PHARMACIA

Pharmacia 73: 1–10
DOI 10.3897/pharmacia.73.e176368

Research Article

Psychometric validation of a culturally adapted medication literacy questionnaire in Indonesian communities: evidence from EFA and Rasch modeling

Seftika Sari[1], Ratna Sari Dewi[1], Prasojo Pribadi[2], Indriyati Hadi Sulistyaningrum[3]

1 *Department of Pharmacy, STIFAR Riau, Pekanbaru, Indonesia*
2 *Pharmacy Department, Faculty of Health Sciences, Universitas Muhammadiyah Magelang, Magelang, Indonesia*
3 *Pharmacy Department, Faculty of Pharmacy, Universitas Islam Sultan Agung, Semarang, Indonesia*

Corresponding author: Prasojo Pribadi (prasojopribadi@unimma.ac.id)

Received 29 October 2025 ♦ **Accepted** 28 November 2025 ♦ **Published** 8 January 2026

Citation: Sari S, Sari Dewi R, Pribadi P, Sulistyaningrum IH (2026) Psychometric validation of a culturally adapted medication literacy questionnaire in Indonesian communities: evidence from EFA and Rasch modeling. Pharmacia 73: 1–10. https://doi.org/10.3897/pharmacia.73.e176368

Abstract

Introduction: Medication literacy describes a crucial determinant of patient safety and rational medicine use, influencing an individual's ability to interpret instructions, avoid errors, and adhere to treatment. In Indonesia, where self-medication practices are widespread and health literacy remains uneven, no validated instrument exists to assess medication literacy. The objective of this study was to evaluate the validity and reliability of a newly developed Indonesian Medication Literacy Questionnaire using Exploratory Factor Analysis (EFA) and Rasch model approaches.

Methods: A cross-sectional survey was conducted among 289 community respondents in Riau Province. The questionnaire was developed through expert panel review and pilot testing, yielding 30 initial items across four domains. Psychometric evaluation involved two stages: (1) EFA to determine factor structure, supported by the Kaiser–Meyer–Olkin measure and Bartlett's test, factor loadings, Average Variance Extracted (AVE), and Cronbach's alpha for reliability; (2) Rasch analysis to assess item fit, person and item reliability, separation indices, and Wright map distributions. Ethical approval was obtained from the institutional review board.

Results: EFA retained 17 items forming four factors, supported by high sampling adequacy (KMO = 0.948; Bartlett's χ^2 = 6013.7, $p < 0.001$). All factors demonstrated satisfactory convergent validity (AVE > 0.50) and internal consistency (Cronbach's $\alpha > 0.80$). Rasch analysis confirmed robust measurement properties, with item reliability = 0.97, person reliability = 0.90, and separation indices exceeding 3. Item difficulty distribution was balanced, supporting discriminatory power across respondent ability levels.

Conclusion: The Indonesian Medication Literacy Questionnaire demonstrated strong validity and reliability. This culturally adapted tool can be applied in research, education, and public health interventions to improve medication safety in Indonesia.

Keywords

community, EFA, medication literacy, Rasch model

Copyright *Sari S et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC-BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

PENSOFT

Introduction

Medication literacy is an essential dimension of health literacy, defined as the ability of individuals to access, understand, evaluate, and apply information related to medicines for safe and effective use. It goes beyond the basic reading of labels and instructions, encompassing numeracy skills, comprehension of dosage and timing, and the capacity to communicate with healthcare professionals about treatment decisions. Adequate medication literacy enables individuals to avoid errors, adhere to prescribed regimens, and make informed health choices, thereby reducing the risks of adverse drug events and improving treatment outcomes (Rahman et al. 2020a). The World Health Organization (WHO) emphasizes health literacy as a fundamental determinant of population health and as a critical element of Universal Health Coverage and the Sustainable Development Goals. Medication literacy, as a subset, is directly tied to rational drug use, medication safety, and patient empowerment, making its measurement and promotion urgent priorities worldwide.

The importance of medication literacy is especially pronounced among young adults and university students. This group often transitions to independent self-care, taking responsibility for managing prescriptions without parental oversight. Limited literacy at this stage can lead to nonadherence, accidental misuse, or inappropriate self-medication. Strengthening medication literacy early can therefore prevent long-term patterns of unsafe drug use, reduce healthcare burdens, and foster active engagement with healthcare systems. Studies have shown that inadequate literacy contributes to higher risks of medication errors, poor adherence, and avoidable complications, particularly in populations with limited educational or socio-economic resources (Gentizon et al. 2020; Wulandari et al. 2025).

Despite its importance, measuring medication literacy presents substantial challenges. The concept has been inconsistently defined, with terms such as pharmacy health literacy and pharmacotherapy literacy used interchangeably. Instruments vary in scope, content, and structure, complicating efforts to establish comparability across studies. Patients frequently struggle with understanding complex instructions, retaining knowledge of drug names and purposes, and performing dosage-related calculations. These difficulties are compounded in populations with low general literacy (Schillinger 2021), where self-reported measures may be biased or relatively inaccurate (Sawkin et al. 2015). Furthermore, socio-economic disparities, cultural differences, and educational inequalities contribute to wide variation in medication literacy levels. As a result, existing instruments often fail to capture the multidimensional and context-specific nature of medication literacy, particularly in low- and middle-income countries (Shi et al. 2020).

In recent years, psychometric research has advanced toward multidimensional frameworks that integrate functional, interactive, and critical aspects of medication literacy. Tools such as MedLitRxSE, the Newest Vital Sign, and the Rapid Estimate of Adult Literacy in Medicine have been employed internationally. However, many of these instruments were developed in Western contexts and are not directly transferable to other populations. State-of-the-art validation methods employ Exploratory Factor Analysis (EFA) and Rasch modeling, which together provide a rigorous approach for assessing construct validity, reliability, and item functioning (Mustafa et al. 2024). A notable example is the Medication Literacy Scale for Adults (MELSA) version II, validated in Türkiye, which used EFA, Confirmatory Factor Analysis (CFA), and Rasch analysis. The instrument demonstrated strong psychometric properties and cultural adaptability, reinforcing the value of combining classical test theory with item response theory approaches (Okuyan et al. 2025). Similarly, other recent studies have highlighted the importance of Rasch analysis in identifying item bias, ensuring unidimensionality (Wu et al. 2024a), and evaluating reliability across diverse groups (Kusuma et al. 2024a).

