Development and Validation of an Adult Periodontal Health Knowledge and Belief Questionnaire in Thai Adults

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ABSTRACT

Introduction and aims: Periodontal diseases pose a significant oral health challenge, with many adults lacking adequate understanding of these conditions. This study aimed to develop and validate a questionnaire, designed for standardized assessment of periodontal health knowledge and beliefs in adults (ALPHABET).

Methods: The ALPHABET questionnaire, initially composed of 70 items focusing on periodontal health knowledge (ALPHA-K) and belief (ALPHA-B), underwent thorough development and validation via expert panel review. Structural validity of ALPHA-B was evaluated using confirmatory factor analysis, while convergent validity was confirmed by expected relationship between the scores of ALPHA-K and ALPHA-B, and reliability was assessed through internal consistency. A cross-sectional analysis involving 380 Thai adult dental patients examined the association between ALPHABET scores and patient types, as well as the association with oral health behaviours.

Results: After refinement, the final 40-item ALPHABET questionnaire showed a strong fit with the underlying model, confirming its structural validity. The correlations between the scores of ALPHA-K and ALPHA-B were proved its convergent validity. It also demonstrated high reliability, with Cronbach's alpha coefficients exceeding 0.7, and favourable item-total correlations ranging from 0.406 to 0.773. Patients with a history of periodontal treatment scored significantly higher on all ALPHABET subscales compared to new patients ($P < .05$). The logistic regression analysis demonstrated association of both knowledge and self-efficacy with both brushing and flossing behaviours.

Conclusions: To our knowledge, this questionnaire is the first to validate and assess periodontal health and belief in adults. It should serve as a valuable standardized tool that would potentially drive intervention and raise awareness of the disease and improve periodontal health outcomes.

Clinical relevance: This questionnaire should improve clinician insights into patient perspectives on periodontal disease so as to provide individualized oral health education, guiding tailored interventions for better outcomes.

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Introduction

Periodontal disease is one of the most prevalent oral diseases worldwide,[1] characterized by inflammation of the periodontium. Without appropriate management, it can lead to tooth loss, significantly compromising oral function, aesthetics, and overall quality of life.[2] Despite its profound impact,[3,4] a notable portion of adults lack a fundamental understanding of the aetiology, clinical manifestations, and comprehensive management of the periodontal disease, including preventive measures and professional interventions.

Periodontal disease is multifactorial, primarily caused by dysbiotic dental biofilm[5] and influenced by various systemic, local, and personal factors such as genetic predisposition and socio-behavioural determinants.[6,7] Among these, oral health behaviour plays a critical role in periodontal health. For instance, effective dental biofilm control positively impacts the prevention and management of periodontal disease, while smoking exacerbates its severity.[8] Achieving optimal long-term management of periodontal disease necessitates a comprehensive approach that includes professional periodontal therapy and addressing modifiable risk factors.[9,10] Emphasizing the correction of individual periodontal health behaviours is essential for achieving satisfactory and sustainable treatment outcomes.

The Health Belief Model (HBM), introduced by social psychologist in the U.S. Public Health Service in the early 1950s, is a widely recognized conceptual model in health education and behaviour research. This model posits that individuals are more likely to engage in health-promoting behaviours if they perceived a threat to their health and value the benefits of preventive actions.[11] According to the HBM, changes in health behaviour can be achieved by addressing personalized factors that influence health-related actions.[11] These factors encompass beliefs and perceptions about a disease, perceived ability to perform a behaviour, and motivations prompting action.[12] Furthermore, personal beliefs, attitudes, and values are significantly shaped by the depth and acquisition of health-related knowledge.

Customizing periodontal disease treatment requires considering each individual's understanding and beliefs about the disease. By evaluating these factors, dental professionals can gain valuable insights into patients' motivations for oral hygiene behaviour. However, there are limited validated questionnaires that address only a subset of periodontal health beliefs, and no existing instruments concurrently appraise both knowledge and beliefs in the literature. Therefore, the present study aims to develop and validate a novel, standardized questionnaire that assesses both knowledge and beliefs related to periodontal health among Thai adults.

The developed questionnaire is expected to be valid and reliable for this purpose. Three types of validity are tested with associated hypotheses: content validity (content of the questionnaire is relevant, comprehensive, and comprehensible for the assessment of periodontal health knowledge and belief), structural validity (items in the questionnaire are structurally aligned with the HBM), and convergent validity (scores of the questionnaire correlate with other tests assessing similar constructs). Reliability is tested through internal consistency reliability.

Methods

Study design

This study was an instrument development and validation study. The study protocol received ethical approval from the Human Research Ethics Committee of the Faculty of Dentistry, Chulalongkorn University (HREC-DCU 2022-121) and adhered to the principles outlined in the World Medical Association Declaration of Helsinki.[13] This study was conducted in three consecutive phases.

Phase I: Questionnaire development and pilot testing

Literature searching and drafting. A thorough literature search was conducted from November to December 2021 to identify HBM-based tools used in the context of oral health. Various databases, including the Cochrane Library, PubMed, and Google Scholar, were searched using keywords such as 'oral health', 'health belief model (HBM)', and 'periodontal health'. No validated instruments specifically tailored for evaluating periodontal health in adults within the HBM framework were identified. Consequently, the decision was reached to create a new questionnaire for this specific purpose. The criteria for selecting relevant publications included their focus on oral health knowledge beliefs, and behaviours; publication within the past 15 years; and alignment with HBM constructs. Using these criteria, nine existing questionnaires related to oral health knowledge, beliefs, and behaviours were reviewed to draft the initial version.[14-22] Specific terms considered during the item selection process included gum diseases, bleeding gums, dental plaque, brushing, and flossing. These terms were chosen based on their relevance in the existing literature and expert consensus. The resulting initial draft included 18 items addressing periodontal health knowledge and 53 items focusing on periodontal health beliefs, for a total of 71 items.

Forward translation. Two independent translators, one specializing in linguistics and the other in periodontology, translated the English questionnaire into Thai. The translators and researchers then held a meeting to finalize the Thai-translated version through consensus.

