Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Psychometric Validation of the Health Literacy School-Aged Children (HLSAC) Questionnaire among Malaysian Adolescents

Zanariah Zaini
National University of Malaysia
Masitah Ahmad
National Institute of Health
Norrafizah Jaafar
National Institute of Health
Mohammad Zabri Johari
National Institute of Health
Noorhayati Kassim
National Institute of Health
Mohd Azahadi Omar
National Institute of Health
Arimi Fitri Mat Ludin
National University of Malaysia
Ruzita Abd Talib
National University of Malaysia
Ismarulyusda Ishak
ismarul@ukm.edu.my

National University of Malaysia

Research Article

Keywords: HLSAC, validation, health literacy, adolescents, Malaysia

Posted Date: April 23rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9067396/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Health literacy (HL) plays an important role in shaping adolescent health, particularly during a developmental stage characterized by increasing autonomy and active engagement with health information. Nevertheless, Malaysia has limited validated tools specifically designed to assess HL among adolescents. The Health Literacy for School-Aged Children (HLSAC) instrument is a theory-driven, capability-based measure developed for school contexts and extensively applied in international research. Therefore, this study aimed to translate and culturally adapt the HLSAC questionnaire and to assess its psychometric properties among Malaysian adolescents.

Methods

This study employed a cross-sectional design, following internationally recognized guidelines for cross-cultural instrument adaptation. The research team translated the HLSAC questionnaire into Malay using a forward–backward translation procedure and subsequently evaluated translation validity through expert review and assessed face validity among adolescents. The study quantified content and face validity using the Content Validity Index (CVI), Content Validity Ratio (CVR), and Face Validity Index (FVI). Construct validity was examined using exploratory and confirmatory factor analyses (EFAs and CFAs) based on pilot data from 128 adolescents aged 13–16 years recruited from school-based settings in Selangor, Malaysia. The study assessed internal consistency reliability using Cronbach's alpha and McDonald's omega.

Results

The HLSAC Malay version demonstrated excellent content validity (S-CVI/Ave = 0.99) and strong face validity (S-FVI/Ave > 0.97). EFA supported a unidimensional factor structure, with all items showing acceptable factor loadings (0.46–0.69). CFA confirmed good model fit (CFI = 0.945; TLI = 0.930; RMSEA = 0.055; SRMR = 0.058). The scale demonstrated good internal consistency (Cronbach's $\alpha = 0.806$; McDonald's $\omega = 0.809$).

Conclusions

The Malay version of the HLSAC is a valid and reliable instrument for assessing health literacy among Malaysian adolescents. Its suitability for school-based administration

supports its application in adolescent health research, population monitoring, and health promotion initiatives, while facilitating cross-national comparisons.

Background

Researchers increasingly recognize health literacy (HL) as a key determinant of health across the life course, particularly during adolescence, a period marked by rapid cognitive development, greater autonomy, and increased engagement with health information. Health literacy (HL) is conceptualized not as mere knowledge accumulation but as a dynamic capability that enables individuals to acquire, process, evaluate, and apply health-related information to make decisions and adopt health-promoting behaviours. [1]. Within this framework, adolescents actively interpret and negotiate health information within complex social and cultural environments shaped by schools, peers, family influences, and digital media exposure [2–4]. Accordingly, researchers increasingly view adolescent HL as an adaptive competence closely linked to agency, self-awareness, and critical engagement rather than as a purely functional skill [5].

Adolescence represents a critical window for HL development because health-related behaviours established during this period, such as dietary practices [6], physical activity [7], and preventive behaviours [8]. Often persist into adulthood and exert long-term public health consequences [9–11]. Early preventive efforts are therefore essential. HL-based interventions have gained prominence as a strategic approach to strengthen adolescents' capacity to make informed decisions and to adopt and sustain health-promoting behaviours across the life course [12]. By enhancing cognitive and critical competencies during this formative stage, such interventions may generate lasting benefits that extend into adulthood.

Schools provide an especially appropriate context for implementing and evaluating HL interventions. They offer structured and equitable environments that support learning, social interaction, and the development of transferable life skills. Effective school-based HL initiatives must therefore adopt a comprehensive approach that addresses not only individual competencies but also the broader school environment, curriculum, and family or community engagement [13]. In parallel, systematic monitoring and evaluation are necessary to assess changes in HL competencies and to determine whether improvements translate into meaningful behavioural outcomes in real-world educational settings [14]. Robust, developmentally appropriate measurement tools are thus central to advancing the evidence base for adolescent HL research and informing policy-relevant decision-making.

In Malaysia, HL research has historically focused on adults, supported by validated instruments such as the HLS-M-Q18, which is used in national surveys [15]. In contrast, adolescent-specific measurement remains limited [16]. However, the recent validation of

the Malaysian Measurement of Health Literacy Among Adolescents Questionnaire (MyMOHLAA-Q) represents important progress [17]. Ongoing methodological challenges highlight the need for complementary instruments grounded in strong theoretical and cross-cultural foundations.

The Health Literacy for School-Aged Children (HLSAC) instrument offers such a framework, aligning conceptually with school-based adolescent research and demonstrating international applicability [18, 19]. Although English is widely spoken as a second language in Malaysia, Malay is the national language and the primary medium of instruction in national schools. A validated Malay version of the HLSAC is therefore essential to ensure semantic comprehension across diverse socioeconomic groups and rural populations, where English proficiency may vary. Translating and validating the HLSAC within the Malaysian context thus represents a necessary step to strengthen adolescent HL assessment and enableeaningful cross-cultural comparisons [20, 21].

Study aims

This study aims to validate the HLSAC instrument for Malaysian adolescents. By validating a capability-based, school-oriented HL measure within the Malaysian context, this study seeks to strengthen adolescent HL assessment, support cross-cultural comparability, and inform school-based health promotion and public health research.