In Indonesia, psychometric validation studies employing Rasch analysis and EFA are emerging but remain limited. While these methods have been applied in education and some health-related assessments, no validated tool currently exists for measuring medication literacy at the community level. This gap is critical, given the country's high prevalence of self-medication, diverse socio-cultural landscape, and uneven access to healthcare information. Without reliable and culturally adapted measurement instruments, efforts to design effective interventions or evaluate medication literacy programs remain fragmented and inconclusive (Wardani et al. 2025).

The context of Riau Province provides an appropriate and meaningful setting for this study. With more than 79 higher education institutions and over 146,000 university students, Riau represents a young, diverse, and educationally active population (Tedy 2019). The region is socio-economically significant, with major industries in oil, gas, and manufacturing that rely heavily on a healthy workforce. High rates of self-medication and increasing healthcare demands underscore the need for reliable tools to assess and improve medication literacy. University students in this setting not only represent a critical demographic at risk of poor medication literacy but also serve as future professionals and community leaders who can shape health behaviors more broadly (Sudhakar et al. 2025). Furthermore, universities in Riau often collaborate in initiatives to enhance educational and health literacy, making this study an ideal pilot site for instrument development and validation.

Practically, this study addresses the gap in Indonesia by developing and validating a culturally adapted Medication Literacy Questionnaire for use in community settings. The validation process employed both Exploratory Factor Analysis and Rasch modeling to establish construct validity, internal consistency, and measurement reliability, ensuring that the instrument reflects the multidimensional construct of medication literacy. To date, no published

research in Indonesia has concurrently applied these two psychometric methods in the validation of a medication literacy tool, making the present work a methodological contribution with practical significance for public health and education. The objective of this study was to assess the validity and reliability of a medication literacy questionnaire utilizing Exploratory Factor Analysis and Rasch modeling in Indonesian communities.

Methods

Research design

This study applied a quantitative, cross-sectional design as part of the preliminary testing phase in the development of a standardized instrument for assessing medication literacy. A cross-sectional approach was considered appropriate because it enables the collection of data from a diverse population at a single point in time, thereby facilitating an efficient evaluation of psychometric properties without the confounding effects of longitudinal variation. The research was conducted in Riau Province, Indonesia, a region chosen for its large and diverse academic population, socioeconomic variety, and high prevalence of self-medication practices. These characteristics made the province a representative and strategic setting for piloting the validation of a new instrument. The study population consisted of community members aged 18 years and above, with at least a high school education or equivalent, as these individuals were expected to possess the basic literacy and numeracy skills required for meaningful participation. A sequential sampling strategy was adopted to ensure that respondents who met the inclusion criteria had equal opportunities to be selected. This pragmatic approach balanced feasibility and representativeness, capturing a heterogeneous sample from both rural and urban settings across Riau.

In terms of sample size, a total of 289 respondents were recruited for this study, and this number was deemed sufficient for psychometric validation. In scale development and validation, sample adequacy is often guided by rules of thumb derived from factor analysis requirements. One commonly accepted principle is the subject-to-item ratio, where between five and 10 study participants are recommended per item in exploratory factor analysis (Hair et al. 2019). Given that the initial questionnaire comprised 30 items, a minimum sample of 150 to 300 participants was necessary to satisfy this criterion. The sample size of 289 therefore not only met but slightly exceeded the recommended threshold, ensuring robust statistical power for factor extraction and Rasch calibration. Furthermore, the Kaiser–Meyer–Olkin (KMO) test was later applied to empirically confirm sampling adequacy for factor analysis. Achieving sample sufficiency is crucial in psychometric studies, since inadequate sample sizes can produce unstable factor structures and compromise the reliability of parameter estimates.

Development of the instrument

The development of the Indonesian Medication Literacy (IML) questionnaire was informed by both theoretical and empirical considerations. Two established conceptual models served as the foundation: the international framework for defining medication literacy proposed by Pouliot et al. (2017) and the conceptual model developed by Barreto et al. (2024). To ensure cultural appropriateness and content validity, an expert panel was convened comprising eight clinicians and academics with doctoral training and expertise spanning emergency medicine, health in disasters, pediatrics, geriatrics, and gerontology. Each expert had a minimum of eight years of professional experience, ensuring that their evaluations were grounded in both clinical practice and academic rigor. The experts independently reviewed the drafted items for clarity, relevance, and cultural suitability. This process was conducted using semi-structured interviews and group brainstorming sessions, which allowed consensus building and the identification of additional themes. Content validity was quantified using the Content Validity Index (CVI), and items with CVI values greater than 0.71 were retained, consistent with established thresholds for acceptable item-level content validity (Du et al. 2025).

The preliminary instrument contained 30 items distributed across four conceptual domains, including Information (13 items), Skills (3 items), Information format (5 items), and Results and objectives (9 items). Response options were provided using a four-point Likert scale ranging from “Not relevant” to “Highly relevant.” To enhance comprehensibility and ensure face validity, the instrument was pilot tested with a group of 10 literate adolescents representing the target population. Feedback obtained during this stage highlighted areas requiring refinement in wording, phrasing, and contextual adaptation, which were subsequently addressed prior to full-scale administration.

