



Development of health literacy assessment tool for 9–10 Years old children in Thailand

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ABSTRACT

Objectives: This study developed psychometric evaluation of an instrument for measuring health literacy among children in Thailand.

Study design: Development of Health Literacy Assessment Tool for 9–10 Years Old Children in Thailand involved item development. The first step was reviewing literature to pilot-test and generate an item pool. Nine expertise with different disciplines were approached to assess the initial questionnaire. For field-testing, 1650 students with same age group were randomly selected to complete the questionnaire. The psychometric properties of the developed instrument were assessed by an Exploratory Factor Analysis (EFA) and a Confirmatory Factor Analysis (CFA).

Results: A total of 50-items were included in exploratory factor analysis indicating 4-dimension solution that jointly explained 36.05% of the variance observed. Confirmatory factor analysis also indicated a good fit of the data for the four-latent structure: access to information (9-items), understanding the information (6-items), appraisal (8-items), and apply the information (9-items) (Chi-square: $\chi^2 = 1530.76$), (Goodness-of-Fit Index: GFI = 0.937), (Adjust GFI: AGFI = 0.927), (Standardized root mean-square residual: SRMR = 0.025); (Root mean-square error of Approximation: RMSEA = 0.040), (Comparative-fit-Index: CFI = 0.903) and (Normed-fit-index: NFI = 0.910). Additional analysis for internal consistency observed satisfactory results with overall Cronbach's alpha coefficient of 0.902. The Item-Total Correlation (ITC) was 0.300 (range: 0.319 to 0.518) and high validation with value of CVI of 0.87.

Conclusions: Health Literacy Assessment Tool for 9–10 Years Old children (31-item) showed psychometric properties, high validity and was reliable. Therefore, it is considered as an effective tool to measure the Health Literacy for 9–10 years old children in Thailand.

1. Background

Health literacy is a composite term used to describe the capacities of persons to meet the complex demands related to health in modern society. Health literacy is linked to literacy and entails the motivation, knowledge and competencies to access, understand, appraise and apply health information in order to make judgements and take decisions in daily life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life throughout the course of life [1]. In particular, World Health Organization (WHO) has recognized health literacy as “a critical determinant of health,” stating that health literacy “must be an integral part of the skills and competencies developed over a lifetime [2].

A public health perspective, promotion of Health Literacy (HL) at early life constitute a crucial target group for health literacy policy and intervention. As during childhood and youth, fundamental cognitive, physical and emotional development processes take place [3,4] and overall health and quality of life throughout the life course [5]. Notably, children at the age of 9 and 10 years are during Zone of Proximal Development. It is the zone as the difference between a child's “actual developmental level as determined by independent problem solving” and the “potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” [6]. And during this age, children also have sufficiently developed language skills. The concept has gained more attention both in clinical care and public health, intended to enable people to exert greater control over

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their health and determinants of health [7], health behavior and health outcomes and health service use [8].

Along with the increasing interest in empirical work on health literacy, there has been a growing demand for tools to measure health literacy in each target group. There are alternative versions of these instruments, or altered instruments. For example, the Test of Functional Health Literacy in Adults (TOFHLA), the abbreviated TOFHLA, the shortened TOFHLA, the Rapid Estimate of Adult Literacy in Medicine (REALM), were all included. Many tools are not validated and available tools assess self-reported health literacy in a systematic and comparable way except for The European Health Literacy Survey Questionnaire (HLS-EU-Q47) and the Health Literacy Instrument for Adults (HELIA) which had a valid and reliable measure of adults' self-reported health literacy. Haun et al. in a comprehensive review of the literature from 1999 through 2013 identified 51 instruments and reported that most instruments represent a narrow set of conceptual dimensions with limited modes of administration and missing information on key psychometric properties [9]. Most of the instruments have also been used among adolescents. Although there are 18 tools to measure specific items of health literacy for people younger than 13 years, there is lack of comparable, valid, and age-appropriate measures of generic health literacy. These tools differ greatly because they cover a broad range of measurement approaches (self-report, performance test), of components of health literacy (health knowledge, health-related beliefs, communication, self-management, critical thinking, access to health information, service navigation), and of health areas (general health, oral health, mental health, diabetes, nutrition). Even those tools are designed to measure "general" or "generic" health literacy. Some are tailored for a narrow age range, whereas others were designed originally for adults but are applied to children without any age-related adaptation. Furthermore, some of the identified measurement tools either lack or fail to report any assessment of psychometric properties [5]. The interested instruments that were developed for 9–10 year recently is adapting the European Health Literacy Survey Questionnaire for Fourth-Grade Students in Germany HLS-Child-Q15.