Methods

This study employed a systematic, sequential methodological approach to translate, culturally adapt, and validate the HLSAC questionnaire for Malaysian adolescents. The researchers began with a forward–backward translation and cultural adaptation process guided by established recommendations to ensure semantic, conceptual, and cultural equivalence between the original and Malay versions [21, 22]. They subsequently evaluated translation validity through expert review and adolescent cognitive assessment. The team then assessed content validity and face validity to confirm the relevance, clarity, and appropriateness of the items for the target population. Following these validation stages, the researchers conducted a pilot pretest to examine item performance and internal consistency. Finally, they evaluated construct validity using an exploratory factor analysis (EFA) to identify the underlying factor structure, followed by a confirmatory factor analysis (CFA) to test the hypothesized measurement model. Figure 1 summarises the sequential methodological procedures undertaken in this study.

Study design

The current study used a cross-sectional design to translate, culturally adapt, and validate the HLSAC questionnaire among Malaysian adolescents. The participants included adolescents aged 13–16 years who could read and communicate in Malay and English, were in good physical health on the day of data collection, and agreed to participate. The research team selected one secondary school using purposive sampling, obtained approval from the Ministry of Education, and obtained institutional consent from the school administration. Within the selected school, the team randomly selected one class from each grade level (Forms 1–4), which represented 13–16 years each, and all students in the selected classes were eligible to participate in the study.

The research team conducted data collection after receiving formal permission from the school principal. Participants completed the questionnaire independently in approximately 15–30 minutes, depending on their class level. The research team offered minimal guidance and provided clarification of instructions only when required, ensuring that responses reflected participants' own understanding. The team obtained written informed consent from teachers, who served as legal guardians, and assent from students. Participation was voluntary, and the team ensured confidentiality and anonymity by using coded identifiers and restricting access to the research team.

A total of 128 adolescents participated, providing an adequate sample for exploratory and preliminary confirmatory factor analyses in line with methodological recommendations [23, 24].

The Instrument

The HLSAC questionnaire is a self-administered instrument developed for school settings and originally validated among adolescents aged 13–15 years in Finland [18]. Conceptually, HLSAC encompasses five domains: theoretical knowledge, practical knowledge, critical thinking, self-awareness, and citizenship, each represented by two items [18]. Although these domains reflect the theoretical framework underpinning the instrument, HLSAC is operationalized and scored as a single global measure of subjective health literacy. Previous empirical studies have similarly supported a unidimensional factor structure despite its multidimensional conceptual basis.

The scale comprises 10 items rated on a four-point Likert scale ranging from 1 ("not at all true") to 4 ("absolutely true"), with higher total scores (range 10–40) indicating greater perceived health literacy. Scores are categorized as low (10–25), moderate (26–35), and high (36–40). The original validation study reported excellent internal consistency (Cronbach's $\alpha = 0.93$) [25]. The research team obtained formal permission from the original developer to translate and adapt the instrument for use in the Malaysian context.

Translation and Cultural Adaptation

The researchers conducted a systematic translation and cultural adaptation of the HLSAC questionnaire to ensure conceptual equivalence, cultural relevance, and clarity for Malaysian adolescents. In accordance with established cross-cultural adaptation guidelines [26–28], two bilingual experts independently performed forward translations, while two English-language experts conducted backward translations. The research team synthesized these versions into a preliminary Malay version (HLSAC_M0).

Adolescents aged 12–16 years participated in face validity assessment through focus group discussions, which informed item refinement and produced an improved version (HLSAC_M0.1). Subsequently, a multidisciplinary panel of six experts independently evaluated translation validity using a seven-point rating scale to assess language and meaning equivalence. Following established cutoff criteria [28], the researchers retranslated unacceptable items (mean > 2.5) and refined problematic items (mean = 1.6–2.5), while items with a mean score of 1.0 indicated optimal equivalence. After incorporating expert feedback, the team finalized the Malay version (HLSAC_M0.2).

Table 1
The expert panel involved in translation and content validation

Expert role	Translation validation (n = 6)	Content validation (n = 9)	Years of professional experience (range)
Health education officers	2	3	10–20
Nutrition officer	1	1	10
Instrument development specialists	1	2	10–20
Educator	1	1	5
Academic researchers (public health/health behaviour)	1	2	15–20

Validity

Content Validity

The Content Validity Ratio (CVR) and the Content Validity Index (CVI), based on independent ratings from nine experts with at least 5 years of professional experience, representing health education, nutrition, instrument development, education, and

academia. This multidisciplinary composition ensured robust judgment of item relevance, clarity, and construct representation. The team calculated the CVR based on item essentiality and subsequently evaluated the CVI at both the item (I-CVI) and scale (S-CVI/Ave) levels using relevance and clarity ratings, following Lawshe's method (Ayre & Scally, 2014; Lawshe, 1975). Consistent with established criteria, the researchers retained items with CVR and I-CVI values ≥ 0.78, while an S-CVI/Ave ≥ 0.90 indicated excellent overall content validity [29].

Face validity

Validation of face validity using quantitative and qualitative approaches to ensure the adapted HLSAC questionnaire was clear, culturally appropriate, and meaningful to adolescents. Quantitatively, adolescents rated item clarity and comprehensibility on a four-point scale, and the team calculated the Face Validity Index (FVI) at both the item (I-FVI) and scale (S-FVI/Ave) levels. Items and the overall scale demonstrated acceptable face validity when I-FVI and S-FVI/Ave values were ≥ 0.80, while items below this threshold underwent further review and refinement [30]. Qualitatively, the team conducted cognitive interviews with 10 adolescents to examine item wording, sentence structure, and terminology. Participant feedback complemented the quantitative FVI findings and informed item revisions, ensuring that the questionnaire reflected adolescents' everyday language and comprehension.

Exploratory Factor Analysis (EFA)

The researchers conducted anEFA to examine the underlying factor structure of the adapted instrument in the Malaysian adolescent context. Before factor extraction, the researchers assessed data suitability using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy, with values ≥ 0.70 indicating acceptable adequacy, and Bartlett's test of sphericity, with $p < 0.05$ confirming sufficient inter-item correlations. Following best-practice recommendations for exploratory factor analysis [23, 31], the analysis extracted factors using principal axis factoring and applied oblique rotation to allow for correlations among latent constructs. To guide factor retention, the researchers considered eigenvalues greater than 1.0, inspection of the scree plot, and theoretical interpretability. The researchers retained items with factor loadings ≥ 0.40 and considered items with loadings below this threshold or with substantial cross-loadings (≥ 0.30 on multiple factors) for removal or revision, in line with established psychometric recommendations [23, 24].

