ORIGINAL ARTICLE

Development and validation of the health literacy towards dietary supplements for beauty among Thai undergraduate students

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ABSTRACT

The aim of this cross-sectional study is to develop a measurement for Health Literacy towards Dietary Supplements for Beauty (HLDS) based on Sørensen's health literacy concept. The measurement is applied to assess the health literacy of undergraduate students. The Thai undergraduate students participating in the study are in years 1–4 at a university in Bangkok. Data collection is performed via a self-administered questionnaire. The following techniques are used in this study to investigate the construct validity of the measurement: confirmatory factor analysis, convergent validity, and discriminant validity. The statistical software Analysis of Moment Structures (AMOS) version 20 is used. To develop the HLDS measurement, 31 items are derived, divided into four dimensions: Access (9 items), Understand (10 items), Appraise (4 items), and Apply (7 items). The findings revealed high discrimination values ($r = 0.54\text{-}0.94$) with Cronbach's alpha coefficients ranging from good to very good ($\alpha = 0.81\text{-}0.91$). The measurement model of the HLDS fits well with the empirical data.

The convergent validity meets the acceptance criteria, while the discriminant validity exhibits values slightly higher than the criteria ($r=0.74\text{-}0.94$). Accordingly, the HLDS measurement is considered to be valid, reliable, and applicable for applying to undergraduate students. However, the addition of the social skill assessment is required to achieve a more comprehensive measurement. This skill is recognized within the process of HLDS development but with some limitations. Thus, it is recommended that this dimension be added for future study.

Key words:
health literacy; dietary supplements; tool

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INTRODUCTION

Over the past few years, the use of beauty-related dietary supplements has increased. Specifically, skin whitening and weight control products have become popular among undergraduate students, and its consumption is high among women.[1] The value placed on beauty is one of the factors influencing these students to practice beauty care which in turn promotes the expansion of dietary supplement businesses in Thailand.[2] Currently, some entrepreneurs apply for product approval while others violate the standards for the manufacturing procedures required by the Ministry of Public Health (MOPH). The latter group may add prohibited substances to their products, use advertising hype, and wrongfully apply the FDA registration number of other products.[3, 4] Consumers who neglect to evaluate or research the products before using them could be taking non-standard dietary supplements, resulting in a potentially adverse effect on their health. For example, it has been found that harmful ingredients damage not only the skin layers but also nervous and visual systems.

In extreme cases, these ingredients could cause acute heart and kidney failure, or even the death of consumers[5] as depicted in online news pictures.[6, 7]

The sale of counterfeit products is increasing. Although the government imposes penalties on entrepreneurs and sellers who violate the law, illegal dietary supplements have not yet been eradicated. Therefore, the consumer's ability to understand, analyze, inquire, and assess the product information plays a crucial role in the selection of a safe product. Taking adequate care of oneself and the constellation of such skills is termed health literacy (HL).

The World Health Organization (WHO) defines HL as the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand, and use information in ways that promote and maintain good health (WHO, 2009).[8] Moreover, Sørensen categorizes HL into four dimensions: (1) Access refers to the ability to seek, find, and obtain health information; (2) Understand refers to the ability to comprehend the health information accessed; (3) Appraise refers to the ability to interpret, filter, judge, and evaluate the health information accessed; and (4) Apply refers to the ability to communicate and use the information gained to decide to maintain and improve health.[9] According to existing evidence, insufficient HL appears to be associated with undesirable health outcomes. People with low HL used emergency care more frequently than those with high HL[10], including late vaccinations, and incorrect use of medication[11, 12]. Failure in self-management among patients has been identified as a contributory factor in the lack of HL. It can be inferred from the findings on the use of dietary supplements for beauty among undergraduate students that this group has high literacy toward them. Consequently, undergraduate students will be able to safely select dietary supplements for beauty.

