Development and Psychometric Testing of the Thai-Nutrition Literacy Assessment Tool for Adolescents

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Abstract: Nutrition literacy is a major component contributing to healthy food consumption behaviors and prevention of diet-related non-communicable diseases; however, existing nutrition literacy assessment tools are limited in their ability to assess Thai adolescents. We report in part the findings of a larger study that used qualitative and quantitative methods to develop and test the psychometric properties of Thai-Nutritional Literacy Assessment Tool for Adolescents. A descriptive design consisting of two phases and six steps was used.

A literature review and in-depth interviews (n=30) were employed to clarify the concept of nutrition literacy in Thai adolescents and generate the items, and in-depth findings regarding these will be reported elsewhere. Content validity was reviewed by a panel of seven experts, whereas face validity was conducted in 10 Thai adolescents. Then, preliminary testing was undertaken with 275 Thai adolescents, and item analysis performed. The final version of this instrument consisted of 61 items. Psychometric testing used concurrent validity to examine the association with the Thai Healthy Eating index as a gold standard. Analysis of the discrimination index revealed that baseline criteria were met. Construct validity using the known-group technique was employed, revealing that nutrition literacy score on energy balance was higher in the healthy group than the unhealthy group.

This is the first instrument aiming to measure nutrition literacy among Thai adolescents, that focuses on understanding the functional, interactive and critical nutrition literacy in various situations. Our instrument has sufficient reliability and validity, and nurses and other health professionals can apply it for nutrition literacy screening and determine suitable interventions for Thai adolescents. Further testing of the instrument warranted with other populations in Thailand.

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Introduction

Food consumption behaviors play a significant role to promote growth and development among adolescents.[1] Promoting healthy food consumption behaviors is an approach to the prevention of diet-related non-communicable diseases (DR-NCDs),[2,3] consistent

with the United Nations' Sustainable Development Goals (SDGs) that aim to address nutrition, health, and well-being improvements by 2030.[4] However, many adolescents consume diets exceeding the recommended dietary allowance (RDA) for total fat and saturated fat, cholesterol, sodium, and sugar, resulting from unhealthy behaviors including skipping breakfast, and consumption of fast food consumption, sweetened beverages and grains and too many of the wrong kinds snacks.[5]

Approximately 97% of adolescents skip their breakfast more than two times a week and 82% consume junk food twice a week.[6] Nutrients are also less than the RDA when they consume too many fast-foods, sweetened beverages, and snacks. In addition, most snacks contain low fiber but have high calories, fat, sugar, and sodium,[7] causing increased sodium intake and thirst, resulting in increased beverage consumption particularly sweetened beverages. Subsequently, thirst is stimulated to maintain body fluid homeostasis.[8] Sweetened beverages and snacks, therefore, contribute to DR-NCDs.[2]

Adolescents' food choices and consumption behaviors are influenced by both personal and environmental factors particularly family and peer influences.[9] Adolescents with low literacy may not be able to select healthy foods due to a lack of knowledge on the nutrition label.[10] As adolescents grow,[11] nutrition literacy (NL) is necessary for them to understand the roles of nutrition, health promotion, and disease prevention.[12] Nutritional literacy is an essential skill for adolescents' nutrition and health.[4] It is a concept applied from original health literacy theory that included six processes: access, understanding, interaction, decision making, behavioral change, and dissemination. Thus, NL is a person's ability to seek, understand, and use nutrition information to make decisions on nutritious food choices. There are two components of NL: knowledge of nutrition principles and use of nutrition knowledge to make the decision on nutrition and food choices; so, the more the NL, the healthier food consumption behaviors are.[13]

Assessment of NL is critical for health providers to screen, identify and understand adolescents' literacy level helpful for nutrition communication planning and reducing risks of DR-NCDs among them. There are eight existing instruments developed to assess NL in adults, but these may not be suitable for adolescents.[13] Moreover, these instruments were developed in western contexts that are different from Thai culture and contexts.

In Thailand, the ABCDE-Health Literacy Scale of Thai Adults (A-Alcohol, B-Baccy, C-coping, D-Diet, and E-Exercise) aims to measure knowledge on the behavioral risk of metabolic syndromes in people aged ≥15 years.[14] In a recent study, the Health Literacy Scale for Thai Childhood Overweight aimed to measure knowledge on preventing overweight and obesity in adolescents aged 9-14 years.[15] However, both of these scales do not cover all the stages of adolescence. Moreover, they cannot capture all nutrition domains of literacy as they do not include nutrition principles particularly that adolescents should obtain skills about portion size, food labels, and numeracy, as well as alcoholic beverages. Also, instruments developed in other populations and may not reflect adolescents' food choices. Therefore, the purposes of this research were to develop a nutrition literacy assessment tool for Thai adolescents and to test its validity and reliability.