Confirmatory Factor Analysis (CFA)

The researchers examined construct validity using CFA to test the theoretical structure of the HLSAC. They evaluated model fit using multiple goodness-of-fit indices, including the chi-square to degrees of freedom ratio (χ^2/df), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) with 90% confidence intervals, and the Standardised Root Mean Square Residual (SRMR). The researchers interpreted values of $\chi^2/df < 3.0$, CFI and TLI ≥ 0.90, RMSEA ≤ 0.08, and SRMR ≤ 0.08 as indicating acceptable model fit [23, 24].

The researchers assessed convergent validity using standardized factor loadings, composite reliability (CR), and average variance extracted (AVE). They considered CR values ≥ 0.70 and AVE values ≥ 0.50 as indicative of adequate convergent validity [23, 24, 32]. The team evaluated internal consistency reliability using Cronbach's alpha, with values of 0.70 or higher considered acceptable [33].

Reliability Analysis

The research team assessed internal consistency using Cronbach's alpha and McDonald's omega. Values of 0.70 or greater indicated satisfactory reliability. The team reported omega alongside alpha because omega provides a more accurate estimate of internal consistency when item loadings are unequal and does not rely on the assumption of tau-equivalence, thereby offering a more robust reliability assessment [23, 34].

Data analysis

The researchers conducted all statistical analyses using JASP online software (version 0.95.4) [35] and set the two-tailed significance level at $p < 0.05$ for all tests. Analysis of translation, content, and face validation is conducted manually in Microsoft Excel.

Results

A total of 128 adolescents participated in the pilot study and contributed to the preliminary analyses. The participants had a mean age of 14.35 years (SD = 1.07), with ages ranging from 13 to 16 years. Male adolescents comprised 54.7% of the sample (n = 70), and the dataset contained minimal missing gender data (0.8%). Indian adolescents represented the largest ethnic group in the sample (46.9%). The participants achieved a mean overall health literacy score of 31.01 (SD = 4.87). Based on established HLSAC cutoff values, most adolescents demonstrated moderate health literacy (68.0%), with 20.3% demonstrating high and 11.7% demonstrating low. The demographic characteristics and distribution of health literacy in the pilot sample provided an appropriate foundation for the preliminary psychometric evaluation of the adapted HLSAC questionnaire.

Table 2 . *Sociodemographic Characteristics of the Adolescents (n=128)*

Characteristic	n	%
Gender		
Male	70	54.7
Female	57	44.5
Missing	1	0.8
Age		
13 years old	35	27.4
14 years old	33	25.8
15 years old	39	30.5
16 years old	21	16.4
Race		
Malay	43	33.6
Chinese	21	16.4
Indian	60	46.9
Others	4	3.1
Health literacy		
Lower	15	11.7
Moderate	87	68.0
High	26	20.3

Translation Validation

The research team evaluated translation validity through cognitive assessment with adolescents and expert review. During cognitive assessment, adolescents generally understood most items in the preliminary Malay version (HLSAC_M0), but identified several items as lengthy, abstract, or linguistically ambiguous. Based on this feedback, the researchers refined item wording, simplified sentence structures, and improved cultural appropriateness, resulting in an improved version (HLSAC_M0.1) (Additional file 1).

Subsequently, six experts independently assessed HLSAC_M0.1 for language and meaning equivalence using a seven-point scale. Most items demonstrated high equivalence, with mean scores close to 1.0. Four items showed moderate ambiguity (mean = 1.6–2.6) and

were revised accordingly, while no item required full retranslation. A second round of expert review confirmed substantial improvement, with all revised items achieving mean equivalence scores near 1.0. These findings indicate that the final Malay version achieved satisfactory semantic and conceptual equivalence and was suitable for subsequent psychometric validation (Additional file 1).

Content Validity

Nine experts rated the items to determine the CVI and CVR. The ratings indicated high item relevance, with I-CVI values ranging from 0.90 to 1.00; nine items achieved unanimous agreement, while one item exceeded the minimum acceptable threshold. Scale-level indices indicated excellent overall validity (S-CVI/Ave = 0.99; S-CVI/UA = 0.90). Most items demonstrated perfect essentiality (CVR = 1.00), while one item met the minimum retention criterion (CVR = 0.78), yielding a high average CVR (S-CVR/Ave = 0.88). Overall, these findings confirm satisfactory to excellent content validity, and the team retained all items for subsequent face validity and psychometric evaluation (Additional file 2).

Face Validity

Following satisfactory content validity, the research team assessed face validity of the adapted HLSAC questionnaire using quantitative ratings and cognitive interviews with ten adolescents. Item-level face validity indices (I-FVI) ranged from 0.80 to 1.00 for clarity and 0.90 to 1.00 for comprehensiveness, with most items achieving unanimous agreement and all exceeding recommended thresholds. Scale-level indices (S-FVI) indicated excellent face validity for both clarity (S-FVI/Ave = 0.97) and comprehensiveness (S-FVI/Ave = 0.99), while universal agreement indices met established criteria ((S-FVI/UA) was 0.80 for clarity and 0.90 for comprehensiveness). Qualitative feedback supported the quantitative findings and informed minor wording refinements, confirming that adolescents perceived the questionnaire as clear, understandable, and comprehensive (Additional file 3).

Reliability

The researchers assessed the internal consistency reliability of the adapted HLSAC using Cronbach's alpha and McDonald's omega in the main sample (n = 128). The scale demonstrated good reliability (ω = 0.809, 95% CI: 0.760–0.859; α = 0.806, 95% CI: 0.756–0.856), with an average inter-item correlation of 0.292, indicating adequate homogeneity without redundancy. Corrected item–total correlations ranged from 0.402 to 0.606, and

deleting any item did not improve reliability. These results support retaining all 10 items and confirm satisfactory internal consistency for the adapted HLSAC (Additional file 4).

Exploratory Factor Analysis (EFA)

The data met the assumptions for factor analysis, with an overall Kaiser–Meyer–Olkin (KMO) value of 0.836 and a statistically significant Bartlett's test of sphericity (χ^2 = 280.79, df = 45, $p < 0.001$). The analysis identified a single-factor solution with an eigenvalue of 2.97, accounting for 29.7% of the total variance. All ten items loaded positively on the factor, with loadings ranging from 0.457 to 0.690, exceeding the predefined retention threshold. These findings indicate a unidimensional structure of the adapted HLSAC instrument and provide the empirical basis for subsequent confirmatory factor analysis.

