Original Article

Construct Validity of Health Literacy Scales and Causal Model of Sufficient Health among NCDs Risk Adults

Ungsinun Intarakamhang PhD[1], Khwanying Sriprasertpap PhD[2], Araya Chiangkhong PhD[3], Niwat Srisawasdi PhD[4], Supitcha Wongchan PhD[5], Patrawut Intarakamhang MD[6], Piya Boocha PhD[7]

[1] Behavioral Science Research Institute, Srinakharinwirot University, Bangkok, Thailand

[2] Faculty of Education, Srinakharinwirot University, Bangkok, Thailand

[3] Kuakarun Faculty of Nursing, Navamindradhiraj University, Bangkok, Thailand

[4] Faculty of Education, Khon Kaen University, Khon Kaen, Thailand

[5] Department of Health, Ministry of Public Health, Nonthaburi, Thailand

[6] Department of Rehabilitation, Phramongkutklao Hospital, Bangkok, Thailand

[7] Innovative Learning Center, Srinakharinwirot University, Bangkok, Thailand

Background: Over 75% of Thai people's deaths are caused by non-communicable diseases (NCDs), which is higher than all deaths worldwide at 71%.

Objective: To develop a health literacy (HL) and sufficient health behavior (SHB) scale and examine the causal relationship model of SHB.

Materials and Methods: The present study was a cross-sectional exploratory study among adults aged 20 to 60 at NCD risks. Six hundred thirty-six participants were sampled through stratified random sampling. The participants consisted of employees in public and private organizations and local people in urban and semi-urban communities. The research was done between August 2021 and March 2022. Confirmatory Factor analysis (CFA), and structural equation modeling (SEM) were used to analyze the data.

Results: 1) In respect of construct validity, the 28-item HL Scale achieved an overall Cronbach's alpha of 0.94 and a factor loading ranging between 0.67 to 0.84. Similarly, the 30-item SHB Scale achieved an overall Cronbach's alpha of 0.94 and a factor loading ranging between 0.40 to 0.82. 2) The causal relationship model of SHB was consistent with the empirical data. In addition, HL positively influenced SHB (direct effect=0.82, $p<0.001$), and HL was a key factor that could predict SHB by 67.00%.

Conclusion: Both developed scales are high-quality assessment instruments that can be used by healthcare providers in assessing NCD risks and predicting SHB to organize activities enhancing people's HL and knowledge for decreasing NCD risk behaviors.

Keywords: Health literacy; Sufficient health behavior; Non-communicable diseases; NCDs Risk; Construct Validity

Non-communicable diseases (NCDs) are a world's health problem in terms of the number of deaths and overall burden of diseases. According to World Health Organization (WHO)[1], the global number of NCD deaths tended to increase from 68% in 2007 to 71% of all deaths worldwide in 2019, and 80% of all deaths from NCDs in 2008 occurred in low- and middle-income countries. Most NCD deaths are caused by cardiovascular diseases (44%), followed by cancers (22%), respiratory diseases (9%), and diabetes (4%). In Thailand, NCDs account for 75% of the Thai people's mortality rate, leading to a rise in disability-adjusted life-years and an immense impact on national economic and social development[2]. According to the Ministry of Public Health, Thailand's reports between 2015 and 2019, the top three causes of NCD deaths were all types of cancer, stroke, and heart attacks, respectively, equivalent to 125.0, 53.0, and 43.7 deaths per 100,000 population[3].

One of the leading causes of NCD sickness and death is health risk behavior. People of all ages should be encouraged to engage in healthy lifestyle behavior, such as healthy eating, exercising, no drinking or smoking, controlling emotions, nurturing

Correspondence to:

Boocha P.

Innovative Learning Center, Srinakharinwirot University, Bangkok 10110, Thailand.

