the four scales were clear, understandable, and used appropriate language except for 1 item in the parental strategies scale. The item was then modified for better clarity from '*Bergilir-gilir dengan anak untuk memberus gigi*' to '*Tbubapa/ penjaga bergilir-gilir dengan anak untuk memberus gigi*'.

Pilot study: demographic characteristics of participants

In this study, 150 respondents completed the entire PACTA, with 15 of them completing the repeated administration for reliability testing. The demographic characteristics of the study respondents are shown in Table 1.

Exploratory factor analyses

The Kaiser-Meyer-Olkin (KMO) indices of sample adequacy demonstrated satisfactory value (>0.60) for various scales: child behaviour (0.874), parental strategies (0.702), attitude (0.810), and knowledge (0.737). Additionally, all scales exhibited significant Bartlett's test of sphericity (P <0.05), confirming the suitability of the collected data for EFA.

In the child behaviour scale, EFA extracted two factors based on parallel analysis. The eigenvalues and total variance explained by the two factors are shown in Table 2. Following Promax rotation, the first factor, labelled 'avoidance behaviour' accounted for 29% of the variance, while the second factor, 'non-compliance', explained 15% of the variance. One item (*Item 22*) with a loading factor less than 0.3 was removed. Both 'avoidance behaviour' (14 items: α =0.964), and 'non-compliance' (7 items: α =0.923) demonstrated high levels of internal consistency.

For the parenting strategies scale (Table 3), EFA suggested three factors which was labelled as 'routine positive methods', defined as those positive strategies that Malaysian parents commonly use; 'uncommon positive methods' which referred to positive strategies less frequently used in the Malaysian culture and 'negative methods' which referred to negative strategies such as verbal and physical punitive techniques used. The variance for 'routine positive methods' 'uncommon positive methods' and 'negative methods' were 16%, 19% and 18% respectively. No items were deleted, as all initial communalities were above 0.3. Internal consistency was high for the 'uncommon positive methods' (11 items: α =0.962), 'negative methods' (7 items: α =0.965) and 'routine positive methods' (9 items: α =0.966).

Table 1 Demographic parameters of the pilot study sample (N = 150)

Variables	N	%
Age of children		
5	81	(54)
6	69	(46)
Gender		
Male	71	(47.3)
Female	79	(52.7)
Relationship to children		
Mother	114	(76)
Father	32	(21.3)
Care giver	4	(2.7)
Relationship status		
Married	144	(96)
Divorced	5	(3.3)
Single	0	(0)
Widow	1	(0.7)
Family structure		
Nuclear family	124	(82.6)
Single parent	6	(4)
Adopted family	2	(1.3)
Extended family	18	(12.0)
Educational level		
No formal education	3	(2)
Primary school	2	(1.3)
Secondary school	50	(33.3)
Diploma	42	(28)
Degree	40	(26.7)
Postgraduate	13	(8.7)
Total Household Income¹		
< RM4850 (B40)	72	(48)
RM4850-10,959 (M40)	63	(42)
> RM10,959 (T20)	15	(10)
Employment status		
Employed	129	(86)
Not employed	4	(2.7)
Housewife	17	(11.3)

¹ Malaysia's household income classification: B40 for bottom 40%; M40 for middle 40%; T20 for top 20%

For the parental attitude scale, two factors were extracted based on the parallel analysis: 'lack of concern' (27% variance) and 'attitude of care' (16% variance) (Table 4). Internal consistency was high for 'lack of concern' (12 items: $\alpha=0.951$), and 'attitude of care' (6 items: $\alpha=0.928$).

Lastly, EFA on all 11 items in the parental knowledge scale revealed two factors: 'general knowledge of tooth brushing' (26% variance) and 'awareness of tooth brushing care' (16% variance) (Table 5). Both factors exhibited excellent internal consistency: 'general knowledge of tooth brushing' (7 items: $\alpha=0.925$), and 'awareness of tooth brushing care' (4 items: $\alpha=0.923$).

For the test-retest reliability, the intra-class correlation (ICCs) were high across different scales: 0.869 for child behaviour, 0.907 for parental strategy: 0.936 for parental attitude, and 0.900 for parental knowledge. The average ICC of 0.903 suggested a high level of test-retest reliability across these scales.