Confirmatory Factor Analysis (CFA)

The CFA results showed that the one-factor model achieved an acceptable fit to the data. The chi-square test was non-significant (χ^2 = 48.57, df = 35, p = 0.063), and multiple fit indices supported model adequacy (CFI = 0.945, TLI = 0.930, IFI = 0.947). The model also demonstrated satisfactory absolute fit, with RMSEA = 0.055 (90% CI: 0.000–0.090; p = 0.385) and SRMR = 0.058. All items loaded significantly on the latent health literacy factor ($p < 0.001$), with item R^2 values ranging from 0.218 to 0.478, indicating moderate explained variance. Although the Average Variance Extracted (AVE) was below the conventional threshold (AVE = 0.306), the construct demonstrated good internal consistency, as reflected by McDonald's omega (ω = 0.808) and Cronbach's alpha (α = 0.806). Collectively, these findings support the unidimensional structure and construct validity of the Malay version of the HLSAC questionnaire.

Discussions

This study provides robust evidence supporting the validity and reliability of the adapted HLSAC questionnaire for use among Malaysian adolescents. Through a systematic validation process encompassing expert review, exploratory and confirmatory factor analyses, and internal consistency reliability testing, the findings demonstrate that the instrument is both conceptually sound and psychometrically adequate within the Malaysian cultural and educational context.

Content and Face Validity

The content validity findings demonstrate strong expert consensus regarding the relevance and essentiality of the HLSAC items for assessing adolescent health literacy. Most items achieved perfect item-level Content Validity Index (I-CVI) values, and all exceeded the recommended threshold of 0.78 for a nine-member expert panel, indicating that the adapted items adequately represented the theoretical dimensions of adolescent health literacy [29, 36, 37]. The excellent scale-level content validity index calculated using the average approach (S-CVI/Ave = 0.99) further confirms the instrument's overall representativeness and conceptual coverage [38].

Although the average scale-level Content Validity Ratio (S-CVR/Ave = 0.88) was lower than the corresponding CVI estimate, all item-level CVR values met the minimum critical threshold for retention, supporting the inclusion of all items in the adapted questionnaire [39]. When interpreted alongside the consistently high CVI scores, this pattern provides robust evidence for content adequacy and reflects the more stringent nature of essentiality judgments embedded in CVR estimation [40].

These findings align closely with previous HLSAC validation studies conducted in diverse cultural contexts. Turkish and Persian adaptations similarly reported high content validity indices, supporting the cross-cultural robustness of the HLSAC theoretical framework [41, 42]. Methodological literature further suggests that CVI offers a more stable and informative estimate of content relevance than CVR, particularly for theoretically well-defined constructs assessed by multidisciplinary expert panels [38]. Within this context, the relatively lower S-CVR/Ave observed in the present study does not undermine content validity; rather, it reflects expected variation in expert judgments of item essentiality.

Face validity assessment among Malaysian adolescents further supported the suitability of the adapted instrument. Participants generally perceived the items as clear, understandable, and meaningful, while both quantitative indices and qualitative feedback indicated that only minor linguistic refinements were required to enhance clarity and cultural appropriateness (Yusoff, 2019b). These findings are consistent with adolescent feedback reported in Danish and French HLSAC adaptations, where translated items were similarly described as comprehensible and relevant to everyday experiences [43, 44]. Collectively, the strong evidence for content and face validity provides a critical foundation for subsequent construct validity testing, ensuring that factor analytic procedures meaningfully evaluate the underlying structure of the adapted HLSAC within the Malaysian adolescent context.

Reliability

Internal consistency analyses indicate that the adapted HLSAC demonstrates good reliability. Both Cronbach's alpha and McDonald's omega exceeded the recommended threshold of 0.70, confirming satisfactory internal consistency of the scale [33]. The

inclusion of McDonald's omega strengthens the reliability assessment, as omega provides a model-based estimate that does not rely on the tau-equivalence assumption. Given the observed variability in factor loadings, omega likely offers a more accurate representation of internal consistency than alpha alone [34].

Importantly, the study sample comprised a relatively high proportion of Indian adolescents (46.9%). Although this distribution differs from national demographic patterns, it provided a rigorous test of the translated instrument's linguistic accessibility. In Malaysia, Bahasa Melayu serves as the national language and primary medium of instruction; however, it may function as a second language for some non-Malay adolescents who primarily use Tamil or English at home. The strong internal consistency ($\omega = 0.809$, $\alpha = 0.806$) and positive face validity findings observed in this linguistically diverse sample suggest that the translated HLSAC employs language that is sufficiently clear, simple, and developmentally appropriate for students from diverse linguistic backgrounds, rather than being limited to native Malay speakers. These findings therefore provide indirect support for the semantic accessibility and inclusiveness of the adapted instrument.

The reliability estimates observed in the present study are comparable to those reported in previous HLSAC validation studies across diverse cultural contexts. High internal consistency has been documented in the original Finnish development study ($\alpha = 0.93$) [18], as well as in Danish ($\alpha = 0.86$)[45] and French ($\omega = 0.82$)[43] adaptations. Moderate to good reliability has also been reported in German ($\alpha = 0.76$) [46], Turkish ($\alpha = 0.77$) [41], and Iranian samples ($\alpha = 0.80$) [42], indicating that the HLSAC maintains stable internal consistency across linguistic and cultural adaptations. Together, these findings support the instrument's robustness and cross-cultural consistency.

Construct Validity

Sequential exploratory and confirmatory factor analyses supported the construct validity of the adapted HLSAC. Exploratory factor analysis confirmed that the data were suitable for factor extraction, with adequate sampling indices and all items loading meaningfully on a single latent factor. Although the proportion of variance explained by the one-factor solution was modest, this level is acceptable for brief, theory-driven instruments designed to capture broad psychosocial constructs. Methodological guidelines indicate that variance explained in the range of 20–30% is common and defensible in social and behavioural research, particularly when scales prioritize construct breadth and feasibility for large-scale applications [23, 32]. All items demonstrated satisfactory loadings and communalities, indicating coherent representation of the underlying construct.