Phone: +66-89-4772804

Email: piyab@g.swu.ac.th

positive relationships with others, sacrificing for the greater good, and doing volunteer work to grow spiritually[4-6]. Health behavior is influenced by factors such as population characteristics, psychological characteristics, and surrounding environments, including health literacy (HL), which is significantly linked with one's health behavior[7-9]. Therefore, to improve people's health behavior, their HL should be enhanced to build their long-term capacity for self-care and the ability to predict potential health risks. The fact that most people in the country have low HL can negatively affect the national health status such as high mortality, hospitalization, and the cost of treatment. People's lack of self-care ability can lead to a growing number of NCD patients[10]. In Intarakamhang et al's studies related to HL and health behavior between 2014 and 2018, scales were developed such as HL scale for childhood overweight, HL scale for Thai adults, the HL scale for unwanted pregnancy prevention of Thai females aged 15 to 21 years, and Environmental HL scale for homebound and bedbound Elder[7,11-13]. All of the scales had high reliability and validity and the studies' results confirmed that HL was associated with health behavior among all age groups. In addition, good health behaviors from the perspective of sustainability mean the action of developing and maintaining well-being, consisting of being self-reliant, being actively engaged with society, developing spiritual wisdom, maintaining a healthy lifestyle, engaging in active learning, building up financial security, and strengthening family[14]. Therefore, the sufficient Thai lifestyle for good health is based on the sufficiency economy philosophy to provide people with immunity and protection against diseases by promoting people's HL throughout their lifespan[15,16]. The researchers found only one qualitative study investigating Thai people's health behavior based on the philosophy of sufficiency economy[17]. No quantitative instrument has yet been developed for assessing sufficiency health behavior (SHB) focused on living the middle way or living a simple, careful life, to avoid health risk factors. The present study aimed to 1) develop the HL and SHB scale, and 2) examine the causal relationships model of SHB. Under the research hypothesis, the measurement model and the causal relationship model were consistent with the empirical data.

Materials and Methods

The present study was a cross-sectional exploratory study, conducted between August 2021 and March 2022. The population and sample group were Thai adults with NCD risks, living in Sing Buri, Sa Kaeo provinces, and Bangkok where levels of HL were low and risks of NCDs were high from the previous surveys in 2016[18].

The sample size was determined based on the size required to confirm a causal relationship model, with 200 people in each group[19]. The total sample consisted of 600 Thai adults at risk of NCDs aged 20 to 65 years old, working age groups were selected through a quota-stratified random sampling technique for making sure that participants were selected equally into three groups, 1) working in government organizations, 2) working in private organizations, and 3) people in the community from three provinces in equal proportions. In the present research, the sample size was increased by 10% to prevent data loss. The number of samples was 660, which 636 complete questionnaires were returned, representing 96.36%.

The inclusion-exclusion criteria were 1) aged between 20 and 65 years, 2) had not non-chronic communicable diseases such as diabetes mellitus, hypertension, and heart disease, 3) able to read, write and agree to provide health information, 4) had a smartphone that could communicate with Line Application and able to do online questionnaires. The exclusion criteria were 1) reluctance or hesitation to provide information, 2) inability to complete the measurement, and 3) withdrawal from the study.

Data collection

After obtaining the Human Research Ethics Certificate, the researchers coordinated with the health personnel in the targeted areas to obtain information about the adult population at risk of NCDs in the area. Once the data were obtained, a random sampling was performed, according to the selection criteria of the research participants and according to the specified sample size. The researchers contacted participants by asking the village health volunteers (VHVs) to set up times to meet with participants in the local meeting room. The researcher assistants explained how to answer the online questionnaire via line application on a smartphone to each participant and asked for cooperation to answer all questions. During the questionnaire, if the participants were worried, they could withdraw from the research.

Instruments and quality assessment

The details were as follows:
1) Demographic Questionnaire: The question-naire gathered data on gender, age, marital status,

education level, occupation, monthly income, living conditions, and NCD risks.

2) HL Scale was developed from HL assessments for adults[11,20]. The 28-item scale assessed four elements of HL, 1) access to health information and services, 2) understanding of health information and services, 3) verification of health information and services, and 4) use of health information and services. The scale items were rated on a 5-point scale from lowest (1 point) to highest (5 points). Three experts reviewed the content validity of the scale. The scale achieved an IOC ranging between 0.60 to 1.00, with an overall reliability of 0.94.