Discussion

This study aimed to determine the psychometric properties of the Malay-translated PACTA for Malaysians. To achieve the study's goals, first, the PACTA was face and content validated, then translated into Malay and back-translated to English. This back-translation was compared with the English PACTA to ensure conceptual, item and semantic equivalence, following the guidelines of the Herdman framework [20]. Subsequently, the reliability and validity of the Malay version were assessed in a pilot study. Malaysia is a culturally diverse country where Bahasa Melayu (Malay) serves as the national language and English second official language [21]. Given that the PACTA is readily available in English, adapting it for cross-cultural use before translating it into Malay allowed us to develop a culturally adapted English version of PACTA that aligns with local cultural norms and understanding. Directly translating a questionnaire without prior cross-cultural adaptation may lead to terms and concepts that do not resonate well with the cultural context and understanding of the target group. Therefore, our approach of first adapting the instrument cross-culturally and then translating it into Malay ensured a more tailored adaptation process that considers cultural nuances before linguistic translation. Subsequently, the Malay-translated PACTA underwent a cognitive debriefing with five preschool parents to assess its clarity and comprehension, as evaluated in the face validation.

The face validity result showed that the items of PACTA were well written in terms of appropriate layout and language used, making it clear and simple to comprehend. To ensure content validity, every item was assessed to ascertain its validity and relevance to each respective scale. Nonetheless, adjustments were made to certain terminologies based on the recommendations from expert committees to enhance their clarity among Malaysians. For instance, in *item 1* (Child behaviour scale), the term 'evening' was replaced by 'bedtime' as, in Malaysian context, the word 'evening' denotes a shift from daytime to relaxation and leisure, whereas 'bedtime' is more appropriate for addressing the brushing before sleep time at night. In *Item 11* (Child behaviour scale), the term 'whinged' in the original PACTA was replaced by 'grumbled', which is more commonly used term among Malaysians. For *item 22* in parental strategy scale, 'missing out story time' was replaced with 'missing out TV/ play time' because TV time/ play is a more common reward

Table 2 Factor loadings of the child behaviour scale*

Item No.	Item	Factor 1 Avoidance behaviour	Factor 2 Non-compliance
3.	Didn't come to brush their teeth when called	0.613	
4.	Made excuses to avoid tooth brushing, e.g., already brushed, sleepy, too tired, etc.	0.469	
5.	Tried to negotiate tooth brushing, e.g., insisted on only brushing the front teeth	0.548	
6.	Tantrumed about tooth brushing	0.749	
7.	Cried about tooth brushing	0.892	
8.	Refused to open their mouth for tooth brushing	0.900	
9.	Needed constant reminding and prompting to keep their mouth open for tooth brushing	0.552	
10.	Didn't stay still enough for tooth brushing	0.629	
11.	Complained or grumbled during tooth brushing, e.g., didn't like toothpaste or toothbrush, or how long it takes to brush	0.549	
12.	Tried to avoid having to brush their teeth, e.g., spat, or chewed or sucked on the tooth brush	0.617	
14.	Talked instead of brushing their teeth	0.646	
15.	Ran away during tooth brushing	0.756	
17.	Didn't allow all teeth to be brushed, e.g., not the teeth at the back	0.620	
21.	Refused to use toothpaste when tooth brushing	0.468	
1.	Refused to brush their teeth before bedtime		0.506
2.	Refused to brush their teeth in the morning		0.357
13.	Played with toothbrush, water or paste instead of brushing		0.457
16.	Insisted on tooth brushing all by themselves		0.683
18.	Tried to rinse toothpaste from their mouth immediately		0.700
19.	Took too long to brush their teeth		0.745
20.	Brushed their teeth too quickly		0.632
	Eigenvalues	6.453	3.272
	Proportion of variance (%)	29	15
	Cronbach alpha	0.964	0.923

Kaiser-Meyer-Olkin was 0.874, Bartlett's test of sphericity was significant (p -value < 0.001)

Principal Components Analysis (PCA) extraction with Promax rotation was applied. Loading less than 0.3 omitted from table

*The scale is adapted from [13]

and leisure activity in the Malaysian context. In *item 22* of the parental strategy scale, 'Pinching' was added to the example of 'physical punishment' alongside 'smacking' as it reflects the common use of pinching as a form of physical punishment among Malaysians.

Disparities exist regarding the utilisation of fluoride as per Australian and Malaysian guidelines. In Australia, the introduction of fluoride toothpaste is advised at 18 months of age [22], whereas in Malaysia, fluoride toothpaste is advocated for individuals of all age groups as soon as their first tooth erupts [23]. Hence *Item 3* in the parental knowledge scale was modified to reflect this. Given that the questionnaire is tailored for pre-school children, adjustments were made to the toothpaste amount specified in *item 4* of the parental knowledge scale. Instead of the term 'pea-sized', it was modified to 'smear layer/pea-sized' to better suit the dental hygiene protocol in Malaysia [23]. Even with the modification made to the content of the PACTA questionnaire, the results regarding content validity for each scale remained

robust, demonstrating high item-content validity with an S-CVI of 0.9.