Content validity. A panel of seven experts, including two periodontists, two methodologists, one epidemiologist, one community dentist, and one dental public health dentist, assessed various aspects of content validity in the Thai-translated version. This evaluation involved examining the relevance, comprehensibility, and comprehensiveness of the items. The criteria were adjusted based on the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN) methodology for assessing the content validity of patient-reported outcome measure.[23]

The Content Validity Index (CVI) score for each item was calculated, with a required a CVI of 0.86 or higher indicating agreement among at least six out of seven experts.[24] Following the discussion and CVI assessment, a revised version of the questionnaire was developed, consisting of 70 items: 20

covering periodontal health knowledge and 50 focusing on periodontal health beliefs.

Pilot test. The updated questionnaire was pilot-tested with a convenience sample of 20 adults to assess its comprehensibility. Participants provided written informed consent prior to the pilot test. All feedback was meticulously reviewed to rectify any possible misconceptions and refine the questionnaire accordingly. **The initial version of the Adult Periodontal Health Knowledge and Belief Questionnaire (ALPHABET)** was developed after incorporating modifications confirmed through expert panel discussions and feedback from pilot participants. The questionnaire was designed to assess the level of periodontal health-related knowledge as well as assessing the aspects of periodontal health-related belief based on the HBM in the adult population (Figure 1). This version of ALPHABET consisted of 2 sections:

1) Periodontal health knowledge (ALPHA-K): This section included 20 True/False questions, with a maximum possible score of 20 points. Higher scores represented a greater level of periodontal health knowledge.
2) Periodontal health belief (ALPHA-B): This section comprised 50 items aligned with six constructs of the HBM:

Perceive susceptibility (SUS) (2 items): Assesses an individual's belief about their risk of developing periodontal disease. Higher perceived susceptibility often motivates preventive behaviours.

Perceive severity (SEV) (6 items): Evaluates how serious an individual believes the consequences of periodontal disease are. Greater perceived severity can lead to increased engagement in health-promoting actions.

Perceive benefits (BEN) (11 items): Measures the belief in the effectiveness of preventive actions to reduce the risk or impact of periodontal disease. Recognizing benefits encourage the adoption of healthy behaviours.

Perceive barrier (BAR) (12 items): Identifies obstacles that may prevent an individual from adopting preventive behaviours. Lower perceived barriers facilitate behaviour change.

Self-efficacy (EFF) (9 items): Assesses confidence in one's ability to perform preventive behaviours. Higher self-efficacy enhances the likelihood of taking action.

Cues to action (CUE) (10 items): Examines factors that prompt individuals to take health-related actions. Effective cues to action can trigger health-promoting behaviours.

Responses were recorded using a five-point Likert scale. For items in the SUS, BEN, BAR, and CUE constructs, response options included: 'Strongly Disagree', 'Disagree', 'Neutral', 'Agree', and 'Strongly Agree', with scores from 1 to 5 points, respectively. However, for BAR items, scores were reverse-coded. Items in the SEV construct offered response choices ranging from 'Not Serious' to 'Very Serious', while items in the EFF construct provided response options ranging from 'Not Confident' to 'Very Confident'. For each subscale, higher scores indicated stronger beliefs or feelings towards each domain, except for BAR which were reverse-coded.

Phase II: Structural validity, convergent validity, and reliability testing

The questionnaire's validity and reliability were assessed to confirm its psychometric properties.[25] Validity assesses how accurately an instrument measures its intended construct, while reliability gauges its consistency in producing dependable results under stable conditions.

Population for validation. The initial version of ALPHABET was administered to adult patients visiting undergraduate and postgraduate periodontal clinics at the Faculty of Dentistry, Chulalongkorn University. Inclusion criteria included adults (≥18 years old) with at least one natural tooth and proficiency in the Thai language. Individuals with limited Thai literacy skill or complete edentulism were excluded.

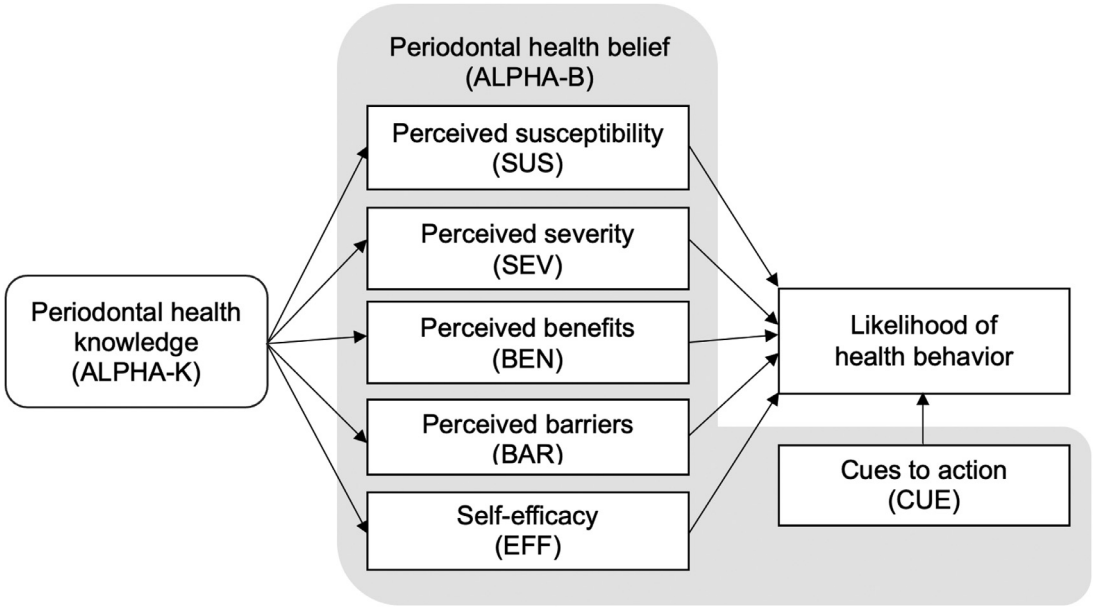

Fig. 1 – Conceptual framework of the questionnaire development.