Previous studies on HL emphasize the development of a generic HL measurement, subsequently leading to an increase in the development of context-based HL measurements such as the Health Literacy Scale for unwanted pregnancy prevention[13], Health Literacy Scale for the prevention of obesity[14], Health Literacy in Dentistry Scale[15], and Environmental Health Literacy Scale.[1, 6] Although the measurements have been developed for use in several contexts, some specifically involve dietary supplements for beauty. Furthermore, the investigation into the health literacy of undergraduate students

toward dietary supplements for beauty is an important issue and should be urgently assessed. The current study focuses on the population of undergraduate students majoring in Hotel Business and Mass Communication. This is because these students are preparing for a job market in which their appearance, such as body shape, skin, and personality, are viewed as important. Thus, this group of students is interested in using dietary supplements for beauty.

This study aims to develop Health Literacy towards Dietary Supplements Scale (HLDSS) based on Sørensen's (2012) health literacy concept which focuses on cognitive and social skills. This concept also involves the promotion of HL in all dimensions of the health systems, including healthcare, health promotion, and disease prevention. Protecting oneself from health fraud scams aligns with Sørensen's disease prevention concept. Therefore, it is appropriate to develop the HLDS measurement based on this concept. The development of this new measurement will greatly benefit the assessment of HLDS in undergraduate students. The results obtained will provide information for further planning of an intervention to promote HLDS among those interested in using dietary supplements for beauty.

METHODS

Study design and participants

This is an exploratory cross-sectional study. The participants consisted of Thai undergraduate students majoring in Hotel Business and Mass Communication, aged between 18 and 24 years, studying in years 1-4 at a Bangkok university. The sample size was determined based on the Jackson (2003) principle[17], the N:q rule. The minimum sample size is the ratio of cases (N) to the number of model parameters requiring statistical estimates (q). The sample size-to-parameter ratio of 10:1 was adopted; 36 parameters required statistical estimates, yielding 360 cases. Moreover, additional participants (15% of the original sample) were included to avoid error or loss of samples, subsequently yielding 420 cases.

Inclusion Criteria: (1) Thai university students majoring in Hotel Business and Mass Communication studying in years 1–4, interested in dietary supplements for beauty, particularly skincare and weight control products. (2) Students aged between 18 and 24 years. Exclusion Criteria: (1) Students not interested in dietary supplements for beauty. (2) Students who have partially completed HLDS measurements.

Ethical considerations

This study was approved by the Committee for Research Ethics (Social Sciences) of Mahidol University, MU-SSIRB No. 2019/261 (B1) on October 14, 2019.

Data collection

Data were collected from November 2019 to February 2020. Self-administered questionnaires were used to collect data from classes for which the university had given authorization. Prior to data collection, the researcher clarified the participants' rights to the students. Students volunteering to participate in this study were given informed consent forms. The questionnaires were subsequently distributed to the volunteer participants. Any student participant who had queries about the questionnaire could ask for further clarification from the researcher. The questionnaires were collected by the researcher upon completion by the participants.

Instruments

This study is divided into two sections. Section 1: Personal Information includes questions on gender, age, educational level, and experience of dietary

supplements for beauty. Participants were asked to provide answers to nine multiple-choice questions and fill in the blanks. Section 2: Health Literacy toward Dietary Supplements for Beauty (HLDS) consisted of 36 items, incorporating four dimensions. A 5-point rating scale was applied, ranging from 1 "cannot do" to 5 "very easy to do." Participants with higher scores were interpreted as having higher health literacy toward dietary supplements for beauty than those with lower scores.

Example questions in each dimension: (1) Access "I am able to access the government websites to search for information on dietary supplements"; (2) Understand "I understand how to check the FDA number for dietary supplements"; (3) Appraise "I am able to weigh up the pros and cons of dietary supplements before making a decision to buy/trust"; and (4) Apply
"I am able to decide when to stop taking dietary supplements."