Conceptual Framework

The NL framework for this study is drawn from Nutbeam's model and Velardo's concept.[16,17,18] Velardo applied Nutbeam's model to guide the NL framework as classified into three levels: functional NL, interactive NL, and critical NL.[18]

1) Functional nutrition literacy (FNL) is a basic skill which refers to the ability to obtain, read, and understand nutrition information such as knowledge about health risks, components of a healthy diet, benefits of good nutrition, sources of macronutrients, and food groups. People with FNL can identify foods containing high sodium, fat or sugar.

2) Interactive nutrition literacy (INL) focuses on knowledge and behavioral modification which refers to the ability to seek out, interpret, comprehend, evaluate, apply and use nutrition information for food choice decisions. For example, a person can calculate portion size, serving size and calories of food when they compare between healthy and unhealthy food.

3) Critical nutrition literacy (CNL) is the ability to interpret, synthesize, analyze, appraise, and manage nutrition information. Furthermore, people with such skill can communicate healthy eating information to manage their social influence, resulting in decision-making and behavioral changes.

Nutrition literacy occurs in the context of intrapersonal and external factors that influence the development of NL which affects individual health through healthy eating behaviors. Social support acts as a mediator between NL and healthy eating behavior.[19,20] Therefore, we decided to develop a nutritional literacy assessment tool using both qualitative and quantitative approaches. The qualitative data and findings from the first phase of this study will be reported in-depth in another paper.

Study Aim

To develop and evaluate the Thai-Nutritional Literacy Assessment Tool for Adolescents (Thai-NLAT) and test its validity and reliability.

Methods

Study design: The findings reported here are part of a larger study employing both qualitative and quantitative methods and which had two phases: *Phase I* was composed of two steps: qualitative interviews generate instrument items and a pilot test; and *Phase II* psychometric testing. The qualitative method was guided by the conceptual framework, and findings provided data about the definition, domain, and structural factors influencing the NL of Thai adolescents as well as a method for achieving healthy eating within the Thai context. For the quantitative method, the psychometric properties of the Thai Nutrition Literacy Assessment Tool (Thai-NLAT) were tested to explore and confirm the subscales of nutrition literacy that classify nutrition literacy levels based on the Nutbeam's model[16,17] and the Verardo's nutrition literacy concept[18] including functional, interactive, and critical subscales.

Sample and Settings: The participants were Thai adolescents studying at secondary schools in Bangkok, Thailand. The sampling frame of secondary schools is divided into four main jurisdictions: (1) the Office of the Basic Education Commission of Thailand, (2) the Department of Education of Bangkok Metropolitan Administration, (3) the University Demonstration of Secondary School and (4) the Office of the Private Education Commission. This study focused on schools in the Office of the Basic Education Commission of Thailand and the Department of Education of Bangkok Metropolitan Administration that cover major populations of adolescents in Bangkok. Multi-stage random sampling was used to select the participants, as explained in **Figure 1.**

Ethical Considerations: This study was approved by the Human Research Review Committee of Faculty of Medicine, Ramathibodi Hospital (ID 09-58-29), Mahidol University, Thailand. The research objectives and participant rights were explained fully to all participants. The informed consent forms were provided to the parents/guardians through the adolescents. The data were collected after the parents/guardians signed the informed consent forms with assents from adolescents.