Data collection procedures

Data were collected through structured interviews conducted by trained researchers and research assistants. Respondents who met the inclusion criteria were approached in community settings and educational institutions and were provided with detailed information about the study. Written informed consent was obtained prior to participation. Interviews typically lasted 10 to 15 minutes and included both administration of the questionnaire and clarification of respondents’ expectations regarding item relevance. Training for field researchers emphasized consistency in questionnaire delivery and adherence to ethical protocols. To maintain data quality, checks were performed on-site to identify and correct missing responses immediately. Cases with incomplete or inconsistent data that could not be resolved during the interview process were excluded from analysis. This approach minimized missing-data bias and ensured that only complete and reliable datasets were included in the final psychometric evaluation.

Data analysis

Psychometric analysis was conducted in two sequential stages. The first stage involved exploratory factor analysis (EFA), a statistical method widely regarded as a cornerstone in instrument validation, as it uncovers the latent factor structure underlying observed variables. Sampling adequacy was assessed using the Kaiser–Meyer–Olkin (KMO) measure, while inter-item correlations were evaluated using Bartlett's test of sphericity. Factor extraction was performed using the maximum likelihood method with varimax rotation to achieve orthogonal and interpretable factor loadings. Items with loading values below 0.40 were eliminated, as recommended in psychometric literature (Maskey et al. 2018). Convergent validity was further assessed by calculating the Average Variance Extracted (AVE) for each factor, with values exceeding 0.50 considered satisfactory. Internal consistency reliability was evaluated using Cronbach's alpha, with $\alpha \geq 0.70$ indicative of acceptable reliability (Nunnally and Bernstein 1994).

The second stage of analysis employed Rasch modeling, an item response theory approach, is considered a gold standard in modern psychometrics because it evaluates measurement at both the item (Bond 2015) and person levels (Tennant and Conaghan 2007). Rasch analysis allows the examination of item fit through infit and outfit mean square statistics (MNSQ), where values between 0.5 and 1.5 denote acceptable fit. Item and person reliability indices, along with separation indices, were calculated to assess the capacity of the scale to discriminate between respondents with differing ability levels. A separation index exceeding 3 was interpreted as evidence of strong differentiation. Wright maps were generated to visually inspect the alignment of item difficulty with person ability, thereby ensuring that the questionnaire was capable of capturing variation across the spectrum of medication literacy. This dual-method approach, integrating both classical test theory (EFA) and modern test theory (Rasch analysis), enhances the robustness of psychometric validation by addressing limitations inherent to either method alone.

Results

Sociodemographic characteristics of participants

The study included a total of 289 respondents from Riau Province, with their sociodemographic characteristics presented in Table 1. The population surveyed was predominantly female, with women accounting for 78.2% of the participants. The majority of respondents were in the youngest age group, with 32.5% aged 17–25 years, followed by 25.6% in the 26–35 years range, 23.5% in the 36–45 years range, and 18.4% aged 46–55 years. Educational attainment showed that most participants had completed secondary education, with 63.5% reporting senior high school as their highest qualification, while 27.8% held a bachelor's degree, 7.6% held a diploma, and only 1% had pursued postgraduate studies. Residence patterns reflected the dominance of urban populations in Riau, with 74.7% of respondents residing in urban areas compared to 25.3% from rural settings. Socioeconomic data revealed that the most common monthly expenditure range was IDR 847,398–2,040,262 (37.2%), reflecting middle-income status in the local context. In terms of academic standing, the largest proportion of respondents (56.3%) were in their third year of university, followed by 29.9% in the second year, 8% in the fourth year, and 5.9% in the first year. One of the most striking findings was the prevalence of self-medication practices, with 87.2% of participants reporting that they had consumed medicines without a physician's prescription at some point in their lives. This observation underscores the urgency of measuring and improving medication literacy within this population, as inappropriate self-medication can increase the risks of drug misuse, treatment failure, and adverse events.

Table 1. Sociodemographic characteristics of the study participants (n = 289).

Characteristic	Frequency (%)
Gender	
Male	61 (21.2)
Female	227 (78.2)
Age (Year)	
17–25	94 (32.5)
26–35	74 (25.6)
36–45	68 (23.5)
46–55	53 (18.4)
Education level	
Postgraduate	3 (1.0)
Bachelor	80 (27.8)
Diploma	22 (7.6)
Senior high school/vocational high school	183 (63.5)
Residence	
Rural	73 (25.3)
Urban	215 (74.7)
Monthly expenses (USD)	
< 36.90	60 (20.8)
≥ 36.90–53.65	76 (26.4)
> 53.65–129.11	107 (37.2)
> 129.11–627.21	43 (14.9)
> 627.21	2 (0.7)
Study year level	
First year	17 (5.9)
Second year	86 (29.9)
Third year	162 (56.3)
Fourth year	23 (8.0)
Have you ever self-medicated (bought and consumed drugs without a prescription from a doctor)?	
Ever	251 (87.2)
Never	37 (12.8)

To examine the underlying structure of this instrument, exploratory factor analysis was performed (Table 2). The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.948, which exceeds the recommended minimum threshold of 0.60 and indicates that the sample size

was highly suitable for factor analysis (Field 2018). Bartlett's test of sphericity yielded a χ^2 value of 6013.709 with 435 degrees of freedom, which was significant at $p < 0.001$. This result confirmed that the inter-item correlation matrix was not an identity matrix, thus meeting the assumptions required to proceed with factor analysis. The high KMO value, coupled with a significant Bartlett's test, provides strong evidence that the dataset was appropriate for factor extraction and confirms the adequacy of the sample for psychometric testing (Tabachnick 2019).

Table 2. KMO and Bartlett's test.