The development of HLDSS involves five stages:

Stage 1: The researchers reviewed the literature related to dietary supplements and then categorized the content on the safe use of dietary supplements for beauty into two domains: knowledge of the nutrients used in products and how to verify dietary supplements. Similarly, according to Sørensen's concept, the HL domains were obtained. The disease prevention domain of HLS-EU-Q47 (i.e., 15 items and four dimensions, namely Access, Understand, Appraise, and Apply) was used as a guideline for the development of the measurement used in this study.

Stage 2: The researchers developed the HLDS operational definitions by integrating the four HL dimensions suggested by Sørensen (i.e., Access, Understand, Appraise, and Apply) with knowledge on the safe use of dietary supplements for beauty (i.e., knowledge of the nutrients used in products and how to verify dietary supplements). Finally, this study defined HLDS as the ability or skill of students to access, understand, and know about the methods for searching and accessing news and information on health, including the ability to evaluate information and apply it to dietary supplements to safely manage their own appearance. Thus, the information on dietary supplements includes: (1) knowledge of the nutrients used in dietary supplements; and (2) knowledge on how to evaluate dietary supplements. The HLDS process was divided into the following four components; (1) Access: The ability of students to search for and access accurate and reliable information about dietary supplements for beauty through various channels. Obtaining information on dietary supplements, including the benefits, harm/precautions, and appropriate practices on the usage of products and how to verify the safety of dietary supplements. (2) Understand: The ability of students to read and comprehend information sets related to dietary supplements for beauty such as the benefits, arm/precautions, and appropriate practices in the use of products and how to verify the safety of dietary supplements. (3) Appraise: The ability of students to filter, sort, and compare the advantages and disadvantages of information sets of dietary supplements for beauty such as benefits, harms/precautions, and appropriate practices in the use of products and how to verify the safety of dietary supplements. (4) Apply: The ability of students to communicate, ask questions, and consult knowledgeable people/experts on dietary supplements in order to make decisions, apply information, and make choices appropriate for the person intending to use dietary supplements for beauty. The ability of students to apply the information set on dietary supplements covering the benefits, harm/precautions, and appropriate practices on the use of products and verify the safety of dietary supplements.

Stage 3: After deriving the operational definitions, the 39 items were constructed for each HL domain: Access = 11, Understand = 11, Appraise = 4, and Apply = 13.

Stage 4: To assess content validity, the researcher invited three experts in four areas (i.e., health literacy, dietary supplements and drugs, public health experts, and psychometrics) to review the 39 items of HLDSS for content validity, appropriateness, and clarity. The index of item-objective congruence (IOC) was constructed under the assessment criteria of -1, 0, and 1. An IOC of 0.60–1.00 was yielded, indicating that all items were applicable.

Stage 5: The researcher tested the measurement with 100 pilot undergraduate students. The reliability and discrimination of HLDSS were tested, and items with reliability values lower than 0.7 and discrimination values lower than 0.4 were then removed. Finally, 36 items met the criteria: Access = 11, Understand = 10, Appraise = 4, and Apply = 11. All items were positive statements with a 5-point rating scale, ranging from "very easy to do" (5) to "cannot do" (1).

Data analysis

1) Descriptive statistics such as frequency, percentage, average, and standard deviation were used to describe the general characteristics of the study participants.

2) Validating the measurement based on classical theory: (1) Discrimination was considered using corrected item-total correlation (CITC) to assess how well the items could discriminate between individuals with high total scores and those with low scores. The CITC values were required to be higher than or equal to 0.30. (2) Reliability testing was conducted by measuring internal consistency using Cronbach's alpha coefficients. Values higher than or equal to 0.7 were considered to be acceptable.[18]

3) Confirmatory factor analysis (CFA) was conducted to evaluate construct validity. The criteria used to evaluate consistency between the hypothesized models and empirical data consisted of absolute fit indices ($\chi 2/df \leq 3$, SRMR < .08 and RMSEA < .07), incremental fit indices (CFI and TLI $\geq$ 0.90) [19], and model comparison indices (AIC, BIC; the model with the smallest values is preferred).[20]