3) SHB was used for NCD Prevention Scale. The 30-item scale assessed desirable behavior based on the philosophy of sufficient economy. Three elements of SHB were investigated, 1) sufficient living behavior, 2) safe behavior, and 3) self-care behavior. The scale items were rated on a 5-point scale from never (1 point) to regularly (5 points). Three experts reviewed the content validity of the scale. The scale achieved an IOC ranging between 0.60 to 1.00 with an overall reliability of 0.94.

Data analysis
Descriptive statistics were used to analyze basic data of variables such as mean and standard deviation, the data were analyzed by using IBM SPSS Statistics, version 26.0 (IBM Corp., Armonk, NY, USA). Confirmatory factor analysis (CFA) was used to analyze the measurement model was consistent with the empirical data. Structure equation model (SEM) was used to analyze the causal relationship model that was consistent with the empirical data. The model fit was determined based on the following benchmarks, a statistically significant chi-square (χ^2), χ^2/df smaller than 5, RMSEA of 0.08 or smaller, SRMR of less than 1.00, CFI greater than 0.90, GFI greater than 0.90, and NFI greater than 0.90[19]. The data were analyzed by using LISREL version 8.72.

Ethical approval
The present study was granted a certificate of ethical approval for research involving human subjects by Srinakharinwirot University (SWUEC-330/2564E). Before beginning the data collection process, the researchers asked for the participants' consent for study participation and explained the significant details about the study, including the reason and method of selecting participants. The researchers also protected the data confidentiality by excluding names and sources of data and explained the

potential impact of each step of the research to protect the participants from any harm that might occur.

Results
General characteristics of the sample
The sample consisted of 636 participants. The majority of participants were female (67.30%), married (52.52%), and aged between 41 and 50 years (32.08%). Most of them reported holding a Bachelor's degree as their highest level of education (66.35%), working in a public organization (38.68%), having an adequate income with savings (32.39%), and without savings (32.23%).

Quality assessment of the scales
The 28-item HL Scale assessed four elements of HL, 1) access to health information and services, 2) understanding of health information and services, 3) verification of health information and services, and 4) use of health information and services. The scale items had discriminating power ranging between 0.50 to 0.86. The Cronbach's alpha for each element fell between 0.67 to 0.84. The overall reliability of the scale equaled 0.94. In respect of construct validity, the CFA results indicated that the model fit the empirical data (χ^2=1020.59, df=336, p<0.001, χ^2/df=3.03, RMSER=0.05, SRMR=0.02, GFI=0.90, CFI=0.99, NFI=0.99). Moreover, all of the scale items had factor loadings ranging from 0.67 to 0.84, which are all above acceptable levels as presented in Table 1.

The 30-item SHB Scale assessed three elements of SHB, 1) sufficient living behavior, 2) safe behavior, and 3) self-care behavior. The scale items had discriminating power ranging between 0.20 to 0.74. The Cronbach's alpha for each element fell between 0.83 to 0.87. The overall reliability of the scale equaled 0.94. In respect of construct validity, the CFA results indicated that the model fit the empirical data (χ^2=1,223.56, df=385, p<0.001, χ^2/df=3.17, RMSER=0.05, SRMR=0.02, GFI=0.90, CF=0.99, NFI=0.98). Moreover, all of the scale items had factor loadings ranging from 0.40 to 0.82, which were all above acceptable levels as presented in Table 2.

Analysis of the causal relationship model of SHB
The results showed that the causal relationship model fitted the empirical data and all values reached acceptable levels (chi-square=6.35, df=10, p=0.78, χ^2/df=0.63, RMSEA=0.00, SRMR 0.01, CFI=1.00, NFI=1.00, GFI=1.00). In addition, health literacy had a positive direct effect on SHB at a significance level