Test	Result
Kaiser–Meyer–Olkin measure of sampling adequacy	0.948
Bartlett's test of sphericity	
- Approx. chi-square	6013.709
- Degrees of freedom (df)	435.000
- Significance (Sig.)	< .001

Factor extraction using maximum likelihood estimation with varimax rotation identified a clear four-factor solution, as presented in Table 3. Of the 30 initial items, 17 were retained based on the established loading criterion of 0.40 or greater. Factor 1 and Factor 2 each comprised five items, Factor 3 included four items, and Factor 4 retained three items. The uniqueness values for most items were relatively low, averaging around 0.50, which suggests that the extracted factors explained a substantial portion of the variance in item responses (Wilkinson and Shapiro 2013). This finding indicates that the questionnaire has a coherent factor structure capable of capturing multidimensional aspects of medication literacy. The scree plot (Fig. 1) further supported the four-factor solution, with the first four factors demonstrating eigenvalues greater than 1, while subsequent factors dropped below this threshold (Hayton et al. 2004). This pattern of eigenvalues indicates a multidimensional construct comprising four interrelated domains of medication literacy.

Table 3. Factor extraction and factor loadings.

Items	Factor 1	Factor 2	Factor 3	Factor 4	Uniqueness
B2	0.622				0.394
A12	0.608				0.471
C3	0.577				0.449
D2	0.519				0.522
D9	0.517				0.434
A10		0.735			0.365
A9		0.680			0.367
A7		0.638			0.411
A11		0.561			0.515
B1		0.543			0.494
A5			0.745		0.280
A6			0.602		0.417
A4			0.574		0.402
A3			0.574		0.447
D5				0.752	0.180
D4				0.594	0.410
D6				0.578	0.375

Note: The applied rotation method was varimax.

The adequacy of the factor model was evaluated using multiple fit indices. The Root Mean Square Error of Approximation (RMSEA), as shown in Table 4, was 0.070, with a 90% confidence interval ranging between 0.063 and 0.076. This value falls below the widely accepted cutoff of 0.08, indicating an adequate model fit. The Standardized Root Mean Square Residual (SRMR) was 0.034, which is well below the 0.08 threshold and suggests that the residuals between observed and predicted covariances were minimal. In addition, the Comparative Fit Index (CFI) reached 0.920, exceeding the commonly recommended level of 0.90, thereby confirming a satisfactory overall model fit (Bentler 1990; Hu and Bentler 1999; Hajji et al. 2016; Sulistyaningrum et al. 2025). Taken together, the RMSEA, SRMR, and CFI values consistently demonstrate that the factor solution provided an appropriate and statistically acceptable representation of the observed data.

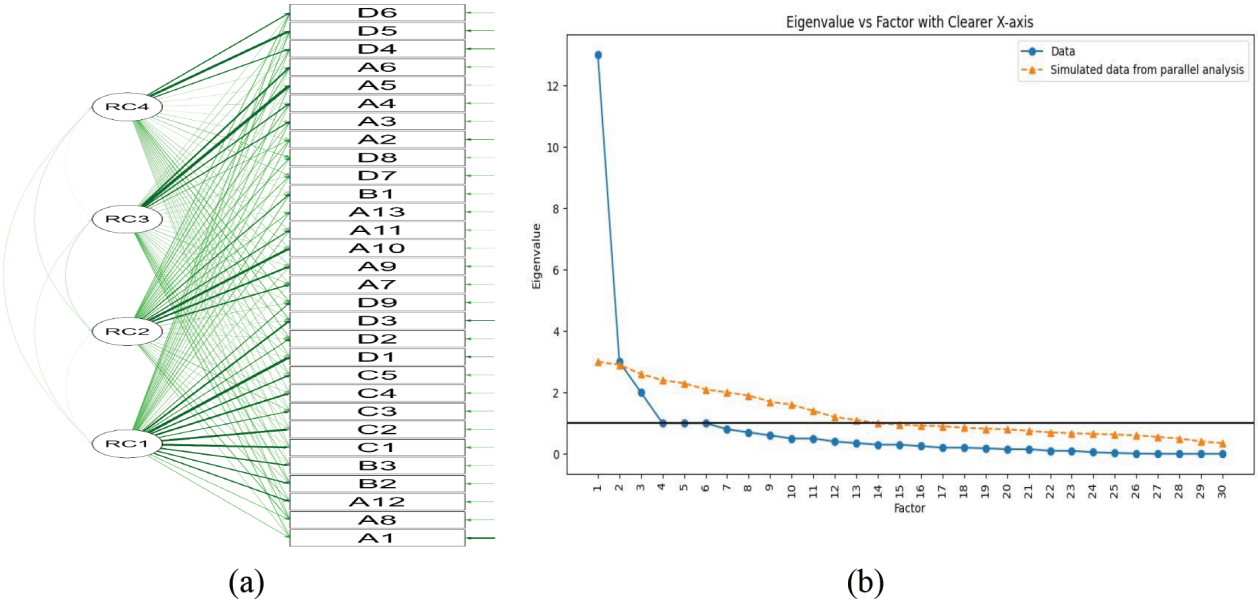

Figure 1. a. EFA path diagram; **b.** Scree plot.

Table 4. Additional fit indices.

RMSEA	RMSEA 90% confidence	SRMR	CFI
0.070	0.063 - 0.076	0.034	0.920

Construct validity (Table 5) was further assessed using the Average Variance Extracted (AVE). All four factors achieved AVE values above 0.50, confirming that the proportion of variance explained by the latent constructs exceeded the recommended threshold for convergent validity. Internal reliability was assessed using Cronbach's alpha, and all four factors demonstrated coefficients above 0.80. These values indicate excellent internal consistency and reliability, suggesting that the items within each factor measure the intended construct consistently. Collectively, the findings provide robust evidence for the reliability and construct validity of the Indonesian Medication Literacy Questionnaire.

Table 5. Additional fit indices.

Factor	AVE	Cronbach's Alpha
Factor 1	0.612	0.820
Factor 2	0.634	0.854
Factor 3	0.700	0.849
Factor 4	0.753	0.845

The results of the construct reliability and validity tests across the four factors show adequate values for Average Variance Extracted (AVE) and Cronbach's Alpha. In general, an AVE value above 0.50 indicates that each factor has good convergent validity, meaning that the proportion of indicator variance explained by the construct is sufficient (Hair et al. 2019). All factors also have Cronbach's alpha values above 0.80, indicating excellent internal reliability (Field 2018). Thus, this instrument demonstrates strong convergent validity and consistent reliability across all four tested factors.