The unidimensional structure identified in this study aligns with international HLSAC validation findings. Previous studies in Poland, Denmark, Iran, and France similarly reported one-factor solutions using EFA or CFA, despite the instrument's original

conceptualization across five domains [42–44,47]. This consistency suggests that, while the five domains provide a useful theoretical framework, the HLSAC functions empirically as a global measure of subjective health literacy at the item level, a pattern commonly observed in short instruments that prioritize parsimony and interpretability [23, 24].

However, empirical evidence from Southeast Asia remains limited, despite the widespread validation of HLSAC in European contexts. The relative scarcity of psychometric data from this region highlights an important gap in the global health literacy literature. The present findings therefore, represent a meaningful contribution to Southeast Asia by demonstrating that the unidimensional structure of the HLSAC remains stable within the Malaysian adolescent population. Notably, this pattern mirrors findings from other non-European contexts, including Iran and Turkey, suggesting that the capability-based framework underpinning HLSAC retains structural coherence across diverse sociocultural environments.

These results also underscore the need for further validation studies across Southeast Asian countries to strengthen regional evidence and enhance cross-cultural comparability in adolescent health literacy research. Expanding psychometric evaluations beyond predominantly European samples should be prioritied to ensure that widely used instruments such as the HLSAC demonstrate conceptual and measurement equivalence in culturally diverse educational settings.

Conclusions

Overall, the findings from the translation and cultural adaptation, content validity, construct validity, and reliability analyses collectively support the validity and reliability of the adapted HLSAC for assessing health literacy among Malaysian adolescents. Cognitive assessment confirmed that the preliminary Malay version was generally understandable, while highlighting specific linguistic and conceptual challenges that were addressed through targeted revisions to enhance clarity and cultural relevance. Subsequent expert translation validation demonstrated high levels of language and meaning equivalence, confirming satisfactory semantic and conceptual alignment with the original instrument.

Although the average variance extracted (AVE) did not reach the conventional threshold of 0.50, this result is consistent with expectations for brief, theory-driven instruments measuring broad psychosocial constructs and, when considered alongside strong factor loadings, acceptable model fit, and good internal consistency, supports the construct validity of the adapted HLSAC as a unidimensional measure of adolescent health literacy. The instrument is therefore suitable for school-based research, population monitoring, and health promotion initiatives in Malaysia, while contributing to the international literature on culturally adapted health literacy measurement.

Nevertheless, the absence of test–retest reliability assessment and the use of a pilot sample limit conclusions regarding temporal stability and generalisability. Additionally, the demographic composition of this pilot sample, which included a disproportionately high proportion of Indian adolescents, does not fully reflect the national ethnic distribution, where the Malay ethnicity predominates. This sampling distribution precludes definitive conclusions regarding national representativeness at this stage. Although the findings suggest that the instrument performs consistently across ethnically diverse groups, future large-scale studies should employ stratified probability sampling to establish nationally representative norms and to confirm the generalisability of the present findings.

Future studies should examine temporal stability, measurement invariance across key demographic subgroups, and the sensitivity of the HLSAC to change over time, as well as explore criterion and predictive validity through associations with health behaviours, health outcomes, and academic indicators, to further strengthen its application in adolescent health research and public health practice.

Declarations

Ethics Approval and Consent to Participate

This study forms part of a larger project registered with the National Medical Research Register, Ministry of Health Malaysia (NMRR ID: NMRR-24-03533-HIF), and received ethical approval from the Secretariat of Research Ethics, Universiti Kebangsaan Malaysia (JEP-2025-158). This study is not a clinical trial (Clinical trial number: not applicable).

The research team obtained institutional approval after the school administration reviewed the study protocol and survey instrument, and the school principal granted permission to conduct the study. The questionnaire contained no sensitive items and posed minimal risk. The research team obtained written assent from participating adolescents before data collection. Participation was voluntary, and students were informed of their right to decline or withdraw at any time without academic or administrative consequences. The study complied with national ethical guidelines for research involving minors and adhered to the Declaration of Helsinki.

Consent for Publication

Not applicable. This manuscript does not contain any identifiable individual data.

Availability of Data and Materials

The datasets generated and analyzed during the current study are available in the Additional Material accompanying this article.

Competing Interests

The authors declare that they have no competing interests.

Funding

The authors did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors for the conduct of this study.

Authors' Contributions

ZZ led the study conceptualization and methodology, conducted the analyses, interpreted the data, managed the project, and drafted the manuscript. MA and NJ contributed to analysis and manuscript revision, particularly the Introduction and validation sections. NK supported data collection, ethics administration, and methodology writing. ZJ and AO critically revised the manuscript. AF and RZT contributed to conceptualization and validation, with AF providing supervision. IYI contributed to conceptualization, methodology, validation, supervision, manuscript revision, and oversight of the submission process. All authors approved the final manuscript and agree to be accountable for the work.

Acknowledgements

Not applicable

Authors' information

Not applicable

References

1. Bröder J, Okan O, Bauer U, Bruland D, Schlupp S, Bollweg TM, et al. Health literacy in childhood and youth: A systematic review of definitions and models. BMC Public Health. BioMed Central Ltd.; 2017;17. https://doi.org/10.1186/s12889-017-4267-y
2. Loer AKM, Domanska OM, Stock C, Jordan S. Subjective generic health literacy and its associated factors among adolescents: Results of a population-based online survey in Germany. Int J Environ Res Public Health. MDPI AG; 2020;17:1–23. https://doi.org/10.3390/ijerph17228682
3. Hamzah SR, Ismail M, Nor ZM. Does attachment to parents and peers influence health literacy among adolescents in Malaysia? Kontakt. Urban and Partner; 2018;20:e348–55. https://doi.org/http://dx.doi.org/10.1016/j.kontakt.2018.10.006