Sample size calculation. Following the COSMIN guideline for patient-reported outcome measure evaluation,[23] a minimum of seven patients per item is recommended for comprehensive validation. Therefore, the sample size for validating the ALPHA-B section was calculated by multiplying 50 items by seven patients per item, totalling 350 patients. This sample size also met the minimum validation requirement for the ALPHA-K section, which comprised 20 items, resulting in a total of 140 patients. Considering a 10% dropout rate, the study's total sample size was set at 385 patients.

Data collection. After obtaining informed consent, study participants completed a comprehensive case report form, covering demographic details (age, gender, education, employment status, income level, and living arrangements), medical history, previous dental visits, oral hygiene behaviour (brushing and flossing) and the ALPHABET questionnaire.

Structural validity. Confirmatory factor analysis was used to assess the alignment of the HBM constructs with the underlying structure of the ALPHA-B questionnaire using observed data from the study. The IBM SPSS AMOS statistical package was utilized. Various goodness-to-fit indices were examined, including the Chi-square statistic (χ^2), normed Chi-square (χ^2/df), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), comparative fit index (CFI) and Tucker–Lewis index (TLI). A good fit was indicated by RMSEA and SRMR < 0.06, and CFI and TLI > 0.9. Items in the ALPHA-B with loadings below 0.5 were considered for removal.[20]

Convergent validity. Given the absence of a previously existing questionnaire suitable for evaluating periodontal health, convergent validity was assessed within the ALPHABET's two components: the ALPHA-K (knowledge) and the ALPHA-B, (belief) sections. Hypotheses were formulated to test expected relationships between these constructs:

1. Positive and at least weak correlations between total ALPHA-K scores (periodontal health knowledge) and total ALPHA-B scores (overall periodontal health belief).
2. Positive and at least weak correlations between total ALPHA-K scores (periodontal health knowledge) and scores on the perceived benefits subscale of the ALPHA-B.

To evaluate these hypotheses, Spearman's rho correlation coefficients were calculated to assess relationships between knowledge (ALPHA-K) scores, subscale scores of ALPHA-B, and individual items within subscales. Correlation strength was categorized as weak (≤0.39), moderate (0.4-0.69), or strong (≥0.7), with statistical significance set as $P < .05$.[26]

Reliability. Following item reduction and structural validity testing, the final version of ALPHA-B was evaluated for internal consistency reliability to understand how the items were interconnected. This assessment was not conducted for the ALPHA-K because it follows a formative measurement model.

Phase III: Cross-sectional study

Following initial psychometric validation of the ALPHABET, a cross-sectional analysis was conducted to explore associations between periodontal health knowledge, beliefs (based on ALPHABET scores), and patient groups.

Data analysis. Levels of periodontal health knowledge and beliefs based on ALPHA-B subscale scores were compared across studied variables. Data normality was assessed using the Kolmogorov-Smirnov test, which indicated that the data was non-normally distributed. Descriptive analysis of ALPHABET scores between subgroups utilized the Mann–Whitney *U* test or Kruskal–Wallis test as appropriate. Participants were categorized into two groups based on their patient history at the Faculty of Dentistry, Chulalongkorn University:

1) **New patient:** A new patient at the periodontal clinic
2) **Returning patient:** A returning patient who had been seen by a dentist in the periodontal clinic at least once.

Patients with prior periodontal treatment were hypothesized to score higher on the ALPHABET knowledge and belief sections and exhibit better brushing and flossing behaviours due to the periodontal health education they received from the dentist. The null hypothesis tested for no significant difference in ALPHABET subscales between new and returning patients.

To explore the association between desirable oral health behaviours (brushing twice a day or more, brushing more than 2 minutes, and using dental floss) and ALPHABET scores —specifically ALPHA-K (knowledge) and ALPHA-B (belief) based on the HBM components—binary logistic regression analysis was performed.

Results

Phase I: Questionnaire development and pilot testing

The initial ALPHABET draft consisted of 71 items, including 18 ALPHA-K items and 53 ALPHA-B items. After content validity assessment conducted by an expert panel, three ALPHA-B items were removed due to low CVI scores, and two ALPHA-K items were added to enhance the knowledge section. The final version comprised 70 items, including 20 ALPHA-K items and 50 ALPHA-B items for assessing periodontal health knowledge and beliefs, respectively (Supplementary File 1). All items achieved high CVI scores, ranging from 0.97 to 1.00, indicating strong content validity across relevance, comprehensibility, and comprehensiveness as assessed by both the expert panel and pilot participants.

Phase II: Structural validity, convergent validity, and reliability

A cohort of 396 adult participants provided consent for study inclusion. Sixteen cases with incomplete or inattentive data were omitted from the analysis, resulting in a final sample size of 380 individuals.

Structural validity

The confirmatory factor analysis results for the initial 50-item ALPHA-B version did not align well with the HBM framework.

