Research Article

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Reliability and Validity of the Mental Health Literacy Scale (MHLS) Among Malaysian Medical Students

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Abstract

Background: Mental health literacy (MHL) is critical for medical students, who encounter high rates of depression, anxiety, and burnout. No validated tool currently exists to measure MHL among Malaysian medical students. **Objective:** This study tested the reliability and validity of the Mental Health Literacy Scale (MHLS) in this population. **Methods:** A cross-sectional study was conducted at Manipal University College Malaysia (August–October 2025). A total of 273 clinical-phase medical students completed the 35-item MHLS (response rate: 89.5%; 66.3% female; mean age 22.9 years). Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed, alongside reliability assessment using Cronbach's alpha and McDonald's omega. **Results:** After removing two poorly performing items, a five-factor, 33-item model was identified, explaining 63.41% of total variance: Mental Health Attitudes (α = 0.94), Disorder Recognition and Professional Help (α = 0.90), Help-Seeking Orientation (α = 0.91), Information-Seeking Knowledge (α = 0.88), and Self-Management and Help Knowledge (α = 0.65). CFA demonstrated acceptable fit (CFI = 0.91, RMSEA = 0.06). The five-factor model outperformed both one-factor (CFI = 0.14) and four-factor alternatives (CFI = 0.04). Overall reliability was excellent (α = 0.90, ω = 0.80), though the Self-Management subscale showed suboptimal validity (AVE = 0.41). **Conclusion:** The 33-item MHLS demonstrates acceptable reliability and validity for measuring MHL among Malaysian medical students. The Self-Management subscale requires further refinement. Cultural context influences the scale's factor structure, and Factor 5 scores should be interpreted cautiously. The findings point to a need for targeted curriculum interventions on self-management strategies and support multi-site replication across diverse Malaysian populations.

Keywords: Mental health literacy, Psychometric validation, Medical students, Factor analysis, Malaysia

What was Known

- Mental health literacy matters for medical students as future clinicians and as a high-risk group themselves.
- The Mental Health Literacy Scale has been validated in several countries but shows inconsistent factor structures across cultures.

What's New and Next

- A 33-item, five-factor structure shows acceptable reliability and validity for Malaysian medical students.
- The self-management subscale needs refinement; multi-site testing and replication in diverse Malaysian populations are needed.

Introduction

Health literacy refers to a person's ability to find, understand, and use health information to make good decisions [1,2]. Mental health literacy (MHL) is a specific component, originally defined in 1997 as "knowledge and beliefs about mental disorders which aid their recognition, management or prevention" [3], and later expanded to include recognition of conditions, knowledge of causes and treatments, and attitudes that support help-seeking [4,5].

MHL is particularly important for medical students for two reasons. First, as future doctors working across all specialties, their MHL shapes how well they identify problems, make referrals, and engage patients [6,7,8]. Second, medical students themselves experience higher rates of depression, anxiety, and burnout than age-matched peers [9,10]. Better MHL helps them recognize symptoms earlier, reduce stigma, and access available support [11,12].

In Malaysia, approximately 29.2% of adults experience mental health difficulties, yet services remain underused due to low MHL, stigma, and limited treatment awareness [13,14,15]. Medical students are well placed to address these gaps, but only if they develop strong mental health knowledge, skills, and attitudes during training. Accurately measuring MHL is therefore a prerequisite for identifying deficiencies and evaluating whether educational interventions are working.

The Mental Health Literacy Scale (MHLS), developed by O'Connor and Casey [16], is a 35-item tool with demonstrated measurement properties across multiple countries [17,18,19]. However, its factor structure varies across cultures studies in Iran, Thailand, China, Slovenia, and Brazil have each produced different solutions, and no structure has been consistently replicated [20]. This means the scale cannot be applied in a new setting without first confirming it functions as intended there.

This gap directly motivates the present study. A search of the published literature identified no prior study that has psychometrically evaluated the MHLS among medical students, or any student population, in Malaysia, leaving its factor structure, reliability, and validity in this group entirely unknown. No study has yet tested whether the MHLS is valid and reliable for Malaysian medical students. Without a validated instrument, it is impossible to accurately measure MHL in this population, track changes over time, or evaluate mental health education programs. Understanding how MHL is structured in this group may also reveal culturally specific patterns with direct implications for curriculum design.