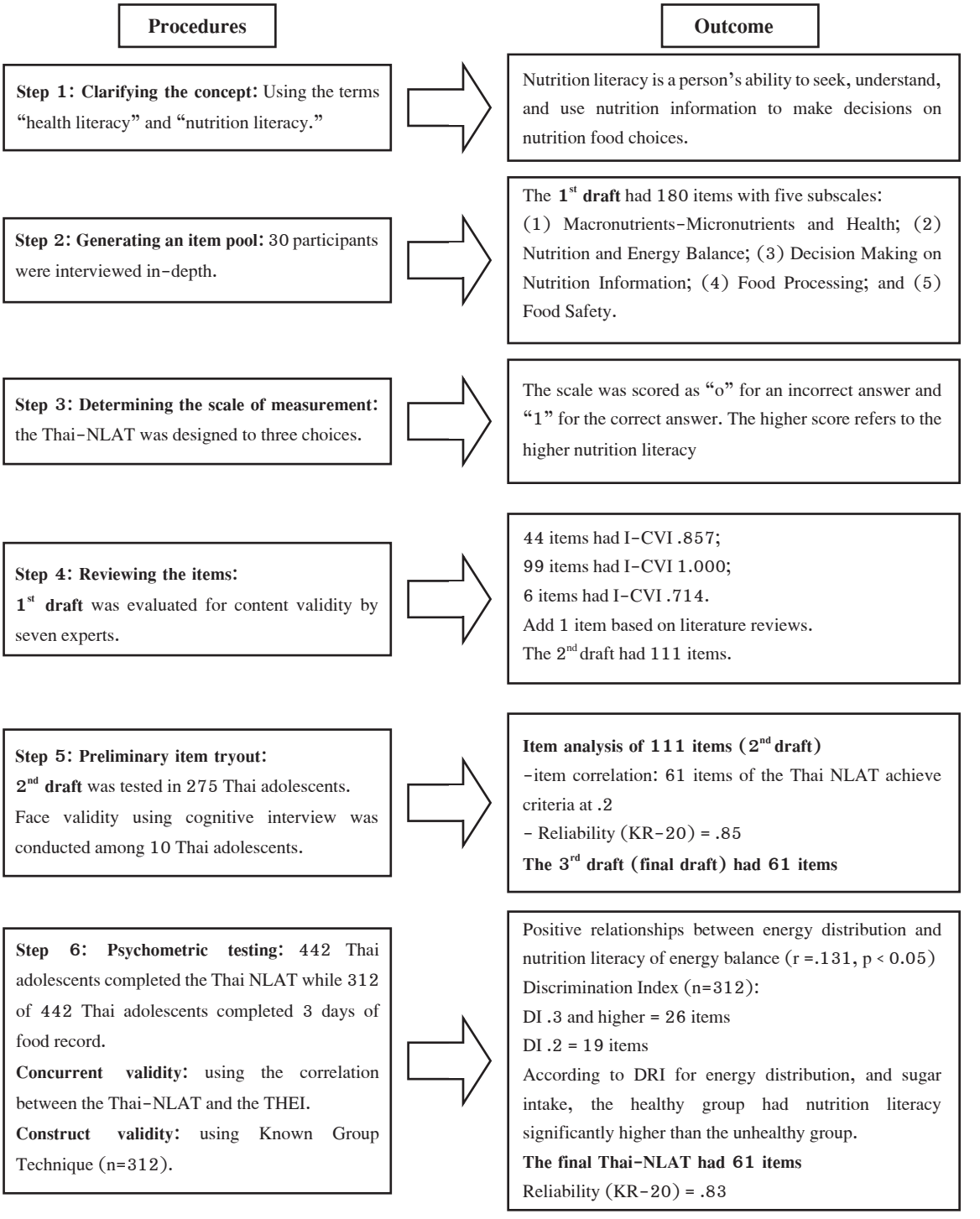

Figure 1 Process of the Thai Nutrition Literacy Assessment Tool Development

Tool Development, Data Collection, and Analysis

This instrument development was based on Waltz, Strickland, & Lenz (2010).[21] Development of the Thai-NLAT had two phases, consisting of six steps (Figure 1):

Phase 1

Step 1: Clarifying the concept: to understand the operational definition of NL concept as aforementioned. Therefore, the literature in various disciplines was reviewed using the terms "health literacy" and "nutrition literacy" The findings were then integrated with the conceptual framework to guide interviews for qualitative data and to generate items.

Step 2: Generating an item pool: Through multistage random sampling, two schools representing large-sized and medium-sized from the Department of Education of Bangkok Metropolitan Administration and three schools from the Office of the Basic Education Commission of Thailand were selected. Then, the purposive sampling was used to select the 30 participants who were thin, underweight, normal weight, overweight and obese. One adolescent was recruited from each grade; therefore, six participants per school were selected from five schools.

The 30 participants were face-to-face interviewed in their schools. The primary investigator (PI) built relationships with them prior to the in-depth interviews and explained the objectives of the interviews. The PI conducted interviews using the interview guide, lasting approximately 30-60 minutes. The interviews were recorded with permissions from the participants. Examples of the interview questions were: "Please tell me about what food you eat?" "Who cooks for you?" "How is this food prepared?" "Is it homemade or takeaway?" Probing questions were asked to clarify points if required. Field notes were completed immediately after the interviews. Qualitative data were analyzed using content analysis.[22] Data were transcribed verbatim in the Thai language. Through open coding, the data were then coded line by line to deeply reflect and interpret the meaning, resulting in sub-themes and themes for the generation.