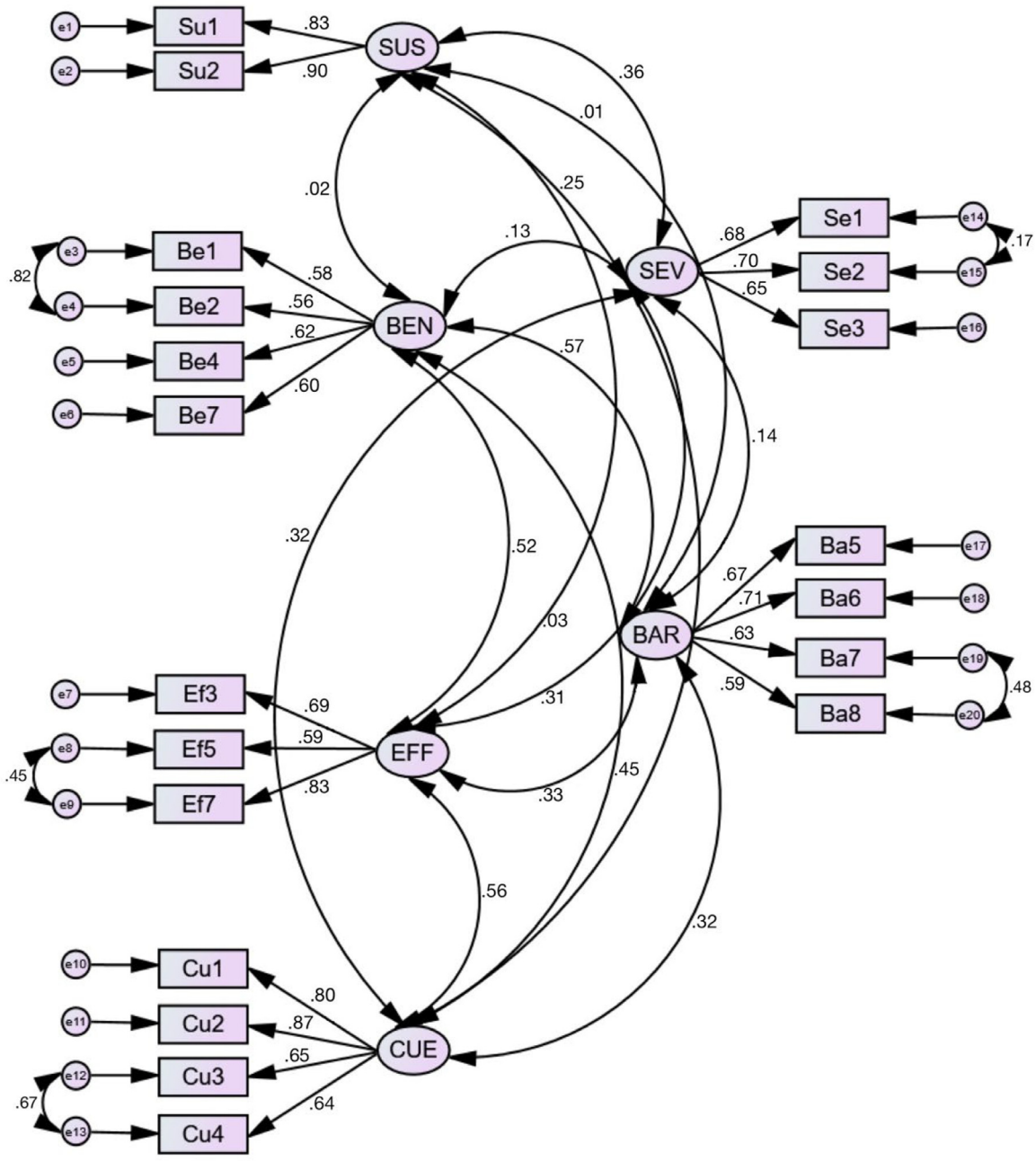

Fig. 2 – The final version of the 20-item ALPHA-B, following CFA of 380 participants, aligns with the HBM and its constructs. Standardized coefficients are represented by black lines. Loading factors greater than 0.5 between items and their corresponding subscales were demonstrated.

Consequently, 30 items with loading factors below 0.5 were removed, resulting in a final 20-item ALPHA-B.[27] Adjustments were made to the model by introducing correlations between certain error variables based on modification indices. The refined model showed satisfactory fit indices: $\chi^2 = 324.82$, $\chi^2/df = 2.17$, RMSEA = 0.055 (90% CI 0.047-0.064), SRMR = 0.052, CFI = 0.948 and TLI = 0.935 (Figure 2).

Convergent validity

The total ALPHA-K scores showed a weak positive correlation with the total ALPHA-B scores ($r_s = 0.293$; $P < .001$). Similarly, a weak positive correlation was observed between the total ALPHA-K scores and the perceived benefits subscale scores of the ALPHA-B ($r_s = 0.225$; $P < .001$), supporting the predefined hypothesis and indicating good convergent validity (Table 1).

Weak positive correlations were also found between ALPHA-K scores and the subscale scores of the ALPHA-B across total sample ($r_s = 0.108$-0.282; $P < .001$-$P = .035$), except for the perceive severity subscale ($P = .177$). Within the ALPHA-B subscales, weak to moderate positive correlations were observed between most subscale scores with statistical significance ($r_s = 0.112$-0.418; $P < .001$-$P = .029$), except for the

Table 1 – Convergent validity between scores of the ALPHA-K (periodontal health knowledge) and the ALPHA-B (periodontal health belief).

Outcome measures	Spearman's rho correlation coefficients	*P* value	Correlation		Interpretation
			Direction	Magnitude*	
ALPHA-K total and ALPHA-B total	0.293	<.001†	Positive	Weak	Support hypothesis
ALPHA-K total and perceived benefits	0.225	<.001†	Positive	Weak	Support hypothesis

* Strong correlation ($r_s \geq 0.7$), moderate correlation ($0.4 \leq r_s \leq 0.69$), weak correlation ($r_s \leq 0.39$).[26]
† *P* value; statistically significant at $P < .05$.

associations involving perceived susceptibility with perceived benefits, perceive barrier, and self-efficacy.

Furthermore, significant relationships were found between each item and its corresponding subscale ($P < .001$), and all interitem correlations were significant ($P < .001$). Spearman's rho correlation coefficients are presented in Supplementary Tables 1 to 7 (Supplementary File 2).

Reliability

The internal consistency reliability of the six subscales of ALPHA-B demonstrated acceptable to good levels of reliability, with Cronbach's α coefficients as follows: 0.87 for Perceived Susceptibility, 0.74 for Perceived Severity, 0.74 for Perceived Benefit, 0.78 for Perceived Barrier, 0.80 for Self-Efficacy, and 0.86 for Cues to Action.

Phase III: Cross-sectional study

Participant descriptive characteristics

The cohort consisted of 40% male and 60% female participants, with an average age of 47 years (SD = 17.6, range 18-84) and a median age of 49 years (interquartile range [IQR] = 33). Approximately two-thirds were classified as new patient, with the remaining as returning patient. Detailed demographic characteristics are summarized in Table 2.

Oral hygiene behaviour

Most participants reported brushing twice a day or more with a manual toothbrush with soft bristles. Notably, a higher proportion of patients in the returning patient group brushed twice daily or more. Individuals in the new patient group typically brushed 2 minutes or less using a combination of scrubbing and up-and-down techniques, while those in the returning patient group brushed for over 2 minutes using the Modified Bass technique (Supplementary Table 8 in Supplementary File 2).