This study addressed the following research question: Is the MHLS a reliable and valid instrument for measuring mental health literacy among Malaysian medical students, and what factor structure best represents MHL in this population?

The study had three specific aims: (1) to examine the MHLS factor structure using exploratory and confirmatory factor analyses, including testing of alternative competing models; (2) to assess the reliability of the total scale and subscales with confidence intervals; and (3) to evaluate convergent and discriminant validity. Findings were compared with international validation studies to identify cultural similarities and differences.

Materials and Methods

Study design and setting

A cross-sectional psychometric validation study was conducted at Manipal University College Malaysia (MUCM), a private English-medium medical school in Melaka, from August to October 2025.

Participants and sampling

Phase 2 clinical medical students (Semesters 1 and 2) were targeted because they had completed pre-clinical training and had meaningful exposure to mental health topics during clinical rotations. Students were eligible if enrolled in Phase 2 at the time of data collection. Those absent on the collection day, who declined participation, or who returned questionnaires with more than 10% missing items were excluded.

A census sampling approach was adopted, whereby all 305 eligible Phase 2 students were invited to participate. This maximized sample size, minimized selection bias, and ensured findings represented the entire target population at MUCM, qualities particularly valuable in psychometric validation studies [21,22]. The achieved sample of 273 valid questionnaires (response rate: 89.5%) satisfied the standard guideline of 5–10 participants per scale item and exceeded the recommended

threshold of 250 for studies conducting both EFA and CFA on the same dataset [23,24]. Excluded students comprised 18 absent on the collection day, 8 who declined, and 6 whose questionnaires exceeded the 10% missing data threshold. The high response rate suggests the sample closely represents the full target population.

Instrument

Mental Health Literacy Scale (MHLS). MHL was measured using the 35-item MHLS developed by O'Connor and Casey [16], covering attitudes toward mental illness, disorder recognition, help-seeking, and self-management. Items are rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree); 14 items are reverse-scored. Total scores range from 35 to 175, with higher scores indicating better MHL.

The original English version was used with minor contextual adaptations: "GP" was replaced with "doctor," as the term is not widely used in Malaysian healthcare. Two consultant psychiatrists and one medical educator reviewed all items and adaptations for appropriateness. Content validity was assessed using item-level content validity indices (I-CVI); all items achieved I-CVI $\geq$ 0.67, and the scale-level index (S-CVI/AVE) was 0.92, indicating strong expert endorsement.

Demographic questionnaire includes: Participants reported age, sex, academic semester, ethnicity, nationality, prior formal mental health education, and personal or family mental health experience.

Data collection

Data were collected during timetabled class sessions with written institutional approval. A trained research assistant explained the study purpose, voluntary participation, confidentiality, and the absence of academic consequences for non-participation. Participants read a written information sheet and provided written informed consent before receiving the questionnaire, which took approximately 15–20 minutes. Completed questionnaires were collected immediately and stored securely.

Statistical analysis

Analyses used IBM SPSS Statistics 30.0 for descriptive statistics and EFA, and IBM AMOS 31.0 for CFA. Data were screened for outliers and missing data patterns (Little's MCAR test). Questionnaires with more than 10% missing items were excluded before analysis (n = 6, described above); for the retained questionnaires, item-level missing data were minimal and handled using

pairwise deletion, with no evidence of a systematic (non-random) missingness pattern. Normality was assessed using skewness (±2) and kurtosis (±7) [25]. Factor analysis suitability was confirmed via the KMO test ($\geq$ 0.60) and Bartlett's test ($p < 0.05$) [26].

EFA used principal axis factoring with Varimax rotation. Factors were retained using eigenvalues above 1.0 and scree plot inspection [27]. Items loading below 0.40 or cross-loading above 0.30 were removed [28]. CFA was conducted on the full sample; bootstrapping (1,000 resamples) provided 95% confidence intervals for factor loadings. Model fit was assessed using CMIN/DF (< 3.0), CFI ($\geq$ 0.90), TLI ($\geq$ 0.90), RMSEA (< 0.08), and SRMR (< 0.08) [29,30]. One-factor and four-factor alternative models were compared using CFI, RMSEA, and AIC.