Table 1. Quality assessment of HL scale

Health literacy items	Correlation coefficient (r)	Factor loading
Element 1: Access to health information and services (Cronbach's alpha=0.90)		
1.1 I can seek self-care information by myself to treat my health problems.	0.84	0.73
1.2 I can seek reliable health information from different sources such as experts, printed materials, and the Internet.	0.81	0.78
1.3 I can seek the latest health information and am open to new information to stay healthy.	0.74	0.78
1.4 I can seek health information or healthcare providers by myself.	0.60	0.75
1.5 I can seek healthcare providers that can provide the health care I need.	0.83	0.80
1.6 I can always seek advice from a doctor or a healthcare provider.	0.50	0.67
1.7 I can access healthcare services that suit my needs or problems.	0.63	0.71
Element 2: Understanding of health information and services (Cronbach's alpha=0.86)		
2.1 I understand information on food or drug labels i.e., how to consume the food or drug, expiry dates, deterioration, and health benefits or side effects.	0.61	0.71
2.2 I can explain information about diseases and their symptoms obtained from different sources such as health manuals, brochures, posters, and prescriptions to other people.	0.62	0.76
2.3 I understand and fill out health information forms given by healthcare providers correctly.	0.62	0.84
2.4 I understand online health information that is available on the Internet, YouTube, videos, Facebook, Line, etc.	0.64	0.80
2.5 I understand healthcare providers' advice on diseases and health care.	0.78	0.84
2.6 I understand health warnings from the government sector such as avoiding sweet, fatty, and salty food, exercising regularly, no smoking/drinking, vaccination, and disease prevention.	0.50	0.74
2.7 I understand health information presented through symbols, graphs, tables, diagrams, numbers, words or signs in healthcare facilities or other places.	0.60	0.82
Element 3: Verification of health information and services (Cronbach's alpha=0.87)		
3.1 I think carefully and consult my family before choosing a healthcare provider.	0.58	0.79
3.2 I compare the pros and cons of health products and services before believing or using them.	0.61	0.78
3.3 When I receive new health information, I will verify the source of information before believing or using the information.	0.69	0.74
3.4 I usually compare health information from different sources to verify the information before passing it to others.	0.64	0.80
3.5 I can logically analyze the pros and cons of health information and services recommended by others before believing or using the information or services.	0.63	0.76
3.6 I review the benefits and reliability of health information before believing or using the information.	0.75	0.78
3.7 Before using health information, I can verify it by consulting healthcare providers about proper health care.	0.57	0.84
Element 4: Use of health information and services (Cronbach's alpha=0.93)		
4.1 I use the health information I have to enhance my own health.	0.75	0.82
4.2 I can choose health information or services to help me adjust my behavior or lifestyle for better health.	0.86	0.81
4.3 I use the health information I have to prevent disease and restore my health effectively.	0.71	0.81
4.4 I use health information to help me make decisions to reduce/stop my health risk behaviors.	0.77	0.83
4.5 I choose appropriate health services for myself and my families such as specialized clinics and traditional Thai medicine.	0.73	0.80
4.6 I use health information to create an effective self-care plan such as eating healthy, working out, reducing stress, and resting.	0.83	0.82
4.7 I use the health information I have to discuss with my doctor to ensure that I receive treatments that suit my lifestyle.	0.76	0.78
Overall reliability of the scale=0.94		

of 0.01 with an effect size of 0.82 and could explain 67.00% of the variation insufficient health behaviors as follow in Figure 1.

Discussion

In regard to the HL Scale, the researchers developed the scale items based on the structural elements of HL concepts by Sorensen et al[20] and Osborne et al[21] and designed the item content based on the Thai context[11]. Each element consisted of seven items, totaling 28 items. The scale had item reliability ranging from 0.86 to 0.93 and overall reliability of 0.94, which is considered excellent according to George and Mallery[22] and therefore a high-quality instrument for data collection. In addition, the factor loadings of the items fell between 0.67 to 0.84, higher than the acceptable level of 0.30[23]. The scale's construct validity was verified by the CFA. The results indicated that the developed HL scale is practical and suitable for people at risk of NCDs.