The first draft of the Thai-NLAT included 180 items within five subscales: Macronutrients-Micronutrients and Health; Nutrition and Energy Balance; Decision Making on Nutrition Information; Food Processing, and Food Safety.

Step 3: Determining the scale of measurement: the Thai-NLAT is designed with three choices based on food choice situations. The participants choose only one answer of three choices. The response is scored as "0" for an incorrect answer and "1" for a correct answer. The final scoring was calculated by summing scores: the higher the sum score, the better NL.

Step 4: Reviewing the items: The first draft was evaluated for content validity by seven experts including a research instrument development expert, a nutritionist, a pediatrician, a public health expert, two nurse educators, and a school nurse. One hundred and eighty items of the Thai-NLAT were calculated for the item-content validity (I-CVI) with a CVI of ≥ .80 indicates good content validity.[21] Forty-four items had the I-CVI at .857, and 99 items had the I-CVI at 1.000. Therefore, 143 items were selected. In cases where the question items were assessed on similar and interchangeable concepts, the researchers kept the higher CVI of the question items. However, in cases where the question items had I-CVI <.80 and no interchangeable items, the researchers retained them. Six question items on the first draft an I-CVI at .714 that were kept. As a result, 110 items remained. One more item was subsequently added based on NL literature. Therefore, the second draft consisted of 111 items.

Step 5: Preliminary item tryout: Face validity using cognitive interview was conducted to assess the cognitive process, interpretation, and comprehension

among 10 adolescents. Some words were modified to increase clarity of language.

Then, preliminary item tryout was performed. The multistage random sampling was used to select participants for testing the Thai-NLAT psychometric properties.[23] Firstly, six schools were randomly selected from the sampling frame, consisting of three schools from the Department of Education of Bangkok Metropolitan Administration and three schools from the Office of the Basic Education Commission of Thailand. Secondly, 50 participants were randomly chosen from these six schools. Approximately, 275 Thai adolescents were selected based on the following inclusion criteria: 1) studying in grade 7-9 (junior high school) and grade 10-12 (senior high school) at public schools in Bangkok, and 2) comprehending the questions (ability to read, write, and speak Thai).

Item analysis, including inter-item correlation, item-subscale, and item-total correlation, was used to assess internal consistency. Item analysis of the second draft revealed that 61 items had an item-item correlation more than .20, achieving the Ferketich's criteria.[24] The item-total scale ranged from -.3889-.5000. According to Ferketich[24], criteria for correlation of item-total scale range from .30 to .70, therefore 27 items met the criteria. Thus, the third draft was the final draft ready for psychometric testing, consisting of 61 items with 5 subscales; Macronutrients-Micronutrients and Health; Nutrition and Energy balance (15 items); Decision Making on Nutrition Information (16 items); Food Processing (5 items), and; Food Safety (12 items). The total items under the subscale and three levels of NL are shown in **Table 1.**

Phase 2: Psychometric testing

Step 6: This phase was composed of reliability, concurrent validity, and construct validity testing. The reliability testing used item analysis. Concurrent validity used correlation coefficient analysis between the Thai-NLAT and a gold standard. For construct validity, known group technique was used.[21,25]

Concurrent validity aimed to determine the correlation coefficient between the new instrument with a standard instrument of the same construct.[26] In this study, the Thai-NLAT was examined using the Thai Healthy Eating index (THEI) as a gold standard. The THEI was developed based on the Thai Nutrition Flag, Thai Recommended Daily Intake (Thai RDI), Dietary Reference Intake (DRI) for Thais, and evidence-based nutrition related to chronic disease. The THEI has 11 subscales: rice-starchy consumption; vegetable consumption; fruit consumption; milk consumption; meat consumption; total fat intake; saturated fat intake; cholesterol intake; sodium intake; the variety of food; and added sugar intake that reflected the diet quality and various food consumptions. Total score for THEI was categorized into 3 levels: good diet (>66), need improvement (55-66), and poor diet (<55).

For the known-group technique, the contrasted-groups were used to assess the ability of the Thai-NLAT to distinguish between healthy and unhealthy groups.[21] In addition, the discrimination index (DI) was used to evaluate the item ability for predicting healthy eating behaviors.

Participants

For reliability testing, the participants were selected through the multi-stage random sampling. The school participating in the pilot test was removed from the sampling frame. The sample size was determined according to Hair et al., and 610 participants were required.[27] Therefore, 122 participants per school were randomly selected from five schools. Approximately 168 adolescents were unable to obtain permission from their guardians; thus, 442 participants remained for item analysis; this number was a large enough sample based on 5-10 participants per variable.[27]

For concurrent validity testing and known group technique, 312 of 442 adolescents completed the 3-day food record using 24-hour recall that included one weekend and two weekdays.