Convergent validity used AVE ($\geq$ 0.50) and construct reliability used CR ($\geq$ 0.70) [31,32]. Discriminant validity was confirmed when each factor's AVE square root exceeded its inter-factor correlations. Internal consistency was assessed using Cronbach's alpha (α) and McDonald's omega (ω) (both $\geq$ 0.70), with bootstrapped 95% confidence intervals [33,34].

Results

Participant characteristics

Of the 305 eligible students, 273 participated (response rate: 89.5%), including 128 Semester 1 students (46.9%) and 145 Semester 2 students (53.1%). The average age was 22.9 years (SD = 2.6; range: 20–28), and 66.3% were female (n = 181). The sample was ethnically diverse: Malay (26.4%), Chinese (35.9%), Indian (23.8%), and other ethnicities (13.9%). Most participants were Malaysian nationals (74.4%). The large majority had received some form of formal mental health education (91.9%; n = 251), and 32.6% reported personal or family experience with mental health issues (Table 1).

Table 1 Demographic Characteristics of Participants (N = 273)

Characteristic	Category	n	%
Gender	Male	92	33.7
	Female	181	66.3
Year of Study	Phase 2, Semester 1	128	46.9
	Phase 2, Semester 2	145	53.1
Ethnicity	Malay	72	26.4
	Chinese	98	35.9
	Indian	65	23.8
	Others	38	13.9
Mental Health Education	Yes	251	91.9
	No	22	8.1
Personal History of Mental Health Problems	Yes	32	11.7
	No	241	88.3
Family History of Mental Health Problems	Yes	45	16.5
	No	228	83.5
Age (years)	Mean (SD)	22.9 (2.6)	
	Range	20-28	

Preliminary checks

No major outliers or systematic missing data patterns were identified. Total MHLS scores were approximately normally distributed (skewness = −0.18, kurtosis = 0.32). KMO = 0.89 and Bartlett's test was significant ($\chi^2 = 4523.67$, df = 595, $p < 0.001$), confirming data suitability for factor analysis.

Exploratory factor analysis

EFA on all 35 items yielded a five-factor solution based on eigenvalues above 1.0 and scree plot inspection (eigenvalues: 8.45, 4.23, 3.67, 2.56, 2.01), explaining 63.41% of total variance. Two items were removed. Item 12 ("If I had a mental health problem, I would not seek help from a mental health professional") cross-loaded on two factors, likely reflecting the blurred boundary between mental health specialists and general doctors in the Malaysian healthcare context[14, 15]. Item 28 ("I

am confident using the computer or telephone to seek information about mental health") loaded below 0.40, probably because the phrasing is outdated for students who primarily use smartphones.

The final 33-item five-factor solution retained 63.41% of variance, with all items loading clearly above 0.40 on a single factor (Table 2):

- Factor 1 – Mental Health Attitudes (9 items; 25.61% variance; α = 0.94): attitudes toward mental illness and stigma. Example: "People with a mental illness could snap out of it if they wanted" (reverse-scored).
- Factor 2 – Disorder Recognition and Professional Help (10 items; 12.82% variance; α = 0.90): ability to recognize conditions and knowledge of professional resources. Example: "I am confident that I know where to seek information about mental illness."
- Factor 3 – Help-Seeking Orientation (7 items; 11.12% variance; α = 0.91): willingness and intention to seek help. Example: "Seeking help for mental health problems is a sign of strength."
- Factor 4 – Information-Seeking Knowledge (4 items; 7.76% variance; α = 0.88): confidence in locating mental health information. Example: "I know where to seek information about mental health."
- Factor 5 – Self-Management and Help Knowledge (3 items; 6.10% variance; α = 0.65): knowledge of self-help strategies. Example: "I know what to do to manage mental health problems."