Convergent validity was performed to assess whether the items measure similar constructs: (1) Factor loading of each observed variable was required to be equal to 0.3 or greater[21, 22]; (2) The average variance extraction (AVE) of each latent variable was required to be 0.5 or greater; and (3) The construct reliability (CR) was required to be equal to 0.7 or greater. Discriminant validity was performed to assess whether each HLDS construct was discriminative, using the following criteria: Correlations between factors in HLDS lower than 0.90 and an AVE higher than the square of correlation (r^2) between constructs. [18, 19]

This study used SPSS Statistics version 18.0 software to analyze the descriptive statistics and those based on classical test theory. In addition, the Analysis of Moment Structures (AMOS) version 20 software was used to analyze construct validity.

RESULTS

Of the total distributed 420 questionnaires, 400 (95.23%) were completed and deemed suitable for analysis. The responses to the questionnaires revealed that 41.0% of the 400 students were in their third year, with more than 70.0% being females aged between 20 and 21. The average age was 20.14 ± 1.10, while 29.3% of students were aged between 18 and 19 and 7.3% between 22 to 23. Of the 400 student participants, 34.0% had incomes ranging from 5,000 to 9,999 baht per month, with the average

being 7,426.01 ± 4,846 baht. Regarding their experience in the use of dietary supplements for beauty, approximately 35.3% of the student participants had previously used dietary supplements for beauty but no longer used it; 57.5% used skin whitening products, and 42.5% used weight control products. 28.6% of them bought products from a department store/shopping mall. As for the purchasing decision, the majority of participants (51.5%) decided on their own, while 16.2% were influenced by friends. 17.3% of them spent approximately 1,000–1,999 baht per month on the products. On average, they spent 867.02 ± 975.12 baht monthly.

HLDSS validation and reliability

According to the analyses based on classical test theory, HLDSS discrimination ranged from 0.54–0.94, indicating a very good level. Similarly, the Cronbach's alpha coefficients obtained were at a high level, while reliability on the whole scale was 0.95, and on each factor 0.89, 0.91, 0.86, and 0.87, respectively.

For CFA, the model did not fit well with the empirical data, with only one index in the primary model meeting the criteria. Thus, the researcher revised the model by removing six items with small factor loadings ($\lambda < 0.59$) (i.e., Hl7, Hl29, Hl31, Hl32, Hl33, and Hl34) and allowed the measurement errors to be correlated (Figure 2). After the revision, the model fitted well with the empirical data, and acceptable model fit statistics were obtained, namely $\chi 2/df$ (2.64), RMSEA (0.06), SRMR (0.03), CFI (0.91), and TLI (0.90). Moreover, the AIC and BIC of the final model showed smaller values or achieved acceptable model fit indices; the better-fit model compared with the primary model was achieved. Factor loadings obtained in the final model ranged between 0.37 and 0.82, with item Hl24 being the highest and Hl35 the lowest (Table 1). The range for the minority to majority of R^2 values indicated a 29–53% variance among Hl items.

In the evaluation of construct validity for the revised model, the convergent validity in the final model reported an AVE higher than 0.5 for Understand, Appraise, and Apply domains, with factor loadings of all items being higher than 0.3 while the CR values of all domains were higher than 0.7. Thus, almost all HLDSS domains exhibited convergent validity. As for discriminant validity, correlations between factors ranged between 0.74 and 0.94, slightly higher than the criteria. Also, four constructs had an AVE lower than the r^2 estimates, failing to support the criteria r^2Access. Understand = 0.93, r^2Access. Appraise = 0.72, r^2Access. Apply = 0.78, r^2 Understand. Appraise = 0.83, r^2 Understand. Appraise = 0.84 and r^2 Appraise. Apply = 0.90 (Figure 2 and Table 1).