The SHB Scale was developed based on the

Table 2. Quality assessment of SHB scale

Sufficient health behavior items	Correlation coefficient (r)	Factor loading
Element 1: Sufficient living behavior (Cronbach's alpha=0.87)		
1.1 I live a simple life and spend wisely by buying only affordable or necessary things.	0.55	0.61
1.2 I plan my daily routine based on reliable and reasonable health information.	0.64	0.70
1.3 I control my food intake based on how much energy I need a day.	0.71	0.74
1.4 I cook only what I need and finish my plate to avoid food waste.	0.61	0.66
1.5 I focus on nutritional values rather than preferences or prices.	0.74	0.75
1.6 I mostly eat home-cooked meals and hardly buy readymade food.	0.27	0.69
1.7 I prefer local, seasonal fruit and vegetables to imported or expensive ones.	0.62	0.73
1.8 I apply the middle way approach when making decisions and handling my health problems.	0.74	0.72
1.9 I spend time on healthy activities to boost my immune system.	0.61	0.76
1.10 I do physical activities that require no expensive equipment such as walking to work, doing activities that require physical power, moving around, running, and jump roping.	0.52	0.81
Element 2: Safe health behavior (Cronbach's alpha=0.83)		
2.1 I avoid eating foods high in carbs, sugar and fat such as fried foods, sausages, instant noodles, baked goods, sweets, and snacks.	0.53	0.77
2.2 I eat organic food to avoid chemicals.	0.67	0.80
2.3 I follow exercise safety guidelines such as warming up, using exercise equipment or doing exercises that suit my age and physical condition, and exercising for an appropriate amount of time.	0.56	0.72
2.4 I monitor my body and emotions to prevent sickness and control symptoms.	0.58	0.79
2.5 I eat fresh, clean food and freshly cooked meals to avoid toxin or bacteria contamination.	0.72	0.79
2.6 I live cautiously to minimize health risks.	0.68	0.76
2.7 I sleep for at least 6-8 hours a day to restore my health and reduce health risk factors.	0.68	0.72
2.8 I create a safe home environment to prevent health or life hazards such as accidents, fires, disease-carrying animals, and other dangers.	0.48	0.77
2.9 I avoid smoking or breathing in smoke from cigarettes and toxic chemicals.	0.27	0.73
2.10 I avoid alcoholic drinks.	0.20	0.75
Element 3: Self-care behavior (Cronbach's alpha=0.86)		
3.1 I control my health behavior such as controlling weight, having an annual check-up, thinking positive, avoiding unhealthy food, and exercising regularly.	0.63	0.81
3.2 I take care of my health to protect myself from disease.	0.62	0.82
3.3 I do regular health checks at home and will consult a doctor or a health expert once I find something wrong.	0.37	0.81
3.4 I eat tasteless food and always avoid adding sugar, fat or salt to my food.	0.57	0.80
3.5 I eat at least half a kilogram of fruit and vegetables a day or always fill half my plate with fruit and vegetables.	0.74	0.82
3.6 I eat a variety of foods to get the nutrients my body needs.	0.67	0.80
3.7 I exercise until I feel tired or sweat for at least 30 minutes a day.	0.59	0.81
3.8 I use positive thinking and optimism to manage my stress.	0.62	0.79
3.9 I control my emotions and adapt well to different situations.	0.45	0.40
3.10 I do health-related activities with my family or friends.	0.57	0.55

Overall reliability of the scale=0.94
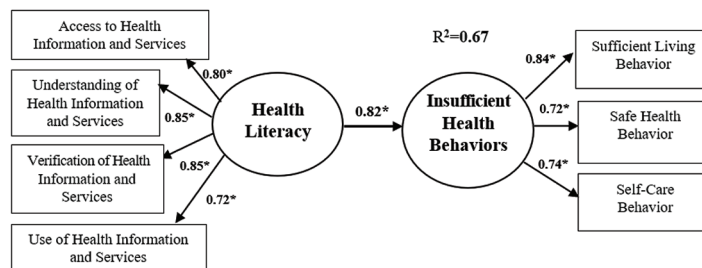
Figure 1. Causal relationship model of sufficient health behavior.

philosophy of sufficiency economy and the item content was designed based on Thai people's health behavior[24]. The scale assessed three elements of SHB. Each element consisted of 10 items, totaling 30 items. Similarly, the scale had item reliability ranging from 0.83 to 0.87 and overall reliability of 0.94, which is considered excellent according to George and Mallery[22] and therefore a high-quality instrument for data collection. The factor loadings fell between 0.40 to 0.82, passing Kline's acceptable level[23]. The developed scale, as confirmed by the CFA results, can assess the actual levels of health-risk behaviors that may lead to NCDs among working-age groups.