Over half of the patients reported daily dental floss use, with a higher percentage in the returning patient group compared to the new patient group (72.2% vs 46.2%, respectively). About 75% of patients used dental floss across all proximal areas, wrapping it around the tooth surface, while others used it only in areas with food impaction and did not curve the floss. Thread floss was the most popular type (75.6%), although some used floss sticks (19.7%) (Supplementary Table 8 in Supplementary File 2).

Periodontal health knowledge

Participants in the present cohort achieved ALPHA-K scores ranging from 7 to 20 out of a possible 20, with a mean score of 13.4 (SD = 2.7) and a median score of 14 (IQR = 4). The returning patient group obtained significant higher mean ALPHA-K scores compare to the new patient group (14.2 (SD = 2.5) vs 12.9 (SD = 2.7), respectively), suggesting a better understanding of periodontal health knowledge in returning patients compared to new patients (Table 3). The proportion of correct responses to each ALPHA-K item within the present cohort is detailed in Table 4. Remarkably, only approximately one-tenth of study participants correctly identified that the primary goal of flossing goes beyond removing food particles between teeth.

Periodontal health belief

Out of the total score of 100, the mean ALPHA-B score in the present cohort was 56.8 (SD = 7.0) with a median score of 57 (IQR = 9). Participants in the returning patient group demonstrated significantly higher mean total ALPHA-B and subscale scores compared to the new patient group, as shown in Table 3. Detailed analysis of each item is available in Table 5.

Association between the ALPHABET scores and oral health behaviours

The results showed that perceived barriers significantly increased the likelihood of brushing twice daily or more (OR = 1.22, 95% CI = 1.08-1.38, $P = .002$). Knowledge (OR = 1.12, 95% CI = 1.03-1.22, $P = .008$) and self-efficacy (OR = 1.11, 95% CI = 1.02-1.20, $P = .011$) positively influenced brushing for more than 2 minutes.

For dental floss use, knowledge (OR = 1.22, 95% CI = 1.11-1.34, $P < .001$), self-efficacy (OR = 1.23, 95% CI = 1.13-1.34, $P < .001$), and cues to action (OR = 1.13, 95% CI = 1.02-1.24, $P = .016$) were significant predictors, while perceived severity had a negative impact (OR = 0.89, 95% CI = 0.80-0.99, $P = .024$). Detailed outcomes of the binary logistic regression analysis are presented in Supplementary Table 9 (Supplementary File 2).

Discussion

This study successfully developed and validated the ALPHABET, a standardized self-reported questionnaire designed to evaluates both periodontal health knowledge and beliefs in adult populations. The initial draft of the ALPHABET underwent meticulous methodological refinement, resulting in the final 40-item version characterized by robust psychometric properties, including validity and reliability.

Comprehensive content validity assessment yielded outstanding CVI ratings across all sections, subscales, and items from both experts and end users. Previous studies have

Table 2 – Demographic characteristics of the study participants.

Characteristics	Patients; *N* (%)			
	Total *N* = 380	New patients *N* = 236 (62.1)	Returning patients *N* = 144 (36.9)	*P* value
Gender				**P = .022***
Woman	226 (59.5)	151 (64.0)	75 (52.1)	
Man	154 (40.5)	85 (36.0)	69 (47.9)	
Age (y)	Mean 47.0 Median 49.0	Mean 42.9 Median 43.5	Mean 53.8 Median 58.0	**P < .001***
<40 y	133 (35.0)	104 (44.0)	29 (20.2)	
40-59 y	128 (33.7)	79 (33.5)	49 (34.0)	
≥60 y	119 (31.3)	53 (22.5)	66 (45.8)	
Education				*P* = .226
Lower degree	157 (41.3)	100 (42.4)	57 (39.6)	
Bachelor	167 (44.0)	107 (45.3)	60 (41.7)	
Higher degree	56 (14.7)	29 (12.3)	27 (18.8)	
Employment status				*P* = .535
Employed	203 (53.4)	129 (54.7)	74 (51.4)	
None (unemployed/retired/student)	177 (46.6)	107 (45.3)	70 (48.6)	
Income (THB)				*P* = .964
<10,000	122 (32.1)	77 (32.6)	45 (31.3)	
10,001-30,000	155 (40.8)	95 (40.3)	60 (41.7)	
30,001-50,000	58 (15.3)	35 (14.8)	23 (16.0)	
>50,000	45 (11.8)	29 (12.3)	16 (11.0)	
Living arrangements				*P* = .692
Alone	59 (15.5)	38 (16.1)	21 (14.6)	
With others	321 (84.5)	198 (83.9)	123 (85.4)	
Medical history				*P* = .130
Systemic diseases	159 (41.8)	90 (38.1)	69 (47.9)	
Systemically health and regular check	104 (27.4)	66 (28.0)	38 (26.4)	
Unknown	117 (30.8)	80 (33.9)	37 (25.7)	
History of periodontitis in family				**P = .028***
Periodontitis	44 (11.6)	22 (9.3)	22 (15.3)	
No periodontitis	165 (43.4)	114 (48.3)	51 (35.4)	
Unknown	171 (45.0)	100 (42.4)	71 (49.3)	
Smoking status				*P* = .100
Nonsmoker	339 (89.2)	210 (89.0)	129 (89.6)	
Smoker	20 (5.3)	16 (6.8)	4 (2.8)	
Former smoker	21 (5.5)	10 (4.2)	11 (7.6)	
Alcohol use				**P = .022***
No	278 (73.1)	162 (68.7)	116 (80.5)	
<3 times/wk	93 (24.5)	69 (29.2)	24 (16.7)	
>3 times/wk	9 (2.4)	5 (2.1)	4 (2.8)	
Dental visit frequency over the past 10 y				*P* = .153
Regular visit	143 (37.6)	80 (33.9)	63 (43.8)	
When having symptoms	198 (52.1)	131 (55.5)	67 (46.5)	
Never	39 (10.3)	25 (10.6)	14 (9.7)	

Pearson Chi-square. Bold values indicate statistically significance.