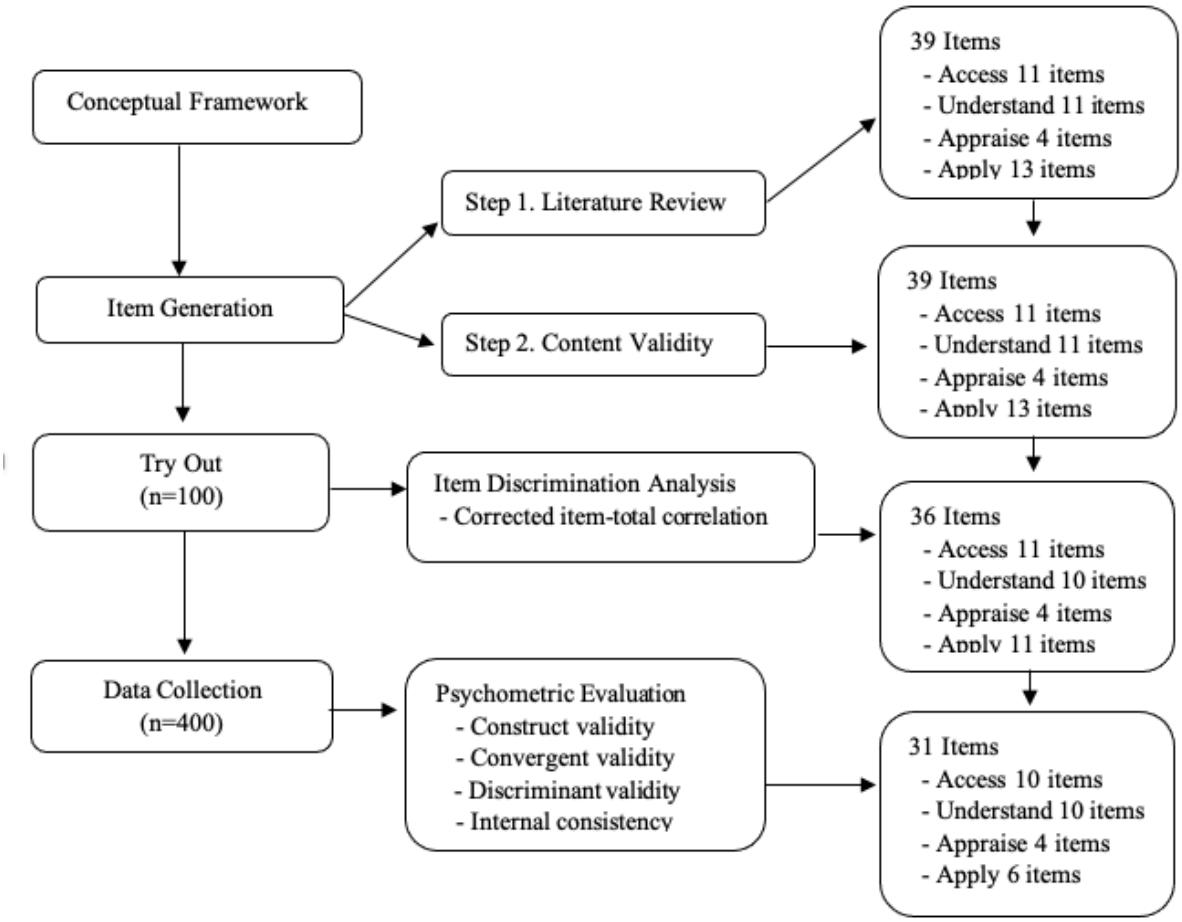

Figure 1. Flowchart showing the development and validation of health literacy toward dietary supplements for beauty.