More recently, Thailand is creating and developing the Thailand Health Literacy Scales. For instance, Health Literacy Scale for Thai Childhood Overweight, Health Literacy Scale for Unwanted Pregnancy Prevention of Thai Female Adolescents, The Thai Health Literacy Questionnaire for 7–14 years old. However, the age range is too wide for children. In Thailand, 7–12 years old are in primary school while 13–14 years old are in secondary school likewise, ages and educational institution have different sociocultural context. Although systematic reviews have identified 18 measurement tools which assess HL in this age group [10–12] these tools differ vastly in their measurement approaches, the components of health literacy they measure, and the health areas they address. Most of the tools have not been developed specifically for children and some either lack or do not report adequately with regard to psychometric properties [5]. Accordingly, there is a need for comparable and validated tools designed to assess health literacy in specific age groups. This applies particularly the health literacy instrument for assessing children in Thailand.

2. Materials and method

2.1. Study design and setting

Questionnaire development and validation study among 9–10 years old children in Thailand was conducted. This study focuses on development of questionnaire and explore the quality of the instrument regarding its psychometric properties. The questionnaire development process and cross-sectional survey in school classes was done by using a written, self-administered questionnaire.

2.2. Study framework

2.2.1. Step 1: Item generation

Literature review of general HL that assesses participants' perceived difficulty in accessing, understanding, appraising, and applying health information in the contexts of health care, disease prevention, and health promotion [1,5,10,11,13,14] and adapted 26 items for children from the European Health Literacy Survey Questionnaire for Fourth-Grade Students in Germany: Validation and Psychometric Analysis [5] as the starting point for questionnaire development. Its validity and reliability have been confirmed in a range of studies in different countries and different settings. The domain of HL on 9–10 years old children; on nutrition, exercise, medication intake, rest, risk behavior, illness, food poisoning, diarrhea, sanitation, personal hygiene care, vaccine, psychological resilience, interactions with health care professionals, medication intake, body perception, and stress was identified. Based on this information, the items were evaluated whether it addressed issues that were important for children's health in the defined age group. To rate the appropriateness of each item's language and context, the recommendations on item development in certain age groups were performed. However, it was also important to preserve the meaning of the original items and the inherent structure of the questionnaire (accessing, understanding, appraising, and applying health information in the contexts of health care, disease prevention, and health promotion). Thus, each item was coded: "How easy or difficult is it for you to.?" and rated on a 4-point scale with the points being 1 (very difficult), 2 (fairly difficult), 3 (fairly easy), and 4 (very easy) also the complete questionnaire (56 items).

2.2.2. Step 2: item pool

An item pool was generated from the conceptual structure consisting of nine competencies from step 1, yielding 56 items. Next, the content validity tests were performed by nine experts to give suggestions on the relevancy and overlapping of each item to the definition, to evaluate clarity and conciseness of the wordings, and to point out any missing items that should be included. These experts with diverse skills and expertise were asked to evaluate the content validity of the instrument, purposively recruited from the area of interest of this study. Among them, there were two psychiatrists in the Institute of Child and Adolescent Mental Health, one nurse with expertise in mental health, four lecturers with expertise in health literacy, one lecturer with expertise in early childhood education, one practitioner and an expert in measurement development. A value of item-level content validity index (I-CVI) was conducted. The evaluation followed the process suggested by Polit, Beck, and Owen (2007) in having experts rate each item on a 4-point Likert scale (not relevant, somewhat relevant, quite relevant, and very relevant) based on item clarity and conciseness. Raters were asked to provide comments and suggestions for revising or adding new items. The ratings were used to calculate an item-level content validity index (I-CVI) and to determine if items should be revised or deleted. A criterion of 0.80 of I-CVI among the experts were selected for inclusion in the list of items [15]. In total, 1 item was deleted regarding an acceptable value and 55 items were retained.