4. Asari AA, Birhanu Z, Godesso A. Adolescents' health literacy perspectives and implications. BMC Public Health. BioMed Central Ltd; 2025;25. https://doi.org/10.1186/s12889-025-22341-y
5. Fleary SA, Joseph P, Pappagianopoulos JE. Adolescent health literacy and health behaviors: A systematic review. Jurnal of Adolescenescene [Internet]. Academic Press; 2018;62:116–27. https://doi.org/10.5993/AJHB.44.4.3
6. Moore Heslin A, McNulty B. Adolescent nutrition and health - Characteristics, risk factors, and opportunities of an overlooked life stage. Proceedings of the Nutrition Society. 2023;142–56. https://doi.org/10.1017/S0029665123002689
7. Chu-Ko F, Chong ML, Chung CJ, Chang CC, Liu HY, Huang LC. Exploring the factors related to adolescent health literacy, health-promoting lifestyle profile, and health status. BMC Public Health. BioMed Central Ltd; 2021;21. https://doi.org/10.1186/s12889-021-12239-w
8. Alsubaie ASR. The importance of investigating adolescents' health-related behaviours: an opportunity for improving public health. International Journal of Development Research [Internet]. 2014;4. http://www.journalijdr.com
9. Kemp L, Elcombe E, Blythe S, Grace R, Donohoe K, Sege R. The Impact of Positive and Adverse Experiences in Adolescence on Health and Wellbeing Outcomes in Early Adulthood. Int J Environ Res Public Health. Multidisciplinary Digital Publishing Institute (MDPI); 2024;21. https://doi.org/10.3390/ijerph21091147
10. Kansky J, Allen JP, Diener E. Early Adolescent Affect Predicts Later Life Outcomes. Appl Psychol Health Well Being. Wiley-Blackwell; 2016;8:192–212. https://doi.org/10.1111/aphw.12068
11. Raphael D. Adolescence as a gateway to adult health outcomes. Maturitas. 2013. p. 137–41. https://doi.org/10.1016/j.maturitas.2013.03.013
12. Fleary SA, Joseph P. Adolescents' Health Literacy and Decision-making: A Qualitative Study. Am J Health Behaviour [Internet]. 2020;44:392–408. https://doi.org/10.5993/AJHB.44.4.3.Adolescents
13. Smith C, Goss HR, Issartel J, Belton S. Health literacy in schools? A systematic review of health-related interventions aimed at disadvantaged adolescents. Children [Internet]. MDPI; 2021;8. https://doi.org/10.3390/children8030176
14. Walters R, Leslie SJ, Polson R, Cusack T, Gorely T. Establishing the efficacy of interventions to improve health literacy and health behaviours: A systematic review. BMC Public Health. BMC Public Health; 2020;20:1–17. https://doi.org/10.1186/s12889-020-08991-0
15. Mohamad EMW, Kaundan MK, Hamzah MR, Azlan AA, Ayub SH, Tham JS, et al. Establishing the HLS-M-Q18 short version of the European health literacy survey

questionnaire for the Malaysian context. BMC Public Health. BioMed Central Ltd.; 2020;20. https://doi.org/10.1186/s12889-020-08704-7

16. Adina A, May LS, Hani Syahida S, Jenn NC, Chinna K. Health literacy research in Malaysia: A scoping review. Sains Malays. Penerbit Universiti Kebangsaan Malaysia; 2020;49:1021–36. https://doi.org/10.17576/jsm-2020-4905-07
17. Ahmad M, Perialathan K, Krishnan M, Yong TSM, Sanusi NHA, Musa KA, et al. Validating Measurement of Health Literacy among Adolescents Questionnaire (MOHLAA-Q) for Malaysian Version (MyMOHLAA-Q). International Journal For Multidisciplinary Research. 2024;6. https://doi.org/10.36948/ijfmr.2024.v06i02.15849
18. Paakkari O, Torppa M, Kannas L, Paakkari L. Subjective health literacy: Development of a brief instrument for school-aged children. Scand J Public Health [Internet]. 2016;44:751–7. https://doi.org/10.1177/1403494816669639
19. Paakkari L, Torppa M, Mazur J, Boberova Z, Sudeck G, Kalman M, et al. A comparative study on adolescents' health literacy in europe: Findings from the hbsc study. Int J Environ Res Public Health [Internet]. 2020;17. https://doi.org/10.3390/ijerph17082720
20. Tsang S, Royse CF, Terkawi AS. Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine. Saudi J Anaesth. 2017;11:S80–9. https://doi.org/10.4103/sja.SJA_203_17
21. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the Process of Cross-Cultural Adaptation of Self-Report Measures. Spine (Phila Pa 1976) [Internet]. 2000;25:3186–91. https://doi.org/10.1080/000163599428823
22. Beaton EA, Simon TJ. How might stress contribute to increased risk for schizophrenia in children with chromosome 22q11.2 deletion syndrome? J Neurodev Disord. England; 2011;3:68–75. https://doi.org/10.1007/s11689-010-9069-9
23. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate data analysis (8th Edition) [Internet]. Cengage Learning; 2019. www.cengage.com/highered
24. Kline RB. Principles and Practice of Structural Equation Modeling (4th Edition). The Guilford Press; 2016.
25. Beaton D, Bombardier C, Guillemin F, Ferraz MB. Recommendations for the Cross-Cultural Adaptation of the DASH & QuickDASH Outcome Measures. For Work e Health [Internet]. 2007; https://www.researchgate.net/publication/265000941
26. Sperber AD, Devellis RF, Boehlecke B. Cross-cultural translation: Methodology and Validation. J Cross Cult Psychol. 1994;25:501–24. https://doi.org/10.1177/0022022194254006
27. Sperber AD. Translation and Validation of Study Instruments for Cross-Cultural Research. Gastroenterology. 2004;126:124–8. https://doi.org/10.1053/j.gastro.2003.10.016