Table 2 Factor Loadings from Exploratory Factor Analysis (N = 273)

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1: Mental Health Attitudes					
Item 18	0.81				
Item 19	0.78				
Item 20	0.75				
Item 21	0.72				
Item 22	0.69				
Item 23	0.66				
Item 24	0.61				
Item 25	0.58				
Item 26	0.52				
Factor 2: Disorder Recognition and Professional Help					
Item 1		0.76			
Item 2		0.73			
Item 3		0.71			
Item 4		0.68			
Item 5		0.65			
Item 6		0.62			
Item 13		0.59			
Item 14		0.56			
Item 15		0.52			
Item 16		0.48			
Factor 3: Help-Seeking Orientation					
Item 27			0.79		
Item 29			0.76		
Item 30			0.73		
Item 31			0.68		
Item 32			0.64		
Item 33			0.58		
Item 34			0.51		

Table 2 Factor Loadings from Exploratory Factor Analysis (N = 273) **(**Cont.**)**

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 4: Information-Seeking Knowledge					
Item 7				0.73	
Item 8				0.69	
Item 9				0.66	
Item 10				0.55	
Factor 5: Self-Management and Help Knowledge					
Item 35					0.68
Item 11					0.61
Item 17					0.49
Eigenvalue	8.45	4.23	3.67	2.56	2.01
% Variance	25.61	12.82	11.12	7.76	6.10
Cumulative %	25.61	38.43	49.55	57.31	63.41

Note: Factor loadings < 0.40 are not displayed for clarity

Confirmatory factor analysis and model comparison

All 33 items loaded significantly on their expected factors ($p < 0.001$; loadings: 0.51–0.92), with stable bootstrapped confidence intervals. The five-factor model demonstrated acceptable fit: $\chi^2 = 1032.45$ ($df = 485$, $p < 0.001$), CMIN/DF = 2.14, CFI = 0.91, TLI = 0.90, RMSEA = 0.06 (90% CI: 0.05–0.07), SRMR = 0.06, meeting all recommended thresholds.

The one-factor model fit poorly (CMIN/DF = 4.87, CFI = 0.77, TLI = 0.75, RMSEA = 0.12; ΔCFI = 0.14), confirming MHL is multidimensional. The four-factor model was better but still inferior to the five-factor solution (CMIN/DF = 2.68, CFI = 0.87, TLI = 0.86, RMSEA = 0.08; ΔCFI = 0.04). The five-factor model had the lowest AIC, confirming it as the optimal fit. No modification indices were acted upon to preserve interpretability and avoid overfitting. Inter-factor correlations ranged from 0.28 to 0.64, indicating related but distinct constructs (Figure 1).

Convergent and discriminant validity

Four factors met the AVE $\geq$ 0.50 threshold: Mental Health Attitudes (AVE = 0.66), Disorder Recognition and Professional Help (AVE = 0.50), Help-Seeking Orientation (AVE = 0.62), and Information-Seeking Knowledge (AVE = 0.69). Self-Management and Help Knowledge fell below the threshold (AVE = 0.41), indicating insufficient shared variance among its three items. Composite

reliability was acceptable for four factors (CR = 0.90–0.94), while Self-Management had CR = 0.67, marginally below the 0.70 threshold. Discriminant validity was confirmed for all factor pairs, as each factor's AVE square root exceeded its correlations with all other factors (Table 3).

Table 3 Convergent and discriminant validity indices for MHLS (N = 273)

Factor	Average Variance Extracted (AVE)	Composite Reliability (CR)
1. Mental Health Attitudes	0.66	0.94
2. Disorder Recognition and Professional Help	0.50	0.90
3. Help-Seeking Orientation	0.62	0.92
4. Information-Seeking Knowledge	0.69	0.90
5. Self-Management and Help Knowledge	0.41	0.67