* *P* value; statistically significant at *P* < .05.

explored various aspects of oral health in diverse populations; however, limited attention has been devoted specifically to understanding periodontal health knowledge and beliefs. For instance, studies in the United States have primarily assessed oral health literacy among low-income adults, the elderly, and diabetes patients, with limited focus on periodontal diseases.[16,21,28] Similarly, research in China and Thailand has examined oral health attitudes and behaviours across various demographics, without specifically focusing on periodontal diseases.[19,22] Thus, the introduction of the ALPHABET marks a significant advancement in periodontology, serving as a pioneering and validated tool designed exclusively for evaluating periodontal health knowledge and beliefs.

According to the ALPHA-K findings, while participants understood that dental plaque is the main cause of gum disease and tooth loss, several persistent misconceptions remained. For instance, half of the participants believed tooth loss is a natural consequence of ageing, aligning with findings from a previous study in which 41.8% of participants shared this perspective.[15] Additionally, 90% misunderstood the primary purpose of flossing, thinking it was mainly for removing food particles rather than for daily interdental cleaning to complement toothbrushing. This suggests a need for clearer

Table 3 – Comparison of the ALPHABET scores between patient groups.

Subscales of ALPHABET (total score)	Total N = 380		New patient N = 236		Returning patient N = 144			
	Mean (SD)	Median	Mean (SD)	Median	Mean (SD)	Median	P value	Effect size
ALPHA-K (20)	13.4 (2.7)	14.0	12.9 (2.7)	13.0	14.2 (2.5)	14.0	**P < .001***	**0.24**
ALPHA-B (100)	56.8 (7.1)	57.0	54.7 (6.4)	55.0	60.1 (6.8)	60.0	**P <.001***	**0.38**
Susceptibility (10)	6.9 (1.9)	7.0	6.5 (1.8)	6.0	7.5 (1.9)	8.0	**P <.001***	**0.29**
Severity (15)	9.1 (2.4)	9.0	8.8 (2.3)	9.0	9.5 (2.6)	9.0	**P = .005***	**0.14**
Benefits (20)	17.2 (2.0)	17.0	16.8 (2.1)	16.0	17.8 (1.7)	18.0	**P <.001***	**0.23**
Barrier (20)	16.5 (2.9)	17.0	16.1 (2.9)	16.0	17.1 (2.7)	17.0	**P = .001***	**0.16**
Self-efficacy (15)	9.3 (3.1)	9.0	8.8 (3.1)	9.0	10.2 (2.9)	10.0	**P <.001***	**0.22**
Cues to action (20)	15.9 (2.8)	16.0	14.9 (2.7)	15.0	17.6 (2.1)	18.0	**P = .000***	**0.48**

SD, standard deviation.

Independent-Samples Mann–Whitney *U* test. Bold values indicate statistically significance.

* *P* value; statistically significant at $P < .05$.

public education on the American Dental Association's recommendation to floss daily for effective plaque control.[29]

Over half of the participants erroneously believed that herbal toothpaste or saltwater gargling could treat gum disease and that fluoride could prevent it. Such misconceptions may lead to neglect of proper oral hygiene practices and inappropriate symptom management. An associated symptom not covered in the knowledge section is halitosis, which has been highlighted in previous studies as an area warranting greater public awareness.[30,31] Future studies should consider including items related to halitosis for a more comprehensive understanding of periodontal health knowledge.

Although over 90% of participants were aware that smokers have a higher risk of developing periodontal disease, 5% continue to smoke, highlighting a gap between knowledge and behaviour. Notably, returning patients with prior oral hygiene instruction had higher ALPHA-K scores, emphasizing the critical role of regular dental visits and professional guidance in improving periodontal health knowledge.

The structure of the final 20-item ALPHA-B aligns well with the six-factor model of the HBM, a widely utilized framework in health behaviour interventions.[12] However, the model has notable limitations, such as its focus on individual factors and lack of consideration for cultural, social, and emotional influences.[32] These shortcomings can lead to oversimplify the complex processes involved in changing habits or adopting new behaviours. Integrating additional frameworks may enhance the understanding and application of health behaviour theories in practice. This final version of ALPHA-B encompasses six subscales: perceived susceptibility (2 items), perceived severity (3 items), perceived benefit (4 items), perceived barrier (4 items), self-efficacy (3 items), and cues to action (4 items). Each subscale exhibited a good level of internal consistency reliability.

Table 4 – Percentage of correct answers for each item of the ALPHA-K.

20 items of ALPHA-K	% of correct answers		
	Total patients	New patients	Returning patients
1. Dental plaque is the primary cause of gum disease.	91.6	88.9	95.8
2. Minor bleeding on gum line when brushing your teeth is normal.	71.8	74.2	68.1
3. If your gums bleed every time when brushing, it is a sign of gum disease.	93.2	91.5	95.8
4. If there is bleeding when brushing, you should avoid brushing that area.	61.1	57.2	67.4
5. If there is bleeding when flossing, you should avoid flossing that area.	50.3	44.5	59.7
6. Gum disease can lead to tooth loss.	97.6	97.5	97.9
7. Teeth loosen naturally as you get older.	53.4	47.9	62.5
8. Tooth loss happens naturally as you get older.	46.6	41.5	54.9
9. Using a hard-bristled toothbrush cleans your teeth better than a soft-bristled one.	88.2	85.2	93.1
10. Flossing can reduce the risk of gum disease.	86.6	84.3	90.3
11. The main goal of flossing is to remove food particles that are stuck between your teeth.	11.8	9.7	15.3
12. Flossing causes gaps between your teeth.	84.7	80.1	92.4
13. Using a toothpick is adequate for cleaning in between teeth.	92.9	92.4	93.8
14. Fluoride can prevent gum disease.	36.1	30.5	45.1
15. Herbs in toothpaste can treat gum disease.	44.7	40.7	51.4
16. Gargling salt water can treat gum disease.	32.9	30.1	37.5
17. Mouthwash can remove tartar.	68.2	63.9	75.0
18. Professional dental cleaning can thin your teeth surface.	67.9	65.7	71.5
19. Diabetic patients are at a higher risk of gum disease than others.	69.2	72.0	64.6
20. Smokers are at higher risk of gum disease than others.	92.6	93.6	90.9

Table 5 – Descriptive item analysis of the ALPHA-B for the present cohort.