28. Yusoff MSB. ABC of Content Validation and Content Validity Index Calculation. Education in Medicine Journal. 2019;11:49–54. https://doi.org/10.21315/eimj2019.11.2.6
29. Yusoff MSB. ABC of Response Process Validation and Face Validity Index Calculation. Education in Medicine Journal. 2019;11:55–61. https://doi.org/10.21315/eimj2019.11.3.6
30. Costello AB, Osborne JW. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. - Practical Assessment, Research & Evaluation. 2005;10. http://www.statsoft.com/textbook/
31. Tabachnick BG, Fidell LS. Multivariate Statistics. Seventh Ed. Encyclopedia of Cancer. 2019. https://doi.org/10.1007/978-3-540-47648-1_3905
32. Kalkbrenner MT. Alpha, Omega, and H Internal Consistency Reliability Estimates: Reviewing These Options and When to Use Them. Counseling Outcome Research and Evaluation. Routledge; 2023;14:77–88. https://doi.org/10.1080/21501378.2021.1940118
33. Hayes AF, Coutts JJ. Use Omega Rather than Cronbach's Alpha for Estimating Reliability. But.... Commun Methods Meas. Routledge; 2020;14:1–24. https://doi.org/10.1080/19312458.2020.1718629
34. JASP Team. JASP (Version 0.95.2) [Computer software] [Internet]. 2025 [cited 2026 Jan 13]. https://jasp-stats.org/. Accessed 13 Jan 2026
35. Lawshe CH. A quantitative approach to content validity".Personnel Psychology. Pers Psychol. 1975;28:563–75.
36. Ayre C, Scally AJ. Critical values for Lawshe's content validity ratio: Revisiting the original methods of calculation. Measurement and Evaluation in Counseling and Development. 2014;47:79–86. https://doi.org/10.1177/0748175613513808
37. Polit DF, Beck CT, Owen S V. Focus on research methods: Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Res Nurs Health. 2007;30:459–67. https://doi.org/10.1002/nur.20199
38. Zamanzadeh V, Ghahramanian A, Rassouli M, Abbaszadeh A, Alavi-Majd H, Nikanfar A-R. Design and Implementation Content Validity Study: Development of an instrument for measuring Patient-Centered Communication. J Caring Sci [Internet]. 2015;4:165–78. https://doi.org/10.15171/jcs.2015.017
39. Madadizadeh F, Bahariniya S. Tutorial on how to calculating content validity of scales in medical research. Perioper. Care Oper. Room Manag. Elsevier Inc.; 2023. https://doi.org/10.1016/j.pcorm.2023.100315
40. Haney MO. Psychometric testing of the Turkish version of the Health Literacy for School-Aged Children Scale. Journal of Child Health Care. SAGE Publications Inc.; 2018;22:97–107. https://doi.org/10.1177/1367493517738124

41. Negarandeh R, Sarkhani N, Heydari M. Evaluation of cross-cultural adaptation and validation of the Persian version of the health literacy for school-aged children scale: Methodological study. Health Sci Rep. John Wiley and Sons Inc; 2024;7. https://doi.org/10.1002/hsr2.1876
42. Rouquette A, Rigal L, Mancini J, Guillemin F, van den Broucke S, Allaire C, et al. Health Literacy throughout adolescence: Invariance and validity study of three measurement scales in the general population. Patient Educ Couns. Elsevier Ireland Ltd; 2022;105:996–1003. https://doi.org/10.1016/j.pec.2021.07.044
43. Bonde AH, Stjernqvist NW, Klinker CD, Maindal HT, Paakkari O, Elsborg P. Translation and Validation of a Brief Health Literacy Instrument for School-Age Children in a Danish Context. Health Lit Res Pract [Internet]. 2022;6:e26–9. https://doi.org/10.3928/24748307-20220106-01
44. Bjørnsen HN, Moksnes UK, Eilertsen MEB, Espnes GA, Haugan G. Validation of the brief instrument "Health Literacy for School-Aged Children" (HLSAC) among Norwegian adolescents. Sci Rep [Internet]. Nature Publishing Group UK; 2022;12:1–11. https://doi.org/10.1038/s41598-022-26388-4
45. Fischer SM, Dadaczynski K, Sudeck G, Rathmann K, Paakkari O, Paakkari L, et al. Measuring Health Literacy in Childhood and Adolescence with the Scale Health Literacy in School-Aged Children - German Version: the Psychometric Properties of the German-Language Version of the WHO Health Survey Scale HLSAC. Diagnostica [Internet]. 2022;68:184–96. https://doi.org/10.1026/0012-1924/a000296
46. Mazur J, Małkowska-Szkutnik A, Paakkari L, Paakkari O, Zawadzka D, Krótkiej Skali W, et al. The Polish version of the short scale measuring health literacy in adolescence. Dev Period Med [Internet]. 2019;XXIII:3. https://doi.org/10.34763/devperiodmed.20192303.190197