The factor analysis conducted on the child behaviour scale clearly differentiated between items representing avoidance behaviour and those representing non-compliance. These findings align with the original PACTA that was conducted in Australia, which also observed distinctions between non-compliance behaviours and avoidance behaviours [13]. The child who exhibits non-compliance behaviours does not blatantly refuse to brush their teeth but rather shows a lack of cooperation. Notably, no items exhibited cross-loading item compared to the original PACTA [13]. Furthermore, the parental confidence scores on the child behaviour scale demonstrated a single-factor structure, consistent with the previous investigation by Tadakamadla et al. (2021) [13]. This finding is in line with the commonality observed in the one-dimensionality of parenting self-efficacy scales [24].

In the parental strategies scale, our analysis identified three distinct factors: 'uncommon positive methods', 'routine positive methods', and 'negative methods'. This

Table 3 Factor loadings for parental strategies scale*

Item No.	Item	Factor 1 Uncommon positive methods	Factor 2 Negative methods	Factor 3 Routine positive methods
2.	Had a routine before bedtime for your child that included tooth brushing	0.397		
3.	Used an alarm or a reminder to help you remember to brush your child's teeth	0.791		
4.	Had rules for tooth brushing, so your child knows what is expected of them	0.639		
5.	Gave your child a choice of which toothbrushes or tooth paste you buy, e.g., favourite colour	0.340		
6.	Used a reward/sticker chart to encourage your child with tooth brushing	0.823		
12.	Made tooth brushing playful, e.g., by singing songs	0.544		
13.	Read books about tooth brushing with your child	0.825		
14.	Used apps/games/videos to help your child get interested in tooth brushing	0.730		
15.	Used a two-minute timer (e.g. sand timer, phone, or in-built toothbrush timer) to make sure that your child's teeth were brushed for 2 min	0.804		
19.	Used a logical consequence when a problem behaviour occurred (e.g., missing out on TV/ playtime for running away during tooth brushing)	0.411		
26.	Used visual aids to demonstrate proper tooth brushing	0.456		
20.	Used time-out when a problem behaviour occurred with your child during tooth brushing		0.595	
21.	Coaxed and pleaded with your child to brush their teeth		0.686	
22.	Used physical punishment (e.g. smacking/pinching) if your child didn't cooperate with tooth brushing		0.800	
23.	Forcibly restrained your child in order to get their teeth brushed (e.g., held their arms down so they couldn't push the brush away)		0.880	
24.	Scolded or yelled if your child didn't cooperate with tooth brushing		0.867	
25.	Threatened your child with consequences for not co-operating while brushing		0.775	
27.	Skipped or shortened tooth brushing when your child resisted		0.716	
1.	Had a morning routine for your child that included tooth brushing			0.635
7.	Explained to your child the importance of brushing teeth properly, e.g. healthy teeth and gums			0.835
8.	Gave your child a clear instruction to come for tooth brushing			0.930
10.	Stayed with your child while they brushed their teeth			0.524
11.	Took turns with your child to brush their teeth			0.356
16.	Brushed your own teeth to show your child how to brush well			0.407
17.	Praised your child when they brushed their teeth well			0.655
18.	Persisted with tooth brushing when your child resisted			0.411
	Eigenvalue	5.033	4.964	4.322
	Proportion of variance (%)	19	18	16
	Cronbach Alpha	0.962-	0.965	0.966

Kaiser-Meyer-Olkin was 0.70, Bartlett's test of sphericity was significant (p -value < 0.001)

Principal Components Analysis (PCA) extraction with Promax rotation was applied

*The scale is adapted from [13]

three-factor structure diverges from the two-factor structure observed in the original PACTA, which was categorised into 'effective strategies' and 'ineffective strategies' [13]. Upon comparison, the items in the original instrument classified as 'effective strategies' were divided into two separate groups, while the items under 'ineffective strategies' remained within a single component. Our exploration revealed that local context and cultural factors influenced parental strategies regarding tooth brushing. These influences contributed to variations in the interpretation of factors compared to the original study.