20 items of ALPHA-B		Mean (total 5 points)	SD	Median (total 5 points)	Floor effect (%)	Ceiling effect (%)	Adjusted item-total correlation
Perceived susceptibility							
SUS1	I can develop gingivitis.	3.5	1.0	4.0	4.5	15.0	0.773
SUS2	I can develop periodontitis.	3.4	1.0	3.0	5.3	14.2	0.773
Perceived severity							
SEV1	If I had gum disease, I feel it would be...	3.3	1.0	3.0	4.5	11.6	0.587
SEV2	If my gums were bleeding, I feel it would be...	3.0	1.0	3.0	6.1	7.9	0.600
SEV3	If I had tartar in my mouth, I feel it would be...	2.7	1.0	3.0	12.1	4.5	0.508
Perceived benefit							
BEN1	I prioritize on maintaining the health of my teeth.	4.4	0.6	4.0	0.8	45.5	0.666
BEN2	I prioritize on maintaining the health of my gum.	4.4	0.6	4.0	0.8	43.9	0.649
BEN4	I think that brushing can help improve my gum health.	4.3	0.7	4.0	0.8	40.3	0.467
BEN7	I think that flossing can help improve my gum health.	4.1	0.7	4.0	1.6	31.3	0.406
Perceived barrier							
BAR5	I think that thorough brushing is a waste of time.	4.3	0.9	4.0	2.6	49.2	0.568
BAR6	I think that thorough flossing is a waste of time.	3.9	0.9	4.0	1.1	30.0	0.516
BAR7	I think that annual dental visits are a waste of time.	4.1	0.9	4.0	1.8	39.7	0.652
BAR8	I think that annual professional tooth cleaning is a waste of money.	4.1	0.9	4.0	1.3	39.2	0.608
Self-efficacy							
EFF3	Brush your teeth correctly.	3.5	1.1	4.0	4.5	19.2	0.540
EFF5	Thoroughly floss once per day even when you don't want to.	2.9	1.3	3.0	20.5	12.1	0.643
EFF7	Use floss correctly.	2.9	1.3	3.0	18.7	12.4	0.753
Cues to action							
CUE1	I have been educated about how to perform correct oral hygiene care.	4.0	0.8	4.0	1.1	26.8	0.663
CUE2	I have been educated about the causes and prevention gum disease.	3.7	0.9	4.0	1.8	16.8	0.699
CUE3	My dentist often encourages me to brush my teeth correctly.	4.1	0.8	4.0	1.1	34.7	0.745
CUE4	My dentist often encourages me to use floss correctly.	4.1	0.9	4.0	1.3	33.7	0.718

Floor effects ≥60% indicating less relevant items, item-total correlations ≥0.30 demonstrating a good reliability.

Regarding periodontal health beliefs, it is crucial for patients to recognize their risk of developing periodontal disease (perceived susceptibility), understand the potential seriousness of untreated disease (perceived severity), acknowledge the benefits of recommended oral hygiene practices (perceived benefit), and overcome obstacles such as financial costs and time constraints (perceived barrier). Additionally, individual self-efficacy significantly influences behavioural improvements, and cues to action can prompt individuals to take health-related actions influenced by their environment. The ALPHA-B score can indicate patients' receptiveness to interventions aimed at managing and preventing periodontal diseases. Previous study has found that self-efficacy and perceived barrier predict toothbrushing and flossing behavior,[33] which aligns with our findings. The logistic regression model revealed an association between self-efficacy and both brushing and flossing behaviour, as well as between perceived barrier and brushing behaviour. Additionally, we incorporated the factor of 'knowledge', which was also found to be associated with brushing more than 2 minutes and with the use of dental floss. Previous studies have linked oral health behaviours to HBM factors, often focusing on children and parents, mainly exploring dental caries.[20,34-37] Standardized data on periodontal health beliefs using ALPHA-B could provide valuable insights for planning periodontal health education program, ultimately enhancing periodontal health in the adult population.

While the ALPHABET was validated using data from adults across a wide age range, the hospital-based settings may not fully represent broader populations. Field testing across diverse groups is crucial for generalizability. Furthermore, self-reported oral health behaviour data may be influenced by social desirability bias. Future research should explore associations between ALPHABET subscales and oral health factors, considering clinical periodontal parameters for a comprehensive outcome assessment.

Conclusion

The present findings underscore the robust validity, reliability, and practical utility of the ALPHABET in assessing periodontal health knowledge and beliefs among adults. This tool holds significant potential for guiding interventions aimed at enhancing awareness of periodontal disease and delivering comprehensive education to the public, thereby fostering improved periodontal health outcomes. By providing a standardized method to evaluate both knowledge and belief, the ALPHABET can help identify misconceptions and areas needing targeted educational efforts. Ultimately, its application in

both clinical and community settings can contribute to better periodontal health and overall well-being.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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During the preparation of this work, the authors used ChatGPT in order to improve readability and language. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Author contributions

Patrika Bodhidatta: Contributed to methodology, data curation, formal analysis, visualization, writing – original draft of the article and final approval of manuscript. Paswach Wiriyakijja: Contributed to the conceptualization, methodology, formal analysis, and critical revision of the manuscript. Pimchanok Sutthiboonyapan: Contributed to the conceptualization, methodology, funding acquisition, and critical revision of the manuscript. All authors have approved the final article.