Table 1 Total Items in Each Subscale and Three Levels of the Thai Nutrition Literacy Assessment Tool (61 items)

No.	Item statement	Level		
		FNL	INL	CNL
***Subscale 1: Macronutrients-Micronutrients and Health* (13 items)**				
1.	Get all the nutrients but low fat			X
2.	Chicken breast is the healthiest to eat	X		
3.	Dyslipidemia diet		X	
4.	King size food			X
5.	Addressing selfcare due to family history of diabetes	X		
6.	Water for health			X
7.	Wake up with fresh fruit juice			X
8.	Avoid burnt food		X	
9.	Reuse fry oil		X	
10.	Eating right to protect your kidney	X		
11.	Sodium in catsup		X	
12.	Source of protein	X		
13.	Avoid trans fatty acid	X		
Subscale 2: Nutrition and Energy Balance (15 items)				
14.	Friendly food during control weight		X	
15.	Unhealthy food in school			X
16.	Not a safe life if you eat the same food		X	
17.	Maintain healthy eating behaviors		X	
18.	Quality food for proper growth			X
19.	Best ratio of macronutrients	X		
20.	Slender and strong		X	
21.	Time limit for breakfast			X
22.	Healthy breakfasts for adequate energy			X
23.	Best foods to eat in the morning			X
24.	All nutrients and energy for morning food	X		
25.	Healthy food for breakfast			X
26.	Don't skip breakfast for weight control		X	
27.	Don't have time for breakfast at home	X		
28.	Balance the various foods you eat and increase physical activity	X		
***Subscale 3: Decision-Making on Nutrition Information* (16 items)**				
29.	Seeking data to confirm nutrition information	X		
30.	Selecting nutrition information and exercise information	X		
31.	Selecting total vitamin	X		
32.	Selecting food with appropriate information	X		
33.	Skinny teenagers need to gain weight	X		

Levels of nutrition literacy; FNL is functional nutrition literacy; INL is interactive nutrition literacy; CNL is critical nutrition literacy.

Table 1: Total Items in Each Subscale and Three Levels of the Thai Nutrition Literacy Assessment Tool (61 items) (Cont.)

No.	Item statement	Level		
		FNL	INL	CNL
Subscale 3: Decision Making on Nutrition Information (cont.)				
34.	Sodium per serving size		X	
35.	Calories from fat		X	
36.	Using the nutrition label		X	
37.	The healthiest milk for teenagers			X
38.	Portion size			X
39.	Read expiration date		X	
40.	Selecting Canned food			X
41.	Old package		X	
42.	Don't drink alcohol		X	
43.	Collagen supplements		X	
44.	Vitamin B complex		X	
Subscale 4: Food Processing (5 items)				
45.	Decrease harm from eating instant noodles			X
46.	Avoid junk food			X
47.	Maintain healthy eating and risk communication		X	
48.	Good quality vinegar	X		
49.	Good instant noodles			X
Subscale 5: Food Safety (12 items)				
50.	Rotten meat			X
51.	Expired food			X
52.	Fresh fish			X
53.	Fresh and pesticide residue free			X
54.	Fresh fruit			X
55.	Naturally white vegetables	X		
56.	Microwave cooking	X		
57.	Meat party			X
58.	Clean restaurant			X
59.	Fresh pork	X		
60.	Preventing hepatitis A			X
61.	Serving spoon		X	
Total		18	19	24

Levels of nutrition literacy; FNL is functional nutrition literacy; INL is interactive nutrition literacy; CNL is critical nutrition literacy.

Results

Psychometric properties of the Thai-NLAT

Reliability

Approximately 442 from 610 Thai adolescents (72.46%) who completed the Thai-NLAT had a mean age of 14.74 ± 1.81 years, ranging from 12-19 years; 57.92 % were males. The majority of them had normal weight (76.92%), whereas 13.35% were obese, 6.11% were overweight, and 3.62% were underweight. Reliability of the Thai-NLAT was evaluated using item analysis. Ferketich suggested that item-item correlations of .20 to .70 are desirable because the item-item correlation over .70 indicates redundancy.[24] Results revealed that the item-item correlation of the Thai-NLAT ranged from 0.359-0.523. Items-total correlation was examined for homogeneity of the measurement. In this study, items-total correlation ranged from .2346-.5453; therefore, 24 items met the criteria at .3 to .70.[24] Items-subscale refers to the homogeneity of subscales for the Thai-NLAT. Results revealed that items-subscale correlation ranged from .357-.575; therefore, 26 items met the criteria at ≥ .5. Subscale-subscale correlation referred to the integrity of items within the subscales and the other. Subscale-subscale correlation ranged from .305-.523 while subscale-total correlation ranged from .627-.781 (**Table 2**). In the entire questionnaire, KR-20 was .83.