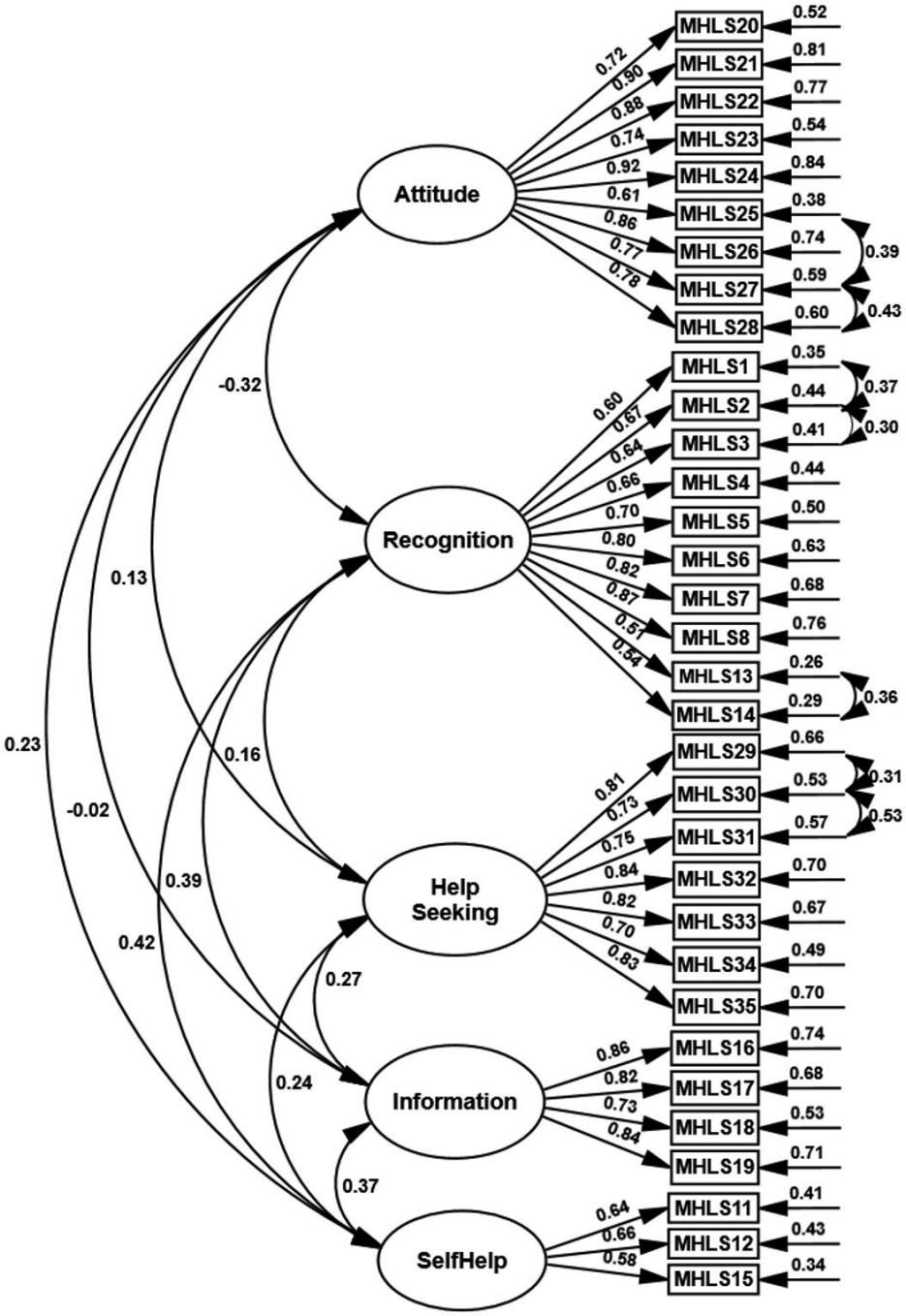
Note. MHLS = Mental Health Literacy Scale

Reliability

Overall scale reliability was excellent: α = 0.90 (95% CI [0.88, 0.92]) and ω = 0.80 (95% CI [0.77, 0.83]). Subscale results were: Mental Health Attitudes (α = 0.94, ω = 0.94), Disorder Recognition and Professional Help (α = 0.90, ω = 0.90), Help-Seeking Orientation (α = 0.91, ω = 0.91), Information-Seeking Knowledge (α = 0.88, ω = 0.88), and Self-Management and Help Knowledge (α = 0.65, ω = 0.66). All item-total correlations ranged from 0.42 to 0.78, exceeding the 0.30 minimum. Removing any single item did not meaningfully alter overall alpha (range: 0.89–0.90).

Cross-cultural comparison

Across 15 international MHLS validation studies, four-factor (35.7%) and unidimensional (28.6%) structures were most common [20]. The present five-factor solution aligns most closely with Iranian [35] and Thai [36] versions. The Thai study is the most direct comparator, also conducted with medical students in Southeast Asia, yet explained less variance (46.9%) and had considerably weaker subscale reliabilities (as low as α = 0.197). The present study removed Items 12 and 28, whereas Items 20, 21, and 22 were most commonly removed internationally, suggesting culturally specific item functioning in the Malaysian context (Table 4).