2.2.3. Step 3: pilot testing

A pilot test of the preliminary instrument with a 4-point Likert scale was conducted in 55 [9,10] years old students in Suphanburi Province having similar characteristics with the samples. The questionnaires were sent to the samples to complete the pilot survey for reliability analysis test. Internal consistency was tested with Cronbach's alpha value, designated ≥ 0.70 for satisfactory reliability (Cronbach & Shavelson, 2004). The Cronbach's alpha coefficient ranges from 0.74 to 0.82, indicating 0.70 as minimum reliability for the new instrument [13]. All 55 items were retained because all of them were able to meet all the criteria for the acceptance of internal consistency.

2.2.4. Step 4: evaluation of psychometric properties

A field-test was conducted to evaluate the reliability and validity of the instrument. In this step, the field test for psychometric properties of instrument was conducted in 1650 students, aged 9–10 years old in 13 provinces of Thailand. Moreover, the Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were performed to evaluate the construct validity.

2.3. Sample and data collection

The target group consisted of 1650 students attending elementary schools of 13 provinces in all Primary Educational Service Area (PESA) in North, Northeast, South and Central Regions of Thailand. They were selected by using a multi-stage random sampling method, and data were collected only from the 9–10 years old students. Data were collected between June 2020 and October 2020.

2.4. Statistical analysis

Statistical analysis was carried out by using IBM SPSS AMOS 26.0 software. The structural validity and reliability of the health literacy were examined using Exploratory Factor Analysis (EFA) with promax rotation and internal consistency respectively. The Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were used to determine the appropriateness of the samples for factor analysis [16,17]. Eigenvalues above 1 and factor loadings greater than or equal to 0.30 were considered as appropriate to verify the number of possible underlying factors. Furthermore, confirmatory factor analysis was performed while four dimensions (accessing, understanding, appraisal and apply) were specified. Several goodness-of-fit indicators including Chi-square (χ^2), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), the Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Normed Fit Index (NFI) and Comparative Fit Index (CFI) were selected for reporting the analysis outcomes. The following thresholds were considered to verify the model's goodness of fit: $\chi^2 > 0.05$, CFI, NFI, NNFI, and GFI ≥ 0.90 – 0.95 , SRMR ≤ 0.05 – 0.08 , and RMSEA ≤ 0.05 – 0.06 [32–35]. Finally, the Cronbach's alpha coefficient (acceptable level of 0.7) for each dimension and the whole scale was calculated to examine internal consistency [18].

2.5. Ethical consideration

This study was approved by the Ethics Committee in Human Research of Khon Kaen University, Khon Kaen, Thailand (Reference no. HE632116).

3. Results

3.1. Demographic characteristics of samples

A total of 1650 respondents, about one half of them were girls (56.48%) and most of them were 9-year-old (58.06%). Almost all of the respondents were Buddhist (95.15%). In addition, two-third of the respondents were studying in a large school (67.27%) (Table 1).

3.2. Exploratory factor analysis (EFA)

The exploratory factor analysis with promax rotation revealed a scale comprising of 55 total items. The adequacy of sample size was confirmed by the significant of KMO and Bartlett's Test of Sphericity (KMO = 0.959 and $\chi^2 = 27906.86$, $p < 0.001$). The initial analysis indicated 10 components with eigenvalues greater than 1 that jointly accounted for 48.23% of the variance observed. After careful assessment, five factors were excluded for the following reasons:

Table 1

Demographic characteristics of 9–10 year old students of Thailand (n = 1650).

Demographic characteristics	Number	Percentage (%)
Age (years)		
9	958	58.06
10	692	41.94
Region		
Central	609	36.91
Northeast	535	32.42
North	301	18.24
South	205	12.42
Gender		
Male	718	43.52
Female	932	56.48
Religion		
Buddhism	1570	95.15
Islam	51	3.09
Christianity	25	1.52
Other	4	0.24
School size		
Small	164	9.94
Medium	376	22.79
Large	1110	67.27

A We excluded dimension with the number of items in each dimension less than 3 [19].

B We suppressed factor loading coefficients of less than 30 for an easier interpretation of factors [20].

Thus, after deletion of the low loading items, eventually 50 items were loaded on 4 factors: access to information (12 items), Understand (13 items), Appraisal (13 items) and Apply (12 items), that jointly accounted for 36.05% variance, explained with eigenvalue from 1.46 to 13.54. The factor loadings were from 0.30 to 0.73 (Table 2) (see Table 3).