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Supplementary materials

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REFERENCES

1. Chen MX, Zhong YJ, Dong QQ, Wong HM, Wen YF. Global, regional, and national burden of severe periodontitis, 1990-2019: an analysis of the Global Burden of Disease Study 2019. J Clin Periodontol 2021;48(9):1165–88.
2. Tonetti MS, Jepsen S, Jin L, Otomo-Corgel J. Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: a call for global action. J Clin Periodontol 2017;44(5):456–62.
3. Hirschfeld L, Wasserman B. A long-term survey of tooth loss in 600 treated periodontal patients. J Periodontol 1978;49(5):225–37.
4. Ravida A, Qazi M, Troiano G, et al. Using periodontal staging and grading system as a prognostic factor for future tooth loss: a long-term retrospective study. J Periodontol 2020;91(4):454–61.
5. Hajishengallis G. Immunomicrobial pathogenesis of periodontitis: keystones, pathobionts, and host response. Trends Immunol 2014;35(1):3–11.
6. Page RC, Kornman KS. The pathogenesis of human periodontitis: an introduction. Periodontol 2000 1997;14:9–11.
7. Kornman KS. Mapping the pathogenesis of periodontitis: a new look. J Periodontol 2008;79:1560–8.
8. Torrungruang K, Nisapakultorn K, Sutdhibhisal S, et al. The effect of cigarette smoking on the severity of periodontal disease among older Thai adults. J Periodontol 2005;76(4):566–72.
9. Sanz M, Herrera D, Kebschull M, et al. Treatment of stage I-III periodontitis-The EFP S3 level clinical practice guideline. J Clin Periodontol 2020;47(Suppl 22):4–60.
10. Genco RJ, Borgnakke WS. Risk factors for periodontal disease. Periodontology 2000 2013;62(1):59–94.
11. Rosenstock IM. The health belief model and preventive health behavior. Health Educ Monogr 1974;2(4):354–86.
12. Champion VL, Skinner CS. The health belief model. Health behavior and health education: theory, research, and practice. 4th ed. San Francisco: Jossey-Bass; 2008. p. 45–65.
13. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. J Am Coll Dent 2014;81(3):14–8.
14. Edwards CB, Randall CL, McNeil DW. Development and validation of the oral health values scale. Community Dent Oral Epidemiol 2021;49(5):454–63.
15. Ehizele A, Chiwuzie J, Ofili A. Oral health knowledge, attitude and practices among Nigerian primary school teachers. Int J Dent Hyg 2011;9(4):254–60.
16. McQuistan MR, Qasim A, Shao C, Straub-Morarend CL, Macek MD. Oral health knowledge among elderly patients. J Am Dent Assoc 2015;146(1):17–26.
17. Soutome S, Kajiwara K, Oho T. Development and validation of the locus of control scale for oral health behavior. J Dent Health 2015;65(4):339–47.
18. Sun Y, Sun J, Zhao Y, Cheng A, Zhou J. A new comprehensive oral health literacy scale: development and psychometric evaluation. BMC Oral Health 2021;21(1):429.
19. Wai Yan Myint Thu S, Ngeonwiwatkul Y, Maneekan P, Phuanukoonnon S. Perception and belief in oral health among Karen ethnic group living along Thai-Myanmar border, Thailand. BMC Oral Health 2020;20(1):322.
20. Xiang B, Wong HM, Cao W, Perfecto AP, McGrath CPJ. Development and validation of the oral health behavior questionnaire for adolescents based on the health belief model (OHBQAHBM). BMC Public Health 2020;20(1):701.
21. Yuen HK, Wolf BJ, Bandyopadhyay D, Magruder KM, Salinas CF, London SD. Oral health knowledge and behavior among adults with diabetes. Diabetes Res Clin Pract 2009;86(3):239–46.
22. Zhu L, Petersen PE, Wang HY, Bian JY, Zhang BX. Oral health knowledge, attitudes and behaviour of adults in China. Int Dent J 2005;55(4):231–41.
23. Terwee CB, Prinsen C, Chiarotto A, et al. COSMIN methodology for assessing the content validity of PROMs—user manual. Amsterdam: VU University Medical Center; 2018.
24. Lynn MR. Determination and quantification of content validity. Nurs Res 1986;35(6):382–6.

25. Souza ACd, Alexandre NMC, Guirardello EdB. Psychometric properties in instruments evaluation of reliability and validity. Epidemiol Serv Saude 2017;26:649–59.
26. Schober P, Boer C, Schwarte LA. Correlation coefficients: appropriate use and interpretation. Anesth Analg 2018;126(5):1763–8.
27. Stevens J. Applied multivariate statistics for the social sciences. Hillsdale: Erlbaum; 1992.
28. Macek MD, Haynes D, Wells W, Bauer-Leffler S, Cotten PA, Parker RM. Measuring conceptual health knowledge in the context of oral health literacy: preliminary results. J Public Health Dent 2010;70(3):197–204.
29. American Dental Association. Flossing. MouthHealthy [cited 2025 Jan 27]. Available from: https://www.mouthhealthy.org/all-topics-a-z/flossing.
30. Grzech-Leśniak Z, Grzech-Leśniak K, Mobadder ME. Diagnosis, management and knowledge of halitosis among Polish and Lebanese dentists: questionnaire-based survey. Adv Clin Exp Med 2023;32(11):1257–64.
31. Sen DO, Durmaz EN, Saraç F. Evaluation of self-perceived halitosis and effective conditions in periodontology clinic applicants: a cross-sectional study. Medicine 2024;103(50):e40424.
32. Rosenstock I. Historical origins of the health belief model. The Health Belief Model and Personal Health Behavior. Thorofare: Charles B Slack, Inc; 1974.
33. Buglar ME, White KM, Robinson NG. The role of self-efficacy in dental patients' brushing and flossing: testing an extended Health Belief Model. Patient Educ Couns 2010;78(2):269–72.
34. Hiratsuka VY, Robinson JM, Greenlee R, Refaat A. Oral health beliefs and oral hygiene behaviours among parents of urban Alaska Native children. Int J Circumpolar Health 2019;78(1):1586274.
35. Mehtari Taheri A, Arabshahi A, Rahimi H, Gharlipour Z, Dehghanzadeh MR. Oral health-related factors based on health belief model in 10th to 12th-grade students in Kashan. J Educ Community Health 2021;8:121–6.
36. Phanthavong S, Nonaka D, Phonaphone T, et al. Oral health behavior of children and guardians' beliefs about children's dental caries in Vientiane, Lao People's Democratic Republic (Lao PDR). PLoS One 2019;14(1):e0211257.
37. Solhi M, Zadeh DS, Seraj B, Zadeh SF. The application of the health belief model in oral health education. Iran J Public Health 2010;39(4):114–9.