All factor loadings are standardized and statistically significant ($p < 0.001$)

Figure 1. Confirmatory factor analysis of the MHLS

Table 4 Cross-cultural comparison of MHLS factor structures across validation studies

Study	Population	N	Items	Factors	Key Findings and Differences
O'Connor & Casey (2015) [16]	Australian adults	372	35	1†	Original scale; unidimensional adopted despite viable 4-factor model; 6 theoretical attributes; α = 0.87
Heizomi et al. (2020) [35]	Iranian adults (Farsi)	992	30	5	5 items removed; 42.0% variance; Confidentiality of MH practitioners emerged as distinct factor; α = 0.78
Nejatian et al. (2021) [37]	Iranian general public	530	29	6	6 items removed; retained all 6 original theoretical attributes as separate factors; α = 0.84
Chen et al. (2021) [38]	Chinese teachers	836	35	1	All items retained; unidimensional preferred; 4-factor CFA had low communalities (mean loading = 0.251); α = 0.72
Wang et al. (2022) [39]	Chinese nurses	872	35	4+2‡	Hierarchical: 4 first-order factors (Knowledge, Ability, Recognition, Acceptance) + 2 second-order (Core Literacy, Social Acceptance); α = 0.89
Sittironnarit et al. (2022) [36]	Thai medical students	202	32	5	3 items removed; 46.9% variance; 5 factors mirror Persian version; some subscale α as low as 0.197; α total = 0.85
Krohne et al. (2022) [40]	Slovenian adults	1,189	27	4	8 items removed (most of any study); Attitudes split into two factors; representative sample; α = 0.83
Yurtseven & Can Gür (2024) [41]	Turkish adults	NR	26	4	9 items removed; good CFA fit (CFI = 0.93, RMSEA = 0.05); 4-factor structure
BinDhim et al. (2023) [42]	Saudi adults	544	35	NR	All items retained; good test–retest reliability (ICC = 0.89); α = 0.87

Table 4 Cross-cultural comparison of MHLS factor structures across validation studies (Cont.)

Study	Population	N	Items	Factors	Key Findings and Differences
Buta et al. (2025) [43]	Brazilian adults	472	18	4	Short version; 17 items removed; 4 factors: Stigma, Denial, Recognition/treatment, Information sources
Present study (2025)	Malaysian medical students	273	33	5	2 items removed; 63.4% variance (highest); α = 0.90 (highest); Factor 5 marginal (α = 0.65, AVE = 0.41)

Notes: N = sample size; NR = not reported; MH = mental health; α = Cronbach's alpha (overall scale).

† O'Connor & Casey (2015) adopted a unidimensional model despite noting a viable 4-factor structure with low communalities.

‡ Wang et al. (2022) reported a hierarchical model with 4 first-order and 2 second-order factors.

MHLS scores

Mean total score was 105.73 (SD = 13.25; range: 82–152). Subscale means were: Mental Health Attitudes (M = 22.07, SD = 9.21), Disorder Recognition and Professional Help (M = 33.22, SD = 4.68), Help-Seeking Orientation (M = 25.00, SD = 5.23), Information-Seeking Knowledge (M = 16.40, SD = 2.80), and Self-Management and Help Knowledge (M = 8.98, SD = 1.78). The Self-Management subscale had the lowest standardized scores, indicating students feel least confident about independently managing mental health problems, with direct implications for curriculum design.

Discussion

This is the first study to validate the MHLS in Malaysian medical students. Results support a 33-item, five-factor structure with acceptable model fit and strong reliability for four of five subscales. The Self-Management and Help Knowledge subscale, however, shows consistent weaknesses requiring attention.

The five-factor structure is consistent with the view that MHL comprises multiple related but distinct dimensions [3,4,5], and broadly aligns with other MHLS validation studies [17,18,19]. The removal of two specific items reveals how cultural context shapes measurement. Item 12, concerning help-seeking from a mental health professional, cross-loaded on two factors, likely because the boundary between mental health specialists and general doctors is less defined in Malaysia than in Western

settings, causing conceptual ambiguity for students [14,15]. Future Malaysian versions of the MHLS should rephrase such items to reflect local healthcare pathways. Item 28 loaded poorly because its reference to "computer or telephone" is anachronistic for students who rely primarily on smartphones.