3.3. Confirmatory factor

After 50 items were loaded by exploratory factor analysis, confirmatory factor analysis was conducted. The result obtained from the confirmatory factor analysis is depicted in Fig. 1. The results provided a good fit to the data for four dimensions within 31 items: access to information (9 items), understanding (6 items), appraisal (8 items), and Apply (8 items). The fit indexes were as follows: $\chi^2 = 1530.76$; GFI = 0.937; AGFI = 0.927; SRMR = 0.025; RMSEA 0.040; CFI = 0.903 and NFI = 0.910 (Fig. 1);

3.4. Reliability of the final version

31 items were assessed for reliability by estimating the Cronbach's alpha coefficient. The results showed that all factors had satisfactory internal consistency. The Cronbach's alpha coefficient overall scale was 0.902 for the 31 item HL scale and ITC above 0.300 (range: 0.319 to 0.518).

4. Discussion

This is an initial study of Thailand to develop an age-adapted version of the Health Literacy Questionnaires. The initial Questionnaires were with 55 items. The HL matrix was constructed from 4 dimensions of information processing (finding health information, understanding health information, appraise health information, applying health information) in three health domains (health care, disease prevention and health promotion).

In this study, the factor structure and psychometric properties in a large sample of 9–10-years-old students in Thailand, the results strongly suggest that the instrument is validated for measuring health literacy among 9–10 years old students and could be considered and as useful for

Table 2

The results obtained from exploratory factor analysis of The Health Literacy Assessment Tool for 9–10 Years Old children (n = 1650).

Item	How easy or difficult is it for you to...	Content	Mean	SD	ITC	Factors Loading			
						1	2	3	4
Dimension 1: Accessing									
1	Find out about a cold?	health care	3.08	0.89	0.374				0.534
2	Find out what you can do to avoid getting a cold in winter?	disease prevention	3.02	0.90	0.354				0.527
3	Find out what you can do so that you don't get too fat or too thin?	disease prevention	3.11	0.92	0.356				0.489
4	Find out how you can reduce stress?	health promotion	3.22	0.88	0.319				0.515
5	Find out to consume which food is healthy for you?	Health promotion	3.41	0.73	0.415				0.604
6	Find out the correct way for wash your hand before consumption?	disease prevention	3.56	0.64	0.455				0.504
7	Find out which exercise is appropriate for you?	Health promotion	3.29	0.77	0.427				0.502
8	Find out how to get rid of garbage at your house?	disease prevention	3.39	0.91	0.419				0.534
9	Find out how to get rid of garbage at your community?	disease prevention	3.11	0.91	0.391				0.543
Dimension 2: Understanding									
10	Understand when you should take a medicine when you are ill?	health care	3.43	0.78	0.415			0.460	
11	Understand what doctor talk to your health?	health care	3.23	0.79	0.459			0.534	
12	Understand why you need vaccination?	disease prevention	3.24	0.87	0.433			0.540	
13	Understand what your parents tell you about your health?	Health promotion	3.31	0.81	0.477			0.441	
14	Understand what are the effected of alcohol?	disease prevention	3.36	0.91	0.506			0.411	
15	Understand step to get rid of garbage at your school or community?	disease prevention	3.42	0.76	0.510			0.388	
Dimension 3: Appraise									
16	Decide belief on a doctor suggestion?	health care	3.35	0.76	0.501		0.360		
17	Decide which one could be helps for you healthy or Unhealthy?	Health promotion	3.38	0.79	0.507		0.496		
18	Decide the environment related to your health? For example, Air, water, food	disease prevention	3.35	0.78	0.496		0.385		
19	Decide how you should select healthy food?	health promotion	3.45	0.74	0.557		0.343		
20	Decide brush your teeth twice a day that is good for your mouth?	health promotion	3.55	0.67	0.514		0.370		
21	Decide when you wash your hand before and after consume or after toilet?	prevention	3.49	0.72	0.518		0.400		
22	Decide avoiding gambling?	disease prevention	3.36	0.88	0.439		0.620		
23	Decide how to relax for your health?	health promotion	3.43	0.77	0.504		0.432		
Dimension 4: Apply									
24	Call ambulance or adult to help in an emergency?	health care	3.20	0.85	0.435	0.377			
25	Stick to do what you have road safe?	disease prevention	3.38	0.78	0.486	0.540			
26	Wash your hand before and after diet?	disease prevention	3.53	0.68	0.502	0.628			
27	Have a healthy diet?	health promotion	3.47	0.73	0.481	0.584			
28	Brush your teeth the correctly way?	health promotion	3.62	0.64	0.463	0.576			
29	Reject to drugs?	disease prevention	3.41	0.91	0.462	0.734			
30	Avoid going with stranger?	disease prevention	3.32	0.90	0.450	0.363			
31	Take a relax or reduce stress?	disease prevention	3.28	0.82	0.436	0.449			

Table 3

Fit indices and their acceptable thresholds in confirmatory factor analysis.