The Rasch analysis provided further insights into the psychometric properties of the instrument by evaluating item functioning and measurement precision. Item difficulty estimates (Table 6) ranged from −1.12 logits for the easiest item (a12) to 1.17 logits for the most difficult item (a10), demonstrating a balanced distribution of item difficulty across the scale (Bond 2015; Wardani et al. 2025). This spread indicates that the questionnaire is capable of differentiating respondents with varying levels of medication literacy. Weighted Mean Square (WMS) and Unweighted Mean Square (UMS) fit statistics generally fell within the acceptable range of 0.5–1.5, confirming that most items fitted the model well (Ingchatcharoen et al. 2016). However, two items, d5 (Std. UMS = −2.63) and d9 (Std. UMS = −2.00), displayed signs of overfit, indicating that responses to these items were overly predictable and contributed limited new information (Morgado et al. 2017). Although these items did not substantially undermine the overall scale, their overfitting suggests the need for refinement in future iterations of the instrument.

The reliability and separation indices from the Rasch model confirmed the strong psychometric performance

Table 6. Scale quality statistic.

item	Difficulty	Std. Error	WMS	Std. WMS	UMS	Std. UMS
a3	−0.65	0.12	1.14	1.48	1.09	0.82
a4	0.32	0.11	1.02	0.25	1.09	0.97
a5	−0.79	0.12	1.11	1.19	1.12	0.99
a6	0.28	0.11	1.01	0.17	1.04	0.47
a7	0.91	0.10	0.98	−0.24	1.00	−0.01
a9	0.61	0.10	0.83	−1.96	0.88	−1.37
a10	1.17	0.10	1.13	1.50	1.16	1.80
a11	0.32	0.11	1.10	1.10	1.21	2.15
a12	−1.12	0.12	1.08	0.92	0.95	−0.36
b1	0.81	0.10	1.04	0.47	1.05	0.63
b2	−0.89	0.12	0.97	−029	0.89	−0.88
c3	−0.03	0.11	1.04	0.47	1.06	0.59
d2	0.10	0.11	1.01	0.15	1.18	1.73
d4	−0.01	0.11	1.07	0.79	1.07	0.74
d5	−0.48	0.12	0.76	−2.80	0.74	−2.63
d6	0.04	0.11	0.89	−1.15	0.91	−0.86
d9	−0.59	0.12	0.82	−2.07	0.79	−2.02

Table 7. Scale quality statistics.

Statistic	Items	Persons	Cutoff value	Evaluation
Separation index	5.7691	3.0832	> 3	Good fit
Number of strata	8.0255	4.4442	> 3	Good fit
Reliability	0.9708	0.9048	> 0.8	Reliable

of the questionnaire. As shown in Table 7, item reliability was 0.9708 and person reliability was 0.9048, both of which exceed the minimum acceptable value of 0.80 (Jhantasana 2023). These results indicate that the questionnaire is highly consistent in measuring both item properties and respondent abilities. The item separation index was 5.7691, and the person separation index was 3.0832, both exceeding the threshold of 3. This suggests that the scale was able to effectively discriminate among items of differing difficulty and among respondents with varying literacy levels (Finbråten et al. 2021). The number of strata, calculated as 8.0255 for items and 4.4442 for persons, further supports the ability of the instrument to distinguish between multiple levels of both item difficulty and participant competence. These findings affirm that the scale demonstrates strong internal validity and robust discriminatory capacity (Phanniphong and Na-Nan 2025).

Fig. 2a presents the Wright map derived from the Rasch analysis, illustrating the alignment between item difficulty and respondent ability along the logit scale. Most respondents were clustered within the logit range of −1 to 2, corresponding to moderate levels of medication literacy. Items were distributed relatively evenly across the difficulty spectrum, with some items positioned above and others below the mean respondent ability (Huang et al. 2025). This alignment indicates good targeting, suggesting that the questionnaire provides informative measurement across the relevant ability range of the study population.

Fig. 2b presents the Test Information Function (TIF), which reflects the precision of measurement across different levels of respondent ability. The TIF indicated

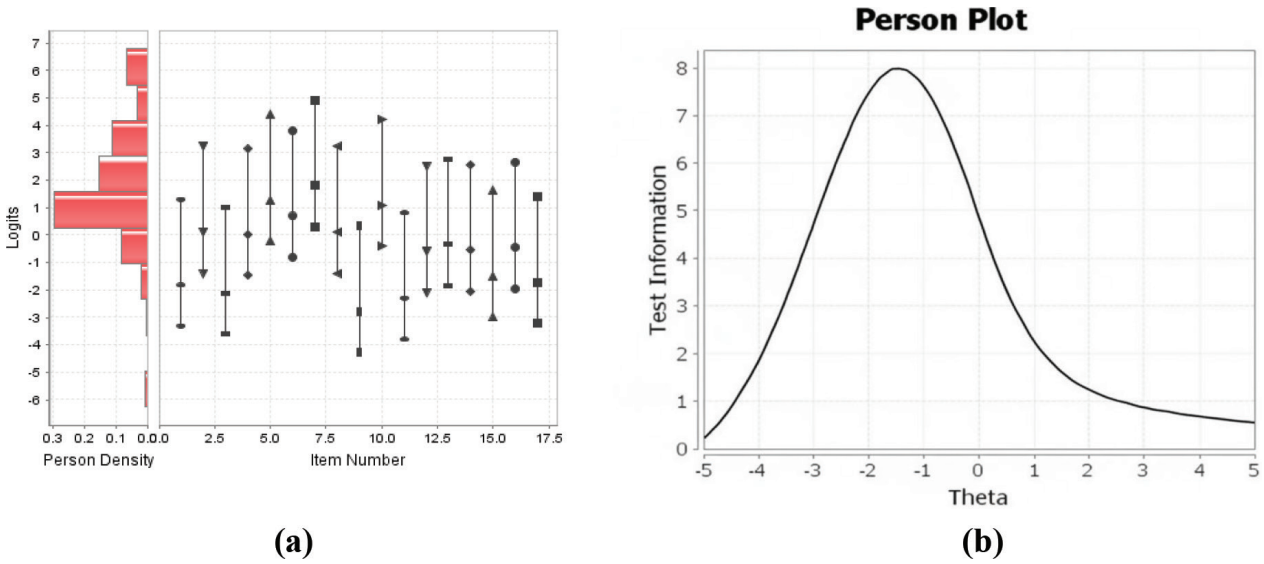

Figure 2. Item maps of the Medication Literacy Index questionnaire: **a.** Wright map or item–person plot; **b.** Item characteristic curve.