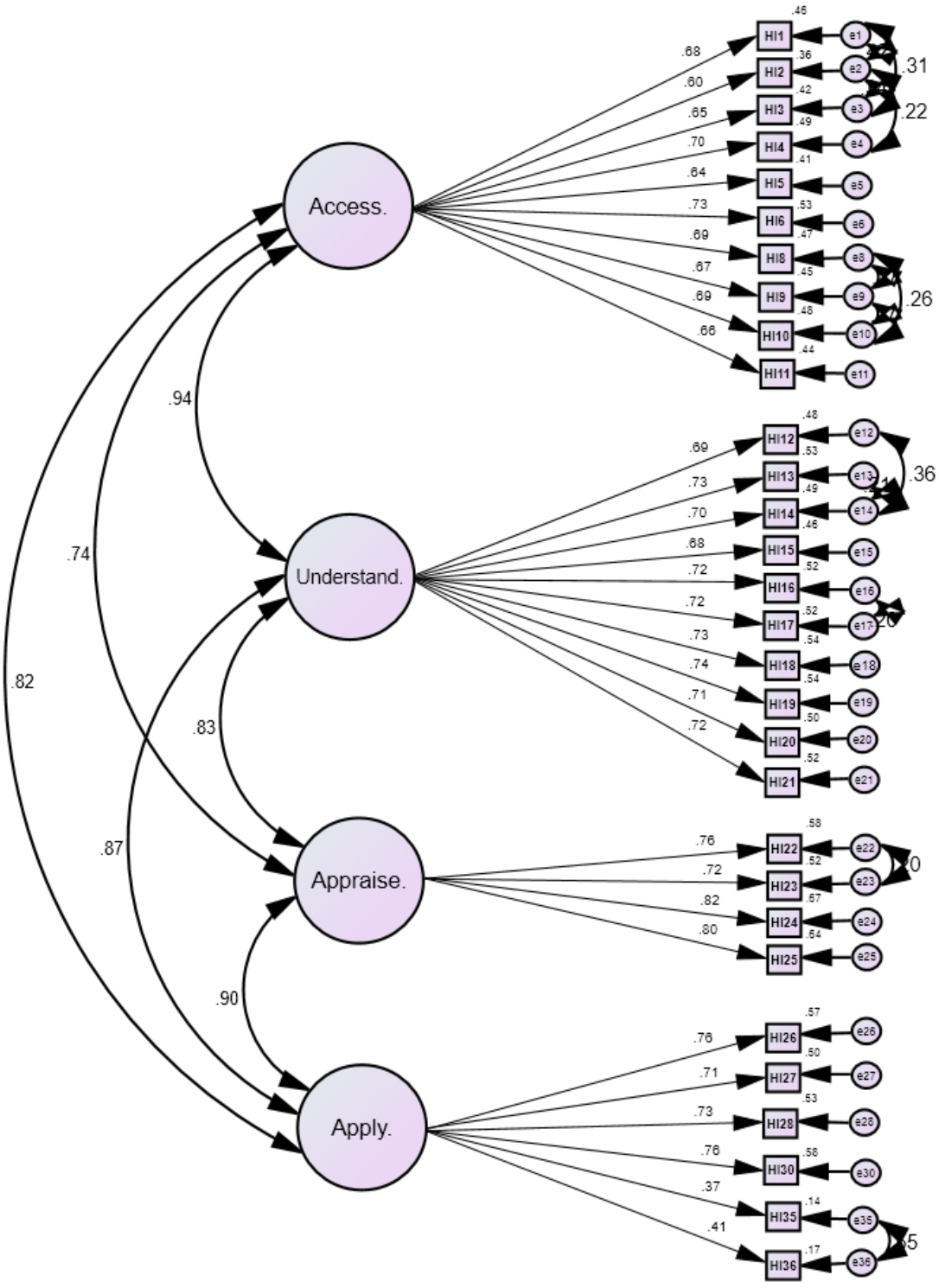

Figure 2. Final model of health literacy towards dietary supplements for beauty scale

Table 1 Validation, Reliability, and Fit Indices of the health literacy towards dietary supplements for beauty scale (N = 400).