In the parental attitude scale, the items were extracted into two parts: the first part addressed parents' attitude of 'lack of concern' regarding tooth brushing in their

children, while the second part focused on the parents' 'attitude of care' associated with tooth brushing. It is noteworthy that parental attitude significantly correlates with the oral health status of their children, and studies have shown that parents with caries-free children have more positive beliefs and attitudes [25, 26]. Mothers often experienced feelings of guilt and claimed responsibility for their children's dental problems, further emphasising the importance of parental attitudes in oral health outcomes [27]. Parents of children who had ECC experienced higher average stress levels, highlighting the potential impact of oral health issues on parental stress levels [28].

Table 4 Factor loadings for parental attitude scale*

Item No.	Item	Factor 1 Lack of concern	Factor 2 Attitude of care
1.	I feel it is okay to not brush my child's teeth if they don't want it done e.g., if they are upset or say they feel sleepy	0.402	
2.	I feel brushing once a day is enough to prevent tooth decay	0.512	
3.	I find it difficult to brush my child's teeth well	0.657	
4.	I feel anxious when it's time to brush my child's teeth	0.776	
5.	I feel stressed out while trying to brush my child's teeth	0.752	
8.	I feel like I am the only parent who has problems with their child's tooth brushing	0.676	
10.	I feel defeated when I think about my child's tooth brushing	0.681	
12.	As long as my child brushes their teeth, I don't care how well it is done	0.518	
13.	I can overlook any misbehaviour while brushing as long as my child is brushing	0.492	
14.	I am unsure where to seek help if/ when my child refuses to cooperate with tooth brushing	0.675	
15.	Brushing teeth is not a priority when there are many other important things that need to be done for my child	0.619	
17.	Brushing my child's teeth is much harder than I thought it would be	0.762	
6.	I feel anxious when my child does not brush their teeth		0.768
7.	I feel guilty when my child does not brush their teeth		0.803
9.	I worry about my child getting tooth decay		0.722
11.	If my child does not brush, I feel like I'm a bad parent		0.441
16.	I would feel ashamed if my child developed tooth decay		0.588
18.	It would be easy to brush my child's teeth if I just knew how to get him/her to cooperate		0.604
	Eigenvalue	4.896	2.939
	Proportion of variance (%)	27	16
	Cronbach Alpha	0.951	0.928

Kaiser-Meyer-Olkin was 0.81, Bartlett's test of sphericity was significant (p -value < 0.001)

Principal Components Analysis (PCA) extraction with Promax rotation was applied

*The scale is adapted from [13]

The 11-item knowledge scale demonstrated a two-factor structure: general tooth brushing knowledge and awareness of tooth brushing care. This outcome contrasts with the original PACTA findings, which had a unidimensional structure. The inclusion of a new subscale in the knowledge scale was driven by cultural disparities in Malaysian' tooth brushing practices. Insufficient comprehension and awareness of tooth brushing techniques often result in inadequate oral hygiene practices [29]. For instance, a common practice among Malaysians is to rinse immediately after tooth brushing rather than spitting out or rinsing with minimal water, highlighting the need for improved knowledge and understanding in this area [6].

This study underscores the robust psychometric properties of the M-PACTA, establishing it as a valuable instrument in both clinical and public health context for evaluating the tooth brushing behaviour of Malaysian preschool children from parental perspectives. This depth of assessment is particularly noteworthy, as many studies traditionally focus solely on oral hygiene practices [6, 30, 31]. This aligns with the growing need for research that delves into the realms of social and

behavioural sciences [32]. With its four distinct scales, M-PACTA can effectively evaluate various constructs and can be utilized individually as needed. For instance, researchers conducting a study on a child's tooth brushing behaviour may solely employ the child behaviour scale of the M-PACTA to assess the child's oral hygiene practices at home, facilitating the development of culturally tailored oral hygiene education programs. Nevertheless, this study is not devoid of limitations. This study's limitations are primarily due to a small sample size, which restricted the conduct of confirmatory factor analysis. Additionally, financial and time constraints made it impractical to obtain a comprehensive sample from every state in Malaysia, potentially limiting its representativeness of the entire Malaysian population. Nevertheless, efforts were made to ensure representativeness from samples collected from Petaling Jaya, Selangor, using a random sampling approach for this specific area. Secondly, the applicability of M-PACTA when assessing older children who can brush their teeth independently may be limited, warranting further investigation into its suitability for such populations. To address the current gap of this study, a confirmatory factor analysis needs to