that measurement accuracy was highest within the theta range of −2 to 0, with peak precision occurring around theta = −1. This indicates that the instrument is particularly effective at differentiating individuals with low to average levels of medication literacy. Measurement precision declined at the extremes of the ability spectrum, especially at very high ability levels (theta > 2) and very low levels (theta < −4). This pattern is consistent with many health literacy instruments and reflects the inherent difficulty of achieving uniform precision across the full ability continuum. Nevertheless, the overall information curve demonstrates that the questionnaire provides adequate measurement precision for the majority of respondents included in the analysis.

Discussion

Key findings of the study

The findings of this study provide compelling evidence that the Indonesian Medication Literacy (IML) Questionnaire demonstrates robust psychometric properties and is suitable for measuring medication literacy in community populations. The application of both exploratory factor analysis (EFA) and Rasch modeling established a four-factor, 17-item structure with high levels of reliability, internal consistency, and validity. These results position the IML questionnaire as a novel contribution to the measurement of medication literacy in Indonesia, where no culturally adapted instrument has previously been validated. Given the high prevalence of self-medication practices in this setting, the development of such a tool is both timely and essential for advancing patient safety and rational medicine use.

This study aligns with and extends findings from international research validating medication literacy instruments. For example, the Medication Literacy Scale for Adults (MELSA) version II was developed and validated in Türkiye using similar methodological approaches, namely EFA, CFA, and Rasch modeling (Okuyan et al. 2025). Compared to its predecessor, MELSA version I, which was limited to highly educated populations, MELSA-II incorporated a broader and more diverse participant base and demonstrated improved psychometric strength. MELSA-II also confirmed construct validity by showing that individuals with higher education and better health literacy achieved higher scores, reinforcing expected associations between literacy and health outcomes. Nevertheless, MELSA-TR was validated only for adults with at least 12 years of education, which may restrict its applicability to lower socioeconomic or less educated populations. In contrast, the present study addressed this gap by validating an instrument within a diverse Indonesian population, including individuals with varying educational backgrounds, thereby broadening the applicability of the scale in low- and middle-income settings.

Other recent instruments, such as the Medication Literacy Scale for Parents of Children with Epilepsy (Wu et al. 2024b), relied on EFA and Cronbach's alpha to demonstrate internal consistency but did not incorporate Rasch analysis. Similarly, Kusuma et al. (2024) validated an antibiotic knowledge questionnaire among Indonesian undergraduate pharmacy students using Rasch modeling, but that instrument was limited to a specific subject area rather than the broader construct of medication literacy. By employing both EFA and Rasch approaches concurrently, the present study advances methodological rigor, as Rasch analysis enables deeper examination of item-level functioning and measurement precision. This dual approach is increasingly recognized as a gold standard for instrument validation because it integrates the strengths of classical test theory with modern psychometric theory (Modern Psychometrics n.d.; Rand et al. 2024).

Implications for public health and education

The validated IML questionnaire holds substantial potential for application across multiple domains. In research, it can serve as a standardized tool for assessing baseline levels of medication literacy and for evaluating the effectiveness of interventions aimed at improving rational medicine use. In public health practice, the instrument may be deployed in campaigns designed to reduce unsafe self-medication behaviors, particularly in communities with limited access to healthcare professionals. Within educational settings, the questionnaire could be integrated into university curricula to identify literacy gaps and inform targeted training in medication management. Furthermore, the instrument may be valuable for policymakers and healthcare providers in monitoring trends, designing evidence-based policies, and tailoring interventions for vulnerable populations. The demonstrated ability of the questionnaire to differentiate across ability levels, as indicated by the separation indices and Wright map analysis, enhances its utility for identifying individuals and groups who may require additional support.

Strengths and limitations of the study

Several strengths distinguish this study from prior research. First, it represents the first validated, culturally adapted medication literacy instrument developed specifically for the Indonesian population, addressing a critical gap in measurement capacity. Second, the application of dual psychometric methods—EFA and Rasch analysis—ensured a comprehensive evaluation of construct validity and item functioning. Third, the sample size of 289 respondents exceeded the recommended subject-to-item ratio of 10:1 for factor analysis, supporting the stability and adequacy of the factor solution. Fourth, the inclusion of respondents with diverse sociodemographic characteristics, including gender, education, and socioeconomic status, enhances the applicability of the instrument across varied populations. Finally, the high prevalence of self-medication observed in the sample underscores the contextual relevance and urgency of developing a tool designed to measure medication literacy in this setting.

Despite these strengths, several limitations should be acknowledged. The cross-sectional design limits the ability to assess changes in medication literacy over time or to establish causal relationships. The study population was predominantly composed of university students in Riau Province, which may restrict generalizability to older adults or rural populations with lower literacy levels. In addition, the regional focus may not fully capture future cultural and linguistic variations across Indonesia's diverse provinces. Psychometric testing also revealed areas requiring refinement, including a relatively low Tucker–Lewis Index (TLI), suggesting the need for further improvement of the factor structure. Moreover, 13 of the initial 30 items were excluded during analysis, and two items were flagged as overfitted in Rasch modeling, indicating potential redundancy or bias in item design. Finally, although internal validity was rigorously evaluated, external validity—such as the ability of questionnaire scores to predict real-world medication use behaviors—was not assessed.

