

Knowledge of Dengue Fever and Vaccination Among the Indonesian General Population: A Rasch-Based Instrument Validation Study

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Abstract: Dengue fever remains a major public health challenge in Indonesia, yet no Rasch-validated instrument exists to assess community knowledge about dengue vaccination. This study aimed to develop and psychometrically validate a dengue vaccination knowledge questionnaire using Rasch analysis among the Indonesian general population. A cross-sectional survey was conducted with 330 participants across 34 provinces using convenience and snowball sampling. A 23-item questionnaire (18 knowledge items covering transmission, prevention, and vaccination) was administered online, and data were analysed using the Rasch measurement model to evaluate reliability, unidimensionality, item fit, and person-item targeting. The instrument demonstrated robust psychometric properties, with person reliability of 0.77, item reliability of 0.98, and Cronbach's alpha of 0.78, indicating good internal consistency. Unidimensionality was confirmed by raw variance explained by the measure (35.3%) and unexplained variance in the first contrast (4.5%). The Wright map revealed a well-defined hierarchy of item difficulty from easiest (K1) to most difficult (K23), with mean person ability exceeding mean item difficulty. Most items showed acceptable fit, although a few (K1, K2, K18, K19) exhibited suboptimal discrimination, suggesting minor revisions for future iterations. The newly developed 23-item dengue vaccination knowledge questionnaire is a valid and reliable tool for assessing knowledge gaps among the Indonesian general population, and can support pharmacists, public health practitioners, and policymakers in delivering targeted education and strengthening evidence-based dengue vaccination strategies.

Keywords: Dengue, Knowledge Level, Psychometric Validation, Rasch, Vaccination

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1. INTRODUCTION

Dengue fever (DF) is one of the most rapidly spreading mosquito-borne viral infections worldwide [1], with an estimated 100 million symptomatic cases and 20,000-25,000 deaths annually [2], [3]. In Indonesia, dengue remains a persistent public health challenge; the 2023 Indonesian Health Survey reported a national prevalence of 0.64%, indicating that approximately six to seven per 1,000 population were diagnosed with dengue in the preceding year [4]. Although vector control has long been the mainstay of prevention, vaccination is increasingly recognised as essential for reducing disease burden [5]. Dengue vaccines can achieve up to 80% efficacy against symptomatic disease and 90% against hospitalisation, yet uptake remains extremely low in low- and middle-income countries due to high costs, distribution constraints, safety concerns in seronegative individuals, and limited public knowledge [6], [7], [8].

Public knowledge about dengue vaccination is a critical determinant of vaccine acceptance and program success. Several studies have assessed knowledge, attitudes, and practices (KAP) related to dengue, including research in Indonesia [9], China [10], and multinational surveys [11]. However, these studies primarily relied on conventional KAP approaches and did not develop or rigorously validate a standardised instrument specifically designed to measure dengue vaccination knowledge in the general population.

This study robust psychometric validation is essential. Unlike Classical Test Theory, which is sample-dependent and yields only ordinal scores [12], Rasch modelling provides interval-level measurement,

independent estimates of person ability and item difficulty, and diagnostic information on item fit and unidimensionality [13], [14]. These advantages make Rasch analysis particularly suited for developing instruments that can accurately identify