Items	Confirmatory item factor analysis				Classical test theory	
	Primary model		Final model		Item discrimination (CITC)	Alpha if item deleted
	Loadings[a]	R^2	Loadings[a]	R^2		
Access	: AVE = 0.45, CR = 0.89				Cronbach's alpha = 0.89	
HI1	0.70	0.03	0.68	0.32	0.68	0.88
HI2	0.65	0.34	0.61	0.37	0.62	0.89
HI3	0.68	0.37	0.65	0.39	0.63	0.88
HI4	0.72	0.43	0.71	0.45	0.68	0.89
HI5	0.65	0.42	0.64	0.42	0.61	0.88
HI6	0.75	0.44	0.73	0.47	0.68	0.88
HI7	0.39	0.38	-	-	-	-
HI8	0.71	0.44	0.70	0.49	0.68	0.88
HI9	0.71	0.46	0.68	0.50	0.67	0.88
HI10	0.72	0.44	0.70	0.48	0.67	0.88
HI11	0.62	0.59	0.65	0.53	0.54	0.89
Understand	: AVE = 0.51, CR = 0.91				Cronbach's alpha = 0.91	
HI12	0.71	0.31	0.69	0.33	0.68	0.90
HI13	0.74	0.40	0.73	0.41	0.69	0.90
HI14	0.73	0.29	0.70	0.31	0.70	0.90
HI15	0.68	0.34	0.69	0.34	0.62	0.90
HI16	0.73	0.42	0.72	0.44	0.71	0.90
HI17	0.73	0.44	0.72	0.45	0.71	0.90
HI18	0.72	0.46	0.73	0.45	0.68	0.90
HI19	0.71	0.39	0.71	0.39	0.70	0.90
HI20	0.71	0.32	0.71	0.31	0.61	0.90
HI21	0.72	0.37	0.73	0.36	0.68	0.90
Appraise	: AVE = 0.60, CR =0.85				Cronbach's alpha = 0.86	
HI22	0.78	0.28	0.78	0.29	0.72	0.82
HI23	0.75	0.30	0.75	0.33	0.71	0.83
HI24	0.82	0.26	0.81	0.26	0.72	0.82
HI25	0.79	0.23	0.80	0.23	0.70	0.83
Apply	: AVE = 0.41, CR = 0.79				Cronbach's alpha = 0.81	
HI26	0.73	0.32	0.75	0.30	0.59	0.77
HI27	0.72	0.31	0.74	0.26	0.61	0.77
HI28	0.73	0.34	0.73	0.34	0.63	0.76
HI29	0.70	0.38	-	-	-	-
HI30	0.77	0.35	0.76	0.36	0.64	0.76
HI31	0.72	0.35	-	-	-	-
HI32	0.54	0.56	-	-	-	-
HI33	0.43	0.56	-	-	-	-
HI34	0.38	0.53	-	-	-	-
HI35	0.44	0.49	0.37	0.57	0.45	0.80

Items	Confirmatory item factor analysis				Classical test theory	
	Primary model		Final model		Item discrimination (CITC)	Alpha if item deleted
	Loadings[a]	R^2	Loadings[a]	R^2		
HI36	0.48	0.23	0.41	0.54	0.49	0.79
Correlation between factors			Primary model	Final model	Cronbach's alpha = 0.95	
Accesses and Understand			0.90	0.94		
Accesses and Appraise			0.72	0.74		
Accesses and Apply			0.77	0.82		
Understand and Appraise			0.81	0.83		
Understand and Apply			0.84	0.87		
Appraise and Apply			0.85	0.90		

Note. [a] *= loadings of all items were significant at $p < .001$; $\chi 2/df$ = the normed chi-square; AIC; Akaike's information criteria; AVE = average variance extracted; BIC = Bayesian information criteria; CFI = comparative fit index; CITC = corrected item-total correlation; CR = composite reliability; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; TLI = TuckereLewis index.*

DISCUSSION

According to the analysis of HLDSS, the mean scores of all items were at a moderate level. This may be due to all participants having completed upper-secondary school, with more than 60% reaching the age of majority. It is likely that these participants possessed good decision-making skills and background knowledge to facilitate the acquisition of basic information on dietary supplements. In addition, 57.5% of the participants have previous experience in using dietary supplements, thus they have background knowledge relating to the use of dietary supplements for beauty. Such results are consistent with the HL process of change in that the health experience of individuals has an impact on learning processes and could improve their HL.