Table 2 Correlation Coefficient (r) of Subscale-Subscale and Subscale-Total in Phase II (n= 442)

		Macronutrients-Micronutrients and Health	Nutrition and Energy Balance	Decision Making on Nutrition Information	Food Processing	Food Safety	Total
Macronutrients-Micronutrients and Health	r	1.000					
	p	.000					
Nutrition and Energy balance	r	.441**	1.000				
	p	.000					
Decision Making on Nutrition Information	r	.305**	.499**	1.000			
	p	.000	.000				
Food Processing	r	.344**	.331**	.446**	1.000		
	p	.000	.000	.000			
Food Safety	r	.315**	.365**	.492**	.523**	1.000	
	p	.000	.000	.000	.000		
Total	r	.627**	.747**	.781**	.653**	.743**	1.000
	p	.000	.000	.000	.000	.000	

**p < .01

Validity

For concurrent validity test, 312 of the 442 adolescents (70.59%) completed the 3-day food record. Their mean age was 14.78 ± 1.77 years, ranging from 12-18 years. Approximately 54.50% were males. Most had normal weight (65.70%), whereas 11.90 % were overweight; 10.60 % were obese, and 11.80 % were underweight.

Data from 3-day food record were analyzed using the INMUCAL-Nutrients version 3 (NB 2.1), Institute of Nutrition, Mahidol University. The distribution of energy and sugar intakes were compared with the percentage of Dietary Reference Intake (% DRI) for THAIS 2003. Results revealed that the healthy group, 155 of the 312 participants (49.7%), had energy intake within 60-70% of the DRI; and 98 of the 312 (31.4%) had sugar intake ≤ 24 g/day. There were significant positive relationships between energy distribution and NL score of energy balance (r =.131, p = .021) while no statistically significant between sugar intake and NL score of sugar intake (r =.104, p = .067) **(Table 3)**.

Table 3 Correlation Coefficient (r) of the Scores for Thai Nutrition Literacy Assessment Tool and the Thai Healthy Eating Index (n= 312)

		Nutrition literacy score	
		Energy balance	**Sugar intake**
Energy distribution	r	.131*	
	p	.021	
Sugar intake	r	-	.104
	p	-	.067

*p < .05

For construct validity test using the known-group technique, NL was compared between the healthy and unhealthy groups according to DRI, using Mann-Whitney U test. Results revealed that according to DRI for energy distribution, and sugar intake, the healthy group had NL significantly higher than the unhealthy group **(Table 4)**.

Table 4 Comparison of the Nutrition Literacy Levels between Healthy and Unhealthy Groups (n = 312)

	N	FNL		INL		CNL	
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Energy distribution							
< 60% DRI or > % DRI[b]	157	.83	.54	2.15	.87	1.73	.86
60-100%DRI[a]	155	.84	.55	2.29	.79	1.96	.87
Sugar intake							
> 24 g/day[b]	214	-	-	-	-	2.28	.68
≤ 24g/day[a]	98	-	-	-	-	2.34	.73

a is the healthy group; b is unhealthy group
Healthy group: Achievement of DRI Group; Unhealthy group: Non-Achievement of DRI group
FNL is functional nutrition literacy; INL is interactive nutrition literacy; CNL is critical nutrition literacy.

The discrimination index is used to evaluate an item's ability to predict all participants' behaviors.[21] According to Ebel's criteria, the items with a DI of .3 and higher should be retained. The items with a DI of .2 are marginal items and need improvement.[28] In this study, 26 from 45 items of the Thai-NLAT met the DI criteria of ≥ .3 while 19 items had DI less than .3.

Discussion

Both adequate nutrition knowledge and optimal dietary food choice are essential factors for health promotion and disease prevention. Multi-dimensional NL that captures broader domains of NL is needed.[13] This is the first instrument developed to measure NL among Thai adolescents, resulting in understanding the functional, interactive and critical nutrition literacy in various situations.