Figures

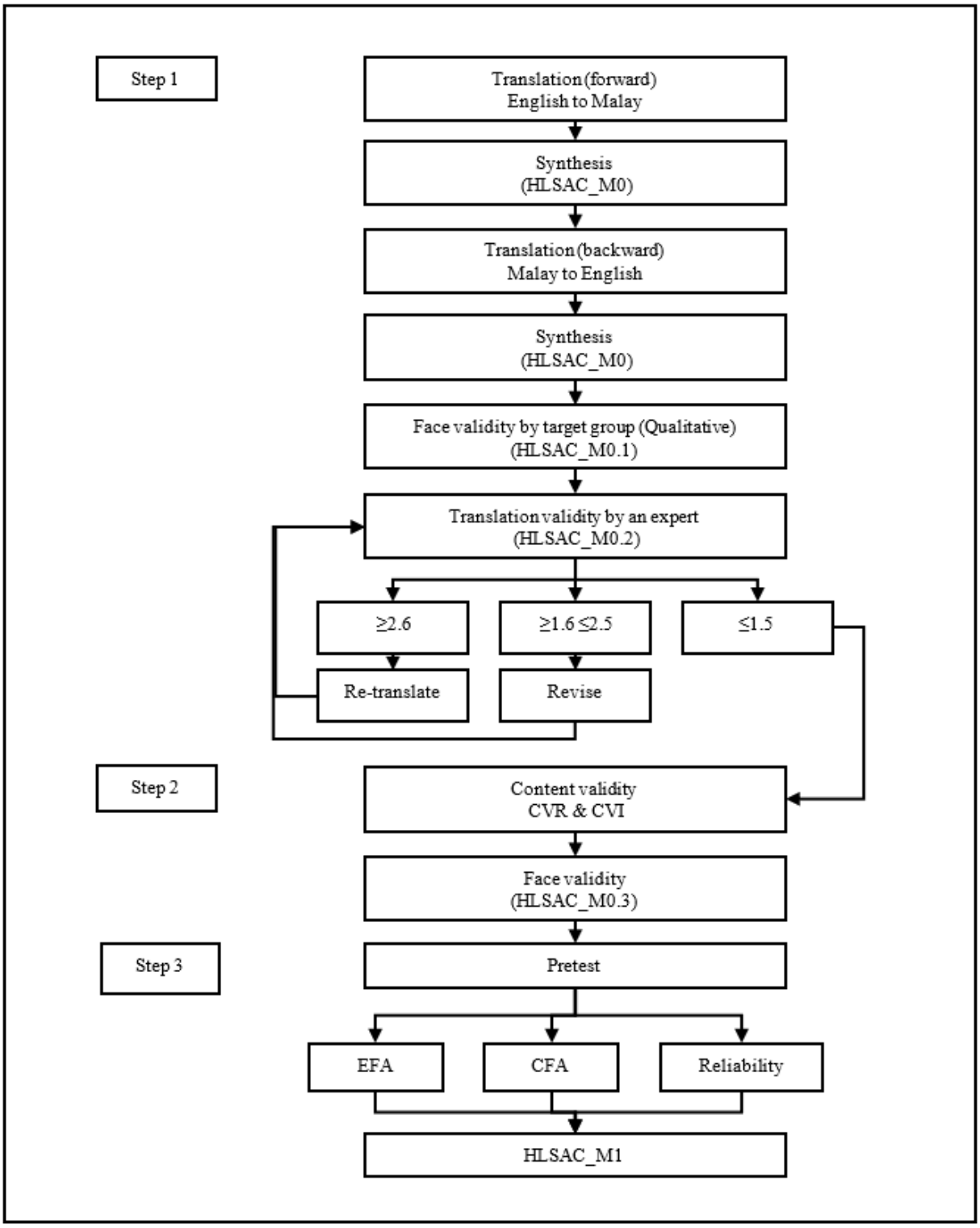


Figure 1

Process of translation, validation, and pretesting the HLSAC Malay version

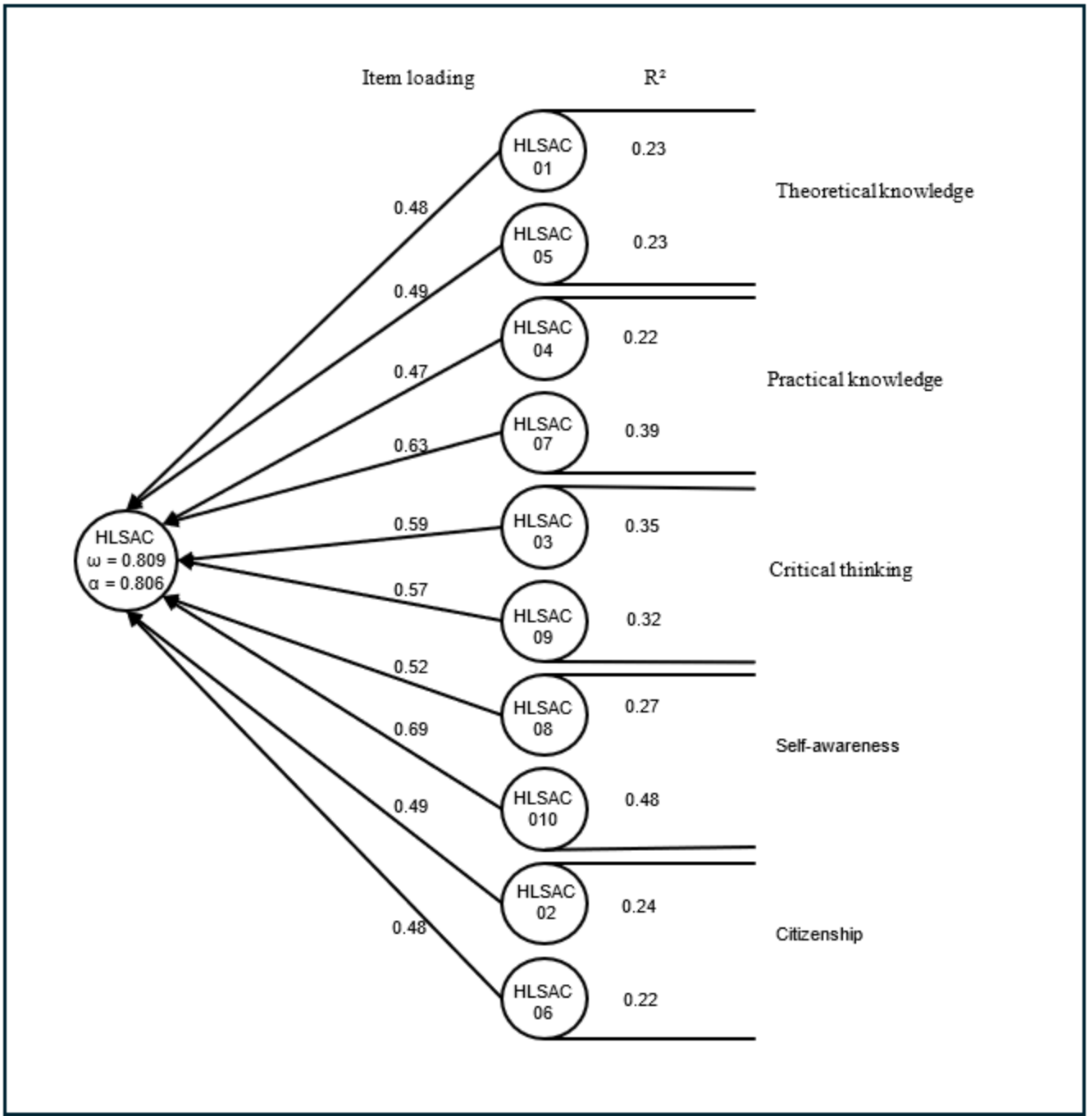


Figure 2

HLSAC Cronbach's alpha, item loading, and R^2 values of CFA

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile1.docx
- Additionalfile2.docx

- Additionalfile3.docx
- Additionalfile4.docx