Table 5 Factor loadings for parental knowledge scale *

Item No.	Item	Factor 1 General knowledge of tooth brushing	Factor 2 Awareness of tooth brush- ing care
1.	It is important to brush children's teeth twice every day to prevent tooth decay	0.475	
2.	Most children younger than 8 years need help from parents to brush their teeth effectively	0.609	
3.	Brushing with fluoridated toothpaste from 6 months of age is important for preventing tooth decay	0.745	
4.	Children are only supposed to use a smear layer/ pea-sized amount of toothpaste	0.587	
5.	Once children have their full set of baby (milk) teeth, tooth brushing needs to be done for at least 2 min to be effective	0.754	
6.	It is a good idea to change tooth brushes every 3 months (earlier if the bristles are frayed)	0.748	
10.	A toothbrush with small head and soft bristles is better for children As long as my child brushes their teeth, I don't care how well it is done	0.493	
7.	It is best not to rinse the mouth at all after finishing tooth brushing		0.718
8.	It is safe if children swallow toothpaste every day		0.818
9.	Routine brushing should only start once the permanent teeth start to come through		0.499
11.	Powered/electric toothbrushes are as effective as manual tooth brushes in children		0.496
	Eigenvalue	1.757	0.893
	Proportion of variance (%)	26	16
	Cronbach Alpha	0.925	0.923

Kaiser-Meyer-Olkin was 0.74, Bartlett's test of sphericity was significant (p-value < 0.001)

Principal Components Analysis (PCA) extraction with Promax rotation was applied

*The scale is adapted from [13]

be conducted on a larger sample size. This analysis will encompass an investigation into the associated factors affecting the child's behaviour as well as parental strategies, attitude and knowledge.

Conclusion

In conclusion, the findings of the present study indicate that the Malay-translated and culturally adapted PACTA did not replicate the constructs of the original PACTA, Nonetheless, the M-PACTA exhibited good construct validity, internal consistency reliability, and test-retest reliability within the Malaysian cultural context.

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Author contributions

CYJ, SAM, JGD contributed to the conception of the study. CYJ collected and performed the analyses. MD contributed to statistical analysis. CJY drafted the manuscript. SAM, JGD, SM revised the manuscript.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval and consent to participant

Ethical approval was obtained from Medical Ethics Committee of the institution [(Reference Number: (DF CD2208/0028 P). Before participating in the study, written informed consent was obtained from all parents of the participants included.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

- Duangthip D, Gao SS, Lo EC, Chu CH. Early childhood caries among 5- to 6-year-old children in Southeast Asia. *Int Dent J.* 2017;67(2):98–106.
- Uribe SE, Innes N, Maldupa I. The global prevalence of early childhood caries: a systematic review with meta-analysis using the WHO diagnostic criteria. *Int J Paediatr Dent.* 2021;31(6):817–30.
- Oral Health Division, Ministry of Health Malaysia. National oral health survey of Preschool Children 2015 (NOHPS 2015). Volume I. Oral Health Status and Caries Treatment Needs of 5-Year-Old children; 2015.
- Huebner CE, Milgrom P. Evaluation of a parent-designed programme to support tooth brushing of infants and young children. *Int J Dent Hyg.* 2015;13(1):65–73.
- Scottish Dental Clinical Effectiveness Programme. Prevention and management of dental caries in children: dental clinical guidance. Scottish Dental Clinical Effectiveness Programme Dundee; 2010.
- Khan IM, Mani SA, Doss JG, Danaee M, Kong LYL. Pre-schoolers' tooth brushing behaviour and association with their oral health: a cross sectional study. *BMC Oral Health.* 2021;21(1):283.