To produce the Thai-NLAT we followed rigorous instrument development steps. In the first phase, the literature review and in-depth interview were conducted to clarify the concept related to NL. Then, the items were reviewed by seven experts and preliminary tryout among Thai adolescents. For the second phase, the Thai-NLAT was tested among a large sample size as appropriate for psychometric testing.[27] Results revealed that the Thai-NLAT had sufficient validity and reliability.

The Thai-NLAT reflects good content validity for a new instrument.[21] There was a significant correlation between energy distribution and NL score on energy balance, supporting the concurrent validity of the energy balance subscale of the Thai-NLAT. While there was a trend showing that the more NL score of sugar intake, the lower sugar intake. Moreover, the relationship between NL and energy distribution could reflect food consumption behaviors in that the healthy group with energy distribution 60-100% DRI had NL at functional, interactive, and critical levels higher than the unhealthy group. For the sugar intake, the NL in the healthy group was higher than the unhealthy group. This result was similar to a previous study reporting that adolescents with high NL had lower sugar intake and better energy balance than those with low NL.[1] Also, this result was consistent with Haidar et al., revealing that adolescents with more nutrition knowledge and nutrition label use consumed food containing lower calories and sugar.[29] However, sugar intake may result from other factors such as access to various foods and added sugars in processed food.

Item analysis was used to assess the internal consistency of the Thai-NLAT, revealing that the item-item correlations were.359-.523, indicating no redundancy. Item-total correlations were -.2346-.5453 which were acceptable. Each item of the Thai-NLAT reflected the same attribute.[24] Item-subscale correlations were .357-.575, indicating that the items measure a similar construct. Moreover, subscale-subscale correlations were not highly correlated (.305-.523), indicating that these five subscales were appropriate. Subscale-total correlations were in the desirable range (.60 to .70).

Based on Netemeyer's criteria, the reliability of the new instrument should be at least.80.[30] The KR-20 of the Thai-NLAT was .83. Therefore, the instrument includes five subscales with 61 items with adequate internal consistency, covered key NL subscales and reflecting food choice decision throughout all stages of adolescence, expanded from existing tools.[15] Moreover, the Thai-NLAT requires only 20-30 minutes for completion. The Thai-NLAT includes five subscales:

Subscale 1: *Macronutrients-Micronutrients and Health* assesses nutrition knowledge and adolescent's understanding about the source of unsaturated fat, saturated fat, trans-fat, whole grain, complex carbohydrate, protein and how to balance that the main source of body energy is related to weight control.[31]

Subscale 2: *Nutrition and Energy Balance* assesses adolescents' management of their food choice

for energy expenditure and how they selected food for their breakfast in various situations such as time constraint, and weight control. In the adolescence period, not only foods containing energy but also those for proper growth are required. Male adolescents require 1,700-2,300 kcal/day whereas females require 1,600 -1,850 kcal/day. The Thai Nutrition Flags also suggest that a healthy diet consists of five food groups with different portions: vegetables 4-6 rice-serving spoons, fruits 3-5 portions, grains (whole grain and refined grains) 8-12 rice-serving spoons, and protein 6-12 rice-serving spoon per day.[32]

Subscale 3: *Decision Making on Nutrition Information* consists of two main topics: food labelling and supplementary food.

Food labelling assesses numeracy skills for the interpretation of food label information. These is a major content of NL since understanding the nutrition label requires basic mathematics for serving size calculation. Therefore, a person with the poor ability in numeracy calculation may be at risk for low NL, resulting in increased diet-related chronic disease.[33] *Supplementary food* assesses an adolescent's nutrition-seeking information about supplementary food and how they understand the source of natural vitamins and minerals in foods and trust this information. Furthermore, these items reflect the decision-making of adolescents on supplementary food.

Subscale 4: *Food processing* assesses how adolescents understand food processing, food ingredients, food exchange, and use nutrition information to promote healthy food intake, indicating the interactive nutrition literacy.[16,18]

Subscale 5: *Food safety* consists of two main topics, food safety and sanitation. *Food safety* assesses knowledge on fresh food and use of nutrition knowledge to select fresh food such as pork, fish, vegetable, and fruit. *Sanitation* considers knowledge on sources of food-borne pathogens and the ability to transfer knowledge to prevent consumption of food cross-contamination with friends. Adolescents should be aware of cross-contamination from sharing their plates and cups with others.[34]

Limitations and Recommendations for Future Research

The Thai-NLAT had sufficient reliability and validity; however, this may not be appropriate to use in rural areas as it was developed based on urban contexts. Predictive validity, a criterion-related validity, was not tested in this study and needs to be tested in further research.