Future directions

Future research should build on these findings in several ways. Longitudinal studies are recommended to examine changes in medication literacy over time and to assess the responsiveness of the instrument to educational or behavioral interventions. Validation efforts should be expanded to include participants from diverse demographic and socioeconomic backgrounds across multiple Indonesian provinces to enhance generalizability and cultural sensitivity. Item refinement is also necessary, particularly for those identified as overfitted or redundant, to improve clarity and informativeness. In addition, CFA should be conducted to further validate the factor structure identified through EFA. Finally, future studies should assess external validity by linking questionnaire scores to real-world outcomes, such as medication adherence, error reduction, or health status.

Conclusion

This study successfully validated the Indonesian Medication Literacy Questionnaire using a dual psychometric approach involving EFA and Rasch modeling, providing strong evidence of its reliability and validity. Comparisons with international instruments highlight its novelty and importance as the first tool adapted for the Indonesian context. Although limitations related to design, sampling, and item reduction remain, the methodological rigor, sample adequacy, and contextual relevance of this study underscore its contribution to advancing medication literacy research. With further refinement and broader application, the IML questionnaire has the potential to become a cornerstone instrument for measuring, monitoring, and improving medication literacy in Indonesia and beyond.

Acknowledgements

The authors acknowledge the Directorate of Research, Technology, and Community Service, Directorate General of Higher Education, Research, and Technology, Ministry of Higher Education, Science, and Technology, Republic of Indonesia.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statements

Ethical approval was granted by the Bioethics Commission for Medical/Health Research at the Faculty of Medicine, Islamic University of Sultan Agung Semarang, Indonesia (Approval No. 283/VI/2025/Komisi Bioetik).

The study was conducted in accordance with the Declaration of Helsinki for research involv-ing human participants. Written informed consent was obtained from all participants prior to in-clusion in the study.

Informed consent was obtained from all participants involved in the study.

The authors declared that no experiments on animals were performed for the present study.

The authors declared that no commercially available immortalised human and animal cell lines were used in the present study.

Use of AI

No use of AI was reported.

Funding

This research was supported by the Regular Fundamental Research Grant from the Direc-torate of Research, Technology, and Community Service, Directorate General of Higher Ed-ucation, Research, and Technology, Ministry of Higher Education, Science, and Technology, Republic of Indonesia.

Author contributions

PP, SS, and RSD: study conception and design; HS and RSD: data collection; PP and SS: analysis and interpretation of results; HIS, PP, RSD, and SS: draft manuscript preparation. All authors reviewed the results and approved the final version of the manuscript.

Data availability

All of the data that support the findings of this study are available in the main text.

References

Barreto MAF, Negreiros FDS, Cestari VRF, Sampaio HAC, Moreira TMM (2024) Evidence of validity of the Risk Self-Medication Questionnaire focused on health literacy. Revista Brasileira de Enfermagem 77(3): e20230386. https://doi.org/10.1590/0034-7167-2023-0386

Bentler PM (1990) Comparative fit indexes in structural models. Psychological Bulletin 107(2): 238–246. https://doi.org/10.1037/0033-2909.107.2.238

Bond T (2015) Applying the Rasch model: Fundamental measurement in the human sciences. Routledge, 3rd edn., 406 pp. https://doi.org/10.4324/9781315814698

Du W, Alias BS, Wahab JLA (2025) Ensuring accuracy: Calculating the content validity index for teacher job satisfaction surveys among Henan private universities in China. Journal of Posthumanism 5(3): 391–408. https://doi.org/10.63332/joph.v5i3.745

Field AP (2018) Discovering statistics using IBM SPSS statistics, 5th edn. Sage.

Finbråten HS, Kleppang AL, Steigen AM (2021) Using the Rasch measurement theory to assess the psychometric properties of the Hopkins Symptom Checklist-10 in adolescents. Health and Quality of Life Outcomes 19: 248. https://doi.org/10.1186/s12955-021-01884-9

Gentizon J, Hirt J, Jaques C, Lang P, Mabire C (2020) Instruments assessing medication literacy in adult recipients of care: A systematic review of measurement properties. International Journal of Nursing Studies 113: 103785. https://doi.org/10.1016/j.ijnurstu.2020.103785

Hair JF, Black WC, Babin BJ, Anderson RE (2019) Multivariate data analysis, 8th edn. Cengage.

Hajji J, Baaziz M, Mnedla S, Jannet ZB, Elloumi A (2016) Validation of the Arabic version of the Inventory of Coping Strategies of Competitive Sport (ISCCS). Advances in Physical Education 6(4): 312–327. https://doi.org/10.4236/ape.2016.64032

Hayton JC, Allen DG, Scarpello V (2004) Factor retention decisions in exploratory factor analysis: A tutorial on parallel analysis. Organizational Research Methods 7(2): 191–205. https://doi.org/10.1177/1094428104263675

Hu L, Bentler PM (1999) Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal 6(1): 1–55. https://doi.org/10.1080/10705519909540118

Ingchatcharoen S, Tangdhanakanond K, Pasiphol S (2016) Testing measurement invariance of quality rating causal models in tutorial-based assessment. Procedia Social and Behavioral Sciences 217: 867–877. https://doi.org/10.1016/j.sbspro.2016.02.018

Kusuma IY, Bahar MA, Nuari DA, Prabandari R, Soeharto S, Csupor D, Benkő R, Matuz M (2024) Antibiotic knowledge assessment questionnaire in undergraduate pharmacy students: A Rasch analysis of validity evidence. Pharmacy Education 24(1): 54–78. https://doi.org/10.46542/pe.2024.241.5478

Maskey R, Fei J, Nguyen H-O (2018) Use of exploratory factor analysis in maritime research. The Asian Journal of Shipping and Logistics 34(2): 91–111. https://doi.org/10.1016/j.ajsl.2018.06.006

Modern psychometrics (n.d.) The science of psychological assessment. ResearchGate.