7. Samosir R, Yusof ZY, Mohamed NH, Shoaib LA. Oral health knowledge, attitudes and practices of 11–12 year old Orang Asli children in Cameron Highland, Malaysia. *Southeast Asian J Trop Med Public Health*. 2018;49(5):894–908.
8. Ceyhan D, Akdik C, Kirzioglu Z. An educational programme designed for the evaluation of effectiveness of two tooth brushing techniques in preschool children. *Eur J Paediatr Dent*. 2018;19(3):181–6.
9. Aliakbari E, Gray-Burrows KA, Vinal-Collier KA, Edwebi S, Marshman Z, McEachan RRC, et al. Home-based toothbrushing interventions for parents of young children to reduce dental caries: a systematic review. *Int J Paediatr Dent*. 2021;31(1):37–79.
10. Aliakbari E, Gray-Burrows KA, Vinal-Collier KA, Edwebi S, Salaudeen A, Marshman Z, et al. Facilitators and barriers to home-based toothbrushing practices by parents of young children to reduce tooth decay: a systematic review. *Clin Oral Investig*. 2021;25(6):3383–93.
11. Gund MP, Bucher M, Hannig M, Rohrer TR, Rupf S. Oral hygiene knowledge versus behavior in children: a questionnaire-based, interview-style analysis and on-site assessment of toothbrushing practices. *Clin Exp Dent Res*. 2022;8(5):1167–74.
12. Blinkhorn A, Wainwright-Stringer Y, Holloway P. Dental health knowledge and attitudes of regularly attending mothers of high-risk, pre-school children. *Int Dent J*. 2001;51(6):435–8.
13. Tadakamadla SK, Mitchell AE, Johnson NW, Morawska A. Development and validation of the parenting and child tooth brushing assessment questionnaire. *Community Dent Oral Epidemiol*. 2022;50(3):180–90.
14. Yusoff MSB. ABC of response process validation and face Validity Index calculation. *Educ Med J*. 2019;11.
15. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. *J Clin Epidemiol*. 1993;46(12):1417–32.
16. Gisev N, Bell JS, Chen TF. Interrater agreement and interrater reliability: key concepts, approaches, and applications. *Res Social Adm Pharm*. 2013;9(3):330–8.
17. Lorenzo-Seva U, Ferrando PJ. FACTOR: a computer program to fit the exploratory factor analysis model. *Behav Res Methods*. 2006;38(1):88–91.
18. Taherdoost H. Validity and reliability of the research instrument; how to test the validation of a questionnaire/survey in a research. *Int J Acad Res Manage*. 2016;5(3):28–36.
19. Koo TK, Li MY. A Guideline of selecting and reporting Intraclass correlation coefficients for Reliability Research. *J Chiropr Med*. 2016;15(2):155–63.
20. Herdman M, Fox-Rushby J, Badia X. A model of equivalence in the cultural adaptation of HRQoL instruments: the universalist approach. *Qual Life Res*. 1998;7:323–35.
21. Adelaar KA. Malay—the national language of Malaysia. In: *Atlas of Languages of Intercultural Communication in the Pacific, Asia, and the Americas* edn. Edited by Stephen AW, Peter M, Darrell TT. Berlin, New York: De Gruyter Mouton; 1996: 729–34.
22. Do LG. Guidelines for use of fluorides in Australia: update 2019. *Aust Dent J*. 2020;65(1):30–8.
23. Oral Health Division Ministry of Health Malaysia. Position document: Use of fluorides in Malaysia 2021. Retrieved on 8th. May 2023 from http://203.217.177.13/eiso/bkpkdh/admin/upload/doc_DL_20211230120010_929312682.pdf
24. Morawska A, Sanders MR, Haslam D, Filus A, Fletcher R. Child adjustment and parent efficacy scale: development and initial validation of a parent report measure. *Aust Psychol*. 2014;49(4):241–52.
25. Chhabra N, Chhabra A. Parental knowledge, attitudes and cultural beliefs regarding oral health and dental care of preschool. *Eur Arch Paediatr Dent*. 2012;13(2):76–82.
26. Mani SA, John J, Ping WY, Ismail NM. Early childhood caries: parent's knowledge, attitude and practice towards its prevention in Malaysia. *Oral Health Care-Pediatric, Research, Epidemiology and Clinical Practices*. 2012;1:1–18.
27. Custódio NB, Scharcosim LR, Piovesan CP, Hochscheidt L, Goettens ML. Maternal perception of the impact of anterior caries and its treatment on children: a qualitative study. *Int J Paediatr Dent*. 2019;29(5):642–9.
28. Gavic L, Tadin A, Mihanovic I, Gorseta K, Cigic L. The role of parental anxiety, depression, and psychological stress level on the development of early-childhood caries in children. *Int J Paediatr Dent*. 2018;28(6):616–23.
29. Abduljalil HS, Abuaffan AH. Knowledge and practice of mothers in relation to dental health of pre-school children. *Adv Genet Eng*. 2016;5(2):1–7.
30. Sandström A, Cressey J, Stecksén-Blicks C. Tooth-brushing behaviour in 6–12 year olds. *Int J Paediatr Dent*. 2011;21(1):43–9.
31. Nordström A, Birkhed D. Attitudes and behavioural factors relating to tooth-brushing and the use of fluoride toothpaste among caries-active Swedish adolescents—a questionnaire study. *Acta Odontol Scand*. 2017;75(7):483–7.
32. McGrath C. Behavioral Sciences in the Promotion of oral health. *J Dent Res*. 2019;98(13):1418–24.

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