Consistency between the causal relationship model of SHB and the empirical data was found, along with HL's positive direct effect on SHB at a significance level of 0.05. The results are consistent with a previous study that found HL's positive direct effect on health behavior and indirect effect on family well-being through health behavior[24]. Similar results were also found in Ginggeaw and Prasertsri's study on the relationships between HL and health behavior among adults with chronic diseases[25]. The study found a statistically significant association between HL and health behavior with a correlation coefficient (r) of 0.46. The results were confirmed by foreign studies that investigated the relationships between HL and health behavior. For example, in Brega et al's study on the relationship between HL and glycemic control in American Indians and Alaska Natives, HL was found to have a statistically significant direct effect on health behavior and health outcomes[8]. Similarly, a study by Suka et al found that HL had statistically significant direct effects on health behavior and health information access[26]. Moreover, the results were also relevant to the finding of Lee and Oh[27], factors affecting a higher health-related quality of life were HL, self-efficacy, and health-promoting behavior in adults. HL was associated with more health-related behavior on the internet among Minnesotan adults with an affected size of 0.35[28].

Limitation

The present research collected data using online questionnaires. As a result, some respondents did not answer all the questions. Therefore, data collection must be increased by 10% to prevent data loss, and the sample size was consistent with the statistical techniques used to analyze.

Conclusion

Both developed scales are high-quality assessment instruments that can be used by healthcare providers in assessing NCD risks and predicting SHB to organize activities enhancing people's HL and knowledge about reducing NCD risk behaviors.

What is already known on this topic?

The research clearly supports that HL has a high influence on Thai people's SHB. If the government agencies can promote Thai people to have a high level of HL, the result of the development in Thai people having SHB is up to 67%. Therefore, this knowledge should be a policy direction for people's health promotion. Health providers and health professionals should continually organize learning activities to improve the HL of Thai people of all ages. Thai people are able to rely on themselves and have immunity to self-health care in accordance with the Thai lifestyle based on the sufficiency economy philosophy.

What this study adds?

The researchers extend the studying area by healthcare providers using these high-quality scales to assess risk factors for NCDs to organize activities promoting HL and health behavior that match working-age people's lifestyles. The yielded results can be used in designing relevant future research such as an exploratory study in which the researchers may use the developed scales before and after the experiment or focus on enhancing HL due to predict health behavior, or a qualitative study in which the researchers study people with high levels of HL and SHB to develop a guideline for insufficient health living for NCD risk reduction.

Conflicts of interest

The authors declare no conflict of interest.

References

1. World Health Organization. Global action plan for the

prevention and control of NCDs 2013-2020 [Internet]. 2013 [cited 2019 May 22]. Available from: https://www.who.int/publications/i/item/9789241506236.

2. Bureau of Non-Communicable Disease Ministry of Public Health. 5-year national NCDs prevention and control plan (2017-2021) [Internet]. 2017 [cited 2021 Apr 22]. Available from: https://www.who.int/docs/default-source/thailand/ncds/national-ncd-prevention-and-control-plan-2017-2021-eng.pdf.

3. Strategy and Planning Division. Public health statistics A.D. 2019 [Internet]. Nonthaburi: Office of the Permanent Secretary Ministry of Public Health; 2020 [cited 2020 May 2]. Available from: http://bps.moph.go.th/new_bps/sites/default/files/statistic62.pdf. [in Thai]

4. Pender NJ, Murdaugh CL, Parsons MA. Health promotion in nursing practice. 5th ed. New Jersey: Pearson Education; 2006.

5. Hacihasanoğlu R, Gözüm S. The effect of patient education and home monitoring on medication compliance, hypertension management, healthy lifestyle behaviours and BMI in a primary health care setting. J Clin Nurs 2011;20:692-705.

6. Sarrami-Foroushani P, Travaglia J, Debono D, Braithwaite J. Key concepts in consumer and community engagement: a scoping meta-review. BMC Health Serv Res 2014;14:250.

7. Intarakamhang U, Intarakamhang P. Health literacy scale and causal model of childhood overweight. J Res Health Sci 2017;17:e00368.

8. Brega AG, Ang A, Vega W, Jiang L, Beals J, Mitchell CM, et al. Mechanisms underlying the relationship between health literacy and glycemic control in American Indians and Alaska Natives. Patient Educ Couns 2012;88:61-8.