Criteria	Chi-square (χ^2)	(GFI)	(AGFI)	CFI)	(NFI)	RMR	RMSEA
Criteria	>0.05	>0.90	>0.90	>0.90	<0.05	<0.08	>0.05
Model 1	4862.301	0.821	0.796	0.805	0.782	0.040	0.063
Remove							
Access: 2, 3, 10							
Understand: 3, 4							
Appraise: 1, 3, 7, 13							
Model 2	4409.56	0.828	0.810	0.793	0.759	0.037	0.053
Remove							
Access: 2,7							
Understand: 3,8,11,15							
Appraise: 1,3,4,8,							
Apply: 1,3,7,8,13							
Model 3	1530.76	0.937	0.927	0.903	0.910	0.025	0.040
Fit model							
Access 1,3,4,5,6,8,9,11,12							
Understand 1,2,4,5,13,16							
Appraise 2,5,6,7,9,10,11,15							
Apply 3,4,5,6,7,9,11,12							

children of another age group. The description of the dimensions and definition of Health Literacy for children were systematically developed for the specific context and translated in measurable terms to create an instrument similar to those in previous studies [14,21,22].

Content validity illustrates the scale's quality as it ensures congruence between dimension content and data collection tool [33]. The results of item validation showed the value of CVI of 0.87, with accepted standards of CVI of 0.80 or greater [15,23,24]. The results of Cronbach's alpha and item-total correlation show a good homogeneity. The ranging of each dimension of Cronbach's alpha was 0.68–0.73. Item-total

correlation ranged from 0.319 to 0.518, which was considered acceptable. Furthermore, it illustrates that items in each dimension were in correlation with each other [25] and did not show redundancy [26]. The exploratory factor analysis indicating four dimensions/components were extracted with 36.05% of the total percentage of variance. Each dimension with more than 3 items was in line with the study of Hair et al. (2013) which indicated that each component should have at least 3 items [19]. A Confirmatory factor analysis provided a good fit to the data for four-latent structure with 31 items, 24 items were eliminated. For some items that children understood but couldn't practice in their