Conclusion and Implications for Practice

The final draft of the Thai-NLAT includes five subscales with 61 items and the scoring of "0" or "1". A higher score indicates better NL. The Thai-NLAT can be used by school nurses and health care providers to monitor NL and guide intervention programs for adolescents in schools, primary care, and community settings. For future research, understanding how the NL of adolescents predicts their self-efficacy on healthy eating behaviors and understanding the level of NL will help to plan to tailor educational and behavioral interventions. In addition, the Thai-NLAT needs to be tested in other populations in Thailand to provide assurance its psychometric properties or the need for further modification.

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การพัฒนาเครื่องมือและการทดสอบคุณสมบัติทางจิตวิทยาของแบบประเมินความรอบรู้ด้านโภชนาการสำหรับวัยรุ่นไทย

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บทคัดย่อ : ความรอบรู้ด้านโภชนาการเป็นปัจจัยที่สำคัญซึ่งนำไปสู่พฤติกรรมการบริโภคอาหารสุขภาพและการป้องกันโรคไม่ติดต่อเรื้อรังที่เกิดจากพฤติกรรมการบริโภคอาหาร อย่างไรก็ตามเครื่องมือประเมินความรอบรู้ด้านโภชนาการยังมีอยู่อย่างจำกัดโดยเฉพาะอย่างยิ่งในวัยรุ่นไทย การศึกษานี้เป็นส่วนหนึ่งของโครงการวิจัยหลักซึ่งใช้วิธีการวิจัยเชิงคุณภาพและเชิงปริมาณ การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อพัฒนาและทดสอบคุณสมบัติทางจิตมิติของแบบประเมินความรอบรู้ด้านโภชนาการของวัยรุ่นไทย โดยใช้แบบวิจัยเชิงพรรณนา ประกอบด้วย 2 ระยะ ซึ่งมี 6 ขั้นตอน

ผู้วิจัยทบทวนวรรณกรรมและสัมภาษณ์รายบุคคล 30 คน เพื่อทำความเข้าใจแนวคิดของความรอบรู้ด้านโภชนาการและสร้างข้อคำถาม ผู้วิจัยนำข้อคำถามที่สร้างขึ้นให้ผู้เชี่ยวชาญจำนวน 7 คน ประเมินความตรงเชิงเนื้อหาและนำแบบประเมินไปสัมภาษณ์เพื่อประเมินกระบวนการคิด การตีความ ความเข้าใจข้อคำถามในวัยรุ่นไทยจำนวน 10 คน จากนั้นนำแบบประเมินไปทดสอบในวัยรุ่นไทย จำนวน 275 คน วิเคราะห์รายข้อและนำแบบประเมินฉบับสุดท้ายซึ่งมีข้อคำถามจำนวน 61 ข้อ ไปทดสอบความตรงตามสภาพในวัยรุ่นไทยจำนวน 442 คน โดยเปรียบเทียบกับแบบสอบถามพฤติกรรมการรับประทานอาหารเพื่อสุขภาพที่ดี (Thai Healthy Eating index) และวิเคราะห์ด้วยดัชนีอำนาจจำแนก พบว่าข้อคำถามของแบบประเมินความรอบรู้ด้านโภชนาการของวัยรุ่นไทยมีความสามารถจำแนกได้ตามเกณฑ์ การวิเคราะห์ความตรงตามโครงสร้างใช้ Known-Group Technique พบว่ากลุ่มวัยรุ่นที่บริโภคอาหารได้ถูกหลักโภชนาการมีคะแนนความรอบรู้ด้านโภชนาการในมิติความสมดุลของพลังงานสูงกว่ากลุ่มที่บริโภคอาหารไม่ถูกหลักโภชนาการ

แบบประเมินความรอบรู้ด้านโภชนาการสำหรับวัยรุ่นไทยเป็นเครื่องมือฉบับแรกที่สามารถประเมินความรอบรู้ด้านโภชนาการสำหรับวัยรุ่นไทยในสถานการณ์ที่หลากหลายโดยแบ่งเป็น ความรอบรู้ด้านโภชนาการระดับพื้นฐาน ระดับปฏิสัมพันธ์และระดับวิจารณญาณ มีความตรงและความเที่ยงระดับดี พยาบาลและทีมสุขภาพ สามารถนำไปใช้คัดกรองและประเมินผลการส่งเสริมความรอบรู้ด้านโภชนาการของวัยรุ่นไทย อย่างไรก็ตาม ในการศึกษาต่อไปควรมีการทดสอบเพื่อยืนยันคุณสมบัติทางจิตมิติก่อนนำไปใช้ในประชากรไทยกลุ่มอื่น

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