9. Hsu W, Chiang C, Yang S. The effect of individual factors on health behaviors among college students: the mediating effects of eHealth literacy. J Med Internet Res 2014;16:e287.

10. Department of Health Service Support. Combine learning management techniques to enhance health literacy for working age groups [Internet]. Nonthaburi: Health Education Division Ministry of Public Health; 2020 [cited: 2020 Oct 12]. Available from: http://www.hed.go.th/linkHed/408.

11. Intarakamhang U, Macaskill A. Multi-group causal model of health literacy and behaviors on family well-being among Thai adults at risk of Non-Communicable Diseases (NCDs). J Res Health Sci 2018;18:e00429.

12. Intarakamhang U, Khumthong T. Measurement development of health literacy and unwanted pregnancy prevention behavior for Thai female adolescents. J Public Health Nurs 2017;31:19-38.

13. Intarakamhang U, Sepsuk P, Suwanwong C, Intarakamhang P. Validity of environmental health literacy scale for homebound and bedbound elder of village health volunteer. J Med Assoc Thai 2020;103:1200-7.

14. Thanakwang K, Isaramalai SA, Hatthakit U. Development and psychometric testing of the active aging scale for Thai adults. Clin Interv Aging 2014;9:1211-21.

15. Arpanantikul M, Phuphaibul R, Khuwatsamrit K. Analysis and integration of sufficiency health indicators with the concept sufficiency economy philosophy. Thai J Nurs Counc [Internet] 2015 [cited 2021 Apr 30];30:41-57. Available from: https://he02.tci-thaijo.org/index.php/TJONC/article/view/34679/29370. [in Thai]

16. The National Economics and Social Development Board. Thailand Tenth National Economic and Social Development Plan (2007-2011) [Internet]. 2007 [cited 2020 Apr 3]. Available from: https://www.greengrowthknowledge.org/national-documents/thailand-tenth-national-economic-and-social-development-plan-2007-2011.

17. Arpanantikul M. Sufficient health. Thai J Nurs Counc [Internet]. 2018 [cited 2020 Apr 2];33:5-14. Available from: https://he02.tci-thaijo.org/index.php/TJONC/article/view/118342/102451. [in Thai]

18. Intarakamhang U, Kwanchuen Y. The development and application of the ABCDE-health literacy scale for Thai adults. Asian Biomed 2016;10:587-94.

19. Hair J, Black W, Babin B, Anderson R. Multivariate data analysis: A global perspective. Upper Saddle River, NJ: Pearson Education; 2010.

20. Sørensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z, et al. Health literacy and public health: a systematic review and integration of definitions and models. BMC Public Health 2012;12:80.

21. Osborne RH, Batterham RW, Elsworth GR, Hawkins M, Buchbinder R. The grounded psychometric development and initial validation of the Health Literacy Questionnaire (HLQ). BMC Public Health 2013;13:658.

22. George D, Mallery P. SPSS for windows step by step: A simple guide and reference. 11.0 update. 4th ed. Boston: Allyn & Bacon 2003.

23. Kline RB. Principles and practices of structural equation modeling. 2nd ed. New York, NY: Guilford Press; 2005.

24. Intarakamhang U. Ekpanyaskul C. Effect of positive psychology and cultural social norm on healthy behavior and family well-being by mediated by health literacy of family in the semi-urban community: Mixed methods. J Behav Sci 2018;24:1-21. [in Thai]

25. Ginggeaw S, Prasertsri N. The relationship between health literacy and health behaviors among older adults who have multi-morbidity. Nurs J Minist Public Health 2015;25:43-54. [in Thai]

26. Suka M, Odajima T, Okamoto M, Sumitani M, Igarashi A, Ishikawa H, et al. Relationship between health literacy, health information access, health behavior, and health status in Japanese people. Patient Educ Couns 2015;98:660-8.

27. Lee HY, Jin SW, Henning-Smith C, Lee J, Lee J. Role of health literacy in health-related information-seeking behavior online: Cross-sectional study. J Med Internet Res 2021;23:e14088.

28. Lee MK, Oh J. Health-related quality of life in older adults: Its association with health literacy, self-efficacy, social support, and health-promoting behavior. Healthcare (Basel) 2020;8:407.