Morgado FFR, Meireles JFF, Neves CM, Amaral ACS, Ferreira MEC (2017) Scale development: Ten main limitations and recommendations to improve future research practices. Psicologia, Reflexão e Crítica [Revista Semestral Do Departamento de Psicologia Da UFRGS] 30: 3. https://doi.org/10.1186/s41155-016-0057-1

Mustafa NK, Ibrahim R, Awang Z, Aizuddin AN, Syed Junid SMA (2024) Validation of a quantitative instrument measuring critical success factors and acceptance of Casemix system implementation in the total hospital information system in Malaysia. BMJ Open 14(8): e082547. https://doi.org/10.1136/bmjopen-2023-082547

Nunnally JC, Bernstein IH (1994) Psychometric theory. McGraw-Hill Companies.

Okuyan B, Atasoy B, Kulak E, Gorpuz G, Sancar M, Ay P (2025) Development and validation of medication literacy scale for adults: MELSA version II. BMC Public Health 25(1): 987. https://doi.org/10.1186/s12889-025-22200-w

Huang L, Wei F, Liu Y, Xu J, Wu J, Wang Q, Wang S, Wu W (2025) Measuring the medication literacy level of community residents: A cross-sectional study. Frontiers in Public Health 13: 1605296. https://doi.org/10.3389/fpubh.2025.1605296

Jhantasana C (2023) Should a rule of thumb be used to calculate PLS-SEM sample size. Asia Social Issues 16(5): e254658. https://doi.org/10.48048/asi.2023.254658

Phanniphong K, Na-Nan K (2025) Development and validation of a factor analysis-validated comprehensive scale for measuring innovative work behavior. Sustainable Futures 9: 100704. https://doi.org/10.1016/j.sftr.2025.100704

Pouliot A, Vaillancourt R, Stacey D, Suter P (2017) Defining and identifying concepts of medication literacy: An international perspective. Research in Social and Administrative Pharmacy 14: 797–804. https://doi.org/10.1016/j.sapharm.2017.11.005

Rahman FI, Aziz F, Huque S, Ether SA (2020) Medication understanding and health literacy among patients with multiple chronic conditions: A study conducted in Bangladesh. Journal of Public Health Research 9(1): 1792. https://doi.org/10.4081/jphr.2020.1792

Rand S, Towers AM, Allan S, Webster L, Palmer S, Carroll R, Gordon A, Akdur G, Goodman C (2024) Exploratory factor analysis and Rasch analysis to assess the structural validity of the Adult Social Care Outcomes Toolkit Proxy version (ASCOT-Proxy) completed by care home staff. Quality of Life Research 33(6): 1555–1567. https://doi.org/10.1007/s11136-024-03631-1

Sawkin MT, Deppe SJ, Thelen J, Stoner SC, Dietz CA, Rasu RS (2015) Health literacy and medication adherence among patients treated in a free health clinic: A pilot study. Health Services Research and Managerial Epidemiology 2: 1–7. https://doi.org/10.1177/2333392815589094

Schillinger D (2021) Social determinants, health literacy, and disparities: Intersections and controversies. HLRP Health Literacy Research and Practice 5(3): e234–e243. https://doi.org/10.3928/24748307-20210712-01

Shi J, Qi L, Li Y, Liu X (2020) Investigation of health literacy status in Beijing, China. HLRP Health Literacy Research and Practice 4(3): e174–e184. https://doi.org/10.3928/24748307-20200731-01

Sudhakar SK, Doshi DP, Nair G, Rao T (2025) Investigating health literacy and sociodemographic factors in college students. Scientific Reports 15: 20455. https://doi.org/10.1038/s41598-025-04389-3

Sulistyaningrum IH, Sarosa H, Arfianto E, Pribadi P (2025) Development and initial valida-tion of the antibiotic use behavior assessment questionnaire based on the COM-B model among university students. Pharmacia 72: 1–10. https://doi.org/10.3897/pharmacia.72.e169411

Tabachnick B (2019) Using multivariate statistics, 7th edn. Pearson.

Tedy C (2019) The influence of service quality, university image on student satisfaction and student loyalty. Benchmarking An International Journal 26(5): 1533–1549. https://doi.org/10.1108/BIJ-07-2018-0212

Tennant A, Conaghan PG (2007) The Rasch measurement model in rheumatology: What is it and why use it? When should it be applied, and what should one look for in a Rasch paper? Arthritis and Rheumatism 57(8): 1358–1362. https://doi.org/10.1002/art.23108

Wardani RT, Nuraeni E, Diana S (2025) Rasch model analysis of essay questions to measure literacy and numeracy skills in plant and animal bioprocess topics based on AKM. REID Research and Evaluation in Education 11(1): 29–44. https://doi.org/10.21831/reid.v11i1.85614

Wilkinson K, Shapiro C (2013) Development and validation of the Non-restorative Sleep Scale (NRSS). Journal of Clinical Sleep Medicine 9(9): 929–937. https://doi.org/10.5664/jcsm.2996

Wilkinson K, Shapiro C (2013) Development and validation of the Non-restorative Sleep Scale (NRSS). Journal of Clinical Sleep Medicine 9(9): 929–937. https://doi.org/10.5664/jcsm.2996

Wu X, Cai S, Zhou Y, Lan Y, Lin Y (2024) Development, reliability and validity of the Medication Literacy Scale for parents of children with epilepsy. Patient Preference and Adherence 18: 165–176. https://doi.org/10.2147/PPA.S446081

Wulandari P, Aziza YN, Ghozali M, Laksitorini M, Endarti D (2025) Pharmacists' and community knowledge on the safety and halal status of pediatric medications containing alcohol. Indonesian Journal of Pharmacy 187–195. https://doi.org/10.22146/ijp.11656