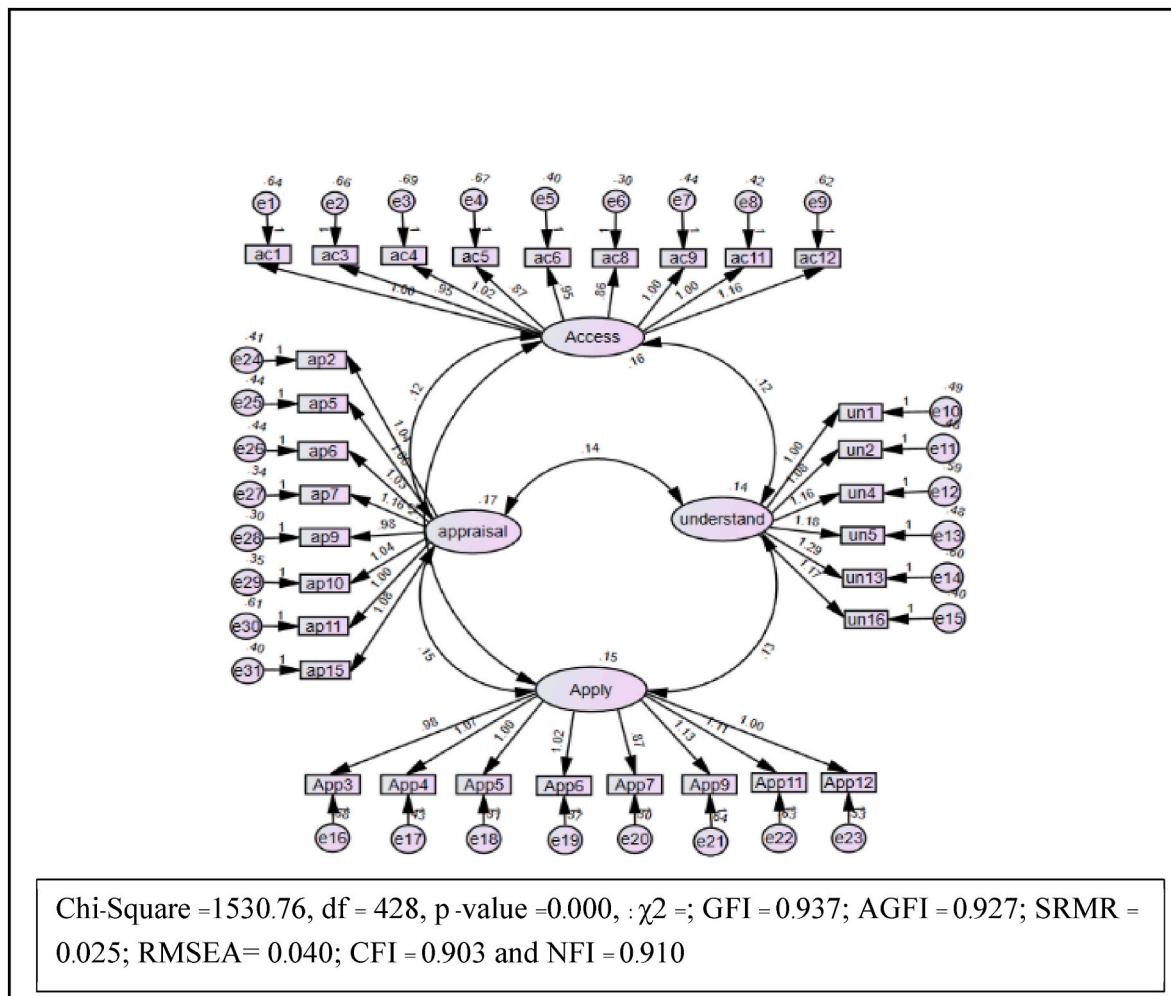


Fig. 1. The result obtained from confirmatory factor analysis of The Health Literacy Tool For 9–10 years old student Chi-Square = 1530.76, df = 428, p -value = 0.000; $\chi^2 =$; GFI = 0.937; AGFI = 0.927; SRMR = 0.025; RMSEA = 0.040; CFI = 0.903 and NFI = 0.910.

daily lives, their parents dealt with it such as smoking, alcohol consumption, abuse. Although this study utilized the European Health Literacy Survey Questionnaire for Fourth-Grade Students in Germany as the starting point for questionnaire development. The results of CFA were different (3 Dimension in term of Access, Understand, Apply). It might be related to the context of Germany that everyday children might not appraise what specific health information by themselves. However, this instrument is similar to the other studies in terms of accessing, understanding, appraising, and applying health information (four dimensions) in the contexts of health care, disease prevention, and health promotion as described by Sorensen [19,26,27]. The Health Literacy Tool For 9–10 years old student contains four subscales (dimensions), which we believe is an important feature of this instrument covering the basic concept and constructs of health literacy. Additionally, the items that included in the health literacy for 9–10 years old students are relevant to public health in general and to healthy lifestyles. In fact, underlying concepts included in the instrument cover the three most important global public health topics, health care, disease prevention, and health promotion. In conclusion, based on the analyses, The Health Literacy tool for 9–10 years old student (31-item) is a valid, reliable, and psychometric properties and therefore is considered as an effective tool to assessing the health literacy for 9–10 years old student in Thailand.

5. Limitations

The limitations of this study, it was performed only on government

schools and not in a private school which has difference context that might influence the health literacy as well.

6. Conclusions

The instrument was systematically developed with 4-dimensions, comprised of 31-items to assess health literacy among 9-10-years-old student in Thailand and presented the original conceptual dimensions of the HLS-EU-Q47 with good validity. We feel it would be useful for easy and accurate assessment of HL in larger childhood population.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

All the authors participated in the study design. WL was the principal investigator who primarily conducted the study, performance of data analysis and preparation of the manuscript. NS is a co-investigator who supervised and verified the results in the quantitative analyses. SB is a co-investigator who supervised and verified the results in the quantitative analyses. All the authors read and approved the submitted manuscript.

Declaration of interests

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 paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:
No conflict of interest.

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