The HLDSS used in this study emphasizes the acquisition of knowledge on the nutrients used in products and how to verify dietary supplements to help students wisely select dietary supplements for beauty. Reliability and construct validity indicate that the scale used in this study is applicable for measuring HLDS for beauty. Based on the suggestions made by Kline (2015)[18], the Cronbach's alpha coefficients of the HLDSS ranged between good and very good. For discrimination, all corrected item-total correlation coefficients are higher than 3.023, indicating that the HLDSS can discriminate between a group with high scores and low ones.

Moreover, the factor loading of each observed variable in the revised model was greater than 0.35, with all indices meeting the acceptable criteria, and the CR values being higher than the acceptable criteria.[18, 19]

Although HLDSS exhibits acceptable convergent validity, the discriminant validity assessment shows an AVE lower than 0.5 in the Access and Apply domains, while it was higher than the square of correlation (r^2) between constructs. Accordingly, these results indicated that HLDSS domains might not be clearly discriminated from each other: Access is not clearly discriminated from Understand, while Appraise is not clearly

discriminated from Apply. This might be due to HL being an internal process with the stages of development occurring in sequence. To acquire HLDS, individuals must use their learning skills in a step-by-step manner, starting with seeking information and accessing sources of health information. This is an important step because individuals need to firstly obtain health content and then progress to the process of understanding. In this step, individuals must read and receive the health information content and then reflect on or identify the facts. Once information extraction has been completed, information processing or selecting beneficial and suitable information can be employed to promote one's own health. Therefore, the HLDSS domains, namely Access, Understand, Appraise, and Apply are correlated, which might be the reason for the AVE and correlations being slightly higher than normal in this study.

Although the statistical values obtained show correlations between HLDSS domains, this study analyzes Access, Understand, Appraise, and Apply independently. However, Sørensen defines the domains of health literacy differently from this study, which aims to validate health literacy theory. Moreover, several previous studies have applied Sørensen's concept to the development of health literacy measurements. For example, a European researcher developed the European Health Literacy Survey Questionnaire to measure HL in the public sector.[9] Intarakamhang, Sepsuk, Suwanwong, and Intarakamhang (2020) adopted the concept of Access, Understand, Appraise, and Apply domains in the development of Environmental Health Literacy Scales.[16] The reliability and validity of these two measurements are similar to the HLDS scale. Accordingly, this confirms that the measurement developed on the basis of Sørensen's concept is suitable to be applied to the HLDSS for beauty in the context of undergraduate students.

RECOMMENDATIONS

This study on the concept of health literacy to explain the usage of beauty supplements may have limitations in that it only extracted the skills relating to the acquisition and understanding of information. It is therefore not possible to recognize the importance of social skills, such as asking for health information and interacting with specialists to discuss, negotiate, and exchange health data. Suggestions from specialists would not only help to screen the accuracy of health information from different sources but also enable the consumer to apply HL to take care of themselves in an appropriate way. However, the importance of the aforementioned factors has not been clearly assessed in this study. Therefore, researchers applying the concept of HL in the future may need to go beyond the interpretation of cognitive skills to include social skills.

Despite the few limitations, the measurement development is found to be valid and acceptable. Thus, it is recommended that educational institutions or related organizations apply the measurement to evaluate the HLDS of students or those interested in using dietary supplements. The information obtained from the measurements would be useful in monitoring and promoting HL in dietary supplements among these groups as well as reducing the risks and harmful effects resulting from the use of improper supplements.

CONFLICTS OF INTEREST

The authors declared no conflict of interest.

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