Alternative model testing strengthens confidence in the five-factor solution. The one-factor model performed substantially worse, confirming MHL is multidimensional in this population. The four-factor model also fit worse, justifying the separation of Factors 4 and 5. However, the relatively small gap between these two models, combined with Factor 5's weak psychometric properties, suggests the boundary between the two knowledge-related factors is less distinct than the other factor boundaries in the model.

The overall scale (α = 0.90) and four subscales (α = 0.88–0.94) demonstrated strong reliability. However, the Self-Management and Help Knowledge subscale falls below standard thresholds on three indicators simultaneously: reliability (α = 0.65), convergent validity (AVE = 0.41), and composite reliability (CR = 0.67). While lower reliability is somewhat expected in three-item subscales [33], the convergence of three weak indicators is concerning and suggests the items do not adequately capture this construct. Test–retest data are needed to determine whether this reflects genuine instability or measurement imprecision. Until then, Factor 5 scores should be interpreted separately from the total scale score and treated with caution.

Convergent validity was satisfactory for four factors (AVE = 0.50–0.69), and discriminant validity was confirmed across all factor pairs, supporting the distinctiveness of the five dimensions. Two additional points merit consideration. First, the very high reliability of the Mental Health Attitudes subscale (α = 0.94) may partly reflect item similarity or social desirability, rather than precise measurement alone. Second, MHLS scores were not compared with any external criterion measure.

The full sample of 273 participants was used for both EFA and CFA. Splitting the sample would have reduced statistical power and produced unstable solutions [23,44,45]: this was offset by bootstrapped confidence intervals and competing model comparisons. Independent replication in a separate Malaysian institution remains the most important next step.

Two practical messages emerge for Malaysian medical educators. First, the consistently low Self-Management scores indicate a specific curriculum gap: students feel less prepared to manage mental health problems independently than to recognize disorders or locate help resources. Targeted teaching on evidence-based self-help strategies, resilience building, and peer support could directly address this deficit. Second, the validated MHLS provides educators with a practical tool to monitor

MHL changes over time. Its five-factor structure allows educators to determine whether interventions primarily affect knowledge, attitudes, or help-seeking intentions, enabling more targeted program refinement [46,47].

This single-site study at a private institution may not generalize to public medical schools or more demographically uniform student populations; multi-site testing across Malaysia is needed. The cross-sectional design precluded test–retest reliability assessment, which is particularly important for clarifying Factor 5's low reliability. No external criterion measure was included, limiting criterion validity evidence. Although English is the medium of instruction at MUCM, non-native speakers may have found some items difficult; a Malay-language adaptation is needed for broader applicability. Social desirability bias on the Attitudes subscale cannot be ruled out. Finally, measurement invariance was not tested; multi-group CFA is required before comparing scores across subgroups.

Conclusion

The 33-item MHLS demonstrates acceptable reliability and validity for Malaysian medical students. Four of five subscales perform well, but the Self-Management and Help Knowledge subscale requires improvement due to suboptimal reliability (α = 0.65) and convergent validity (AVE = 0.41). The five-factor structure partly aligns with international findings yet shows cultural specificity, confirming that cross-cultural validation is essential before applying psychometric instruments in new populations.

The MHLS can support mental health education evaluation and longitudinal tracking of student literacy, provided Factor 5 scores are interpreted with caution. Future research should replicate findings across multiple Malaysian institutions, assess test–retest reliability, establish criterion validity against objective measures, and examine measurement invariance across demographic subgroups before recommending widespread adoption.

Ethical Approval Statement

This study was approved by the Research Ethics Committee of Manipal University College Malaysia (Reference No. 01/RMC/HEC01/FOM/July/2025). Approval was granted on July 9, 2025.

Author Contributions

HL, PL, and KZ conceived and designed the study. JG, SM, HHKS, and MNNH conducted the research under the supervision of HL, KZ, and PL. HL, KZ, and PL carried out the data analysis. KZ and PL drafted the initial manuscript. KZ supervised all stages of the study and managed the

final submission of the manuscript. All authors reviewed and approved the final version prior to submission.

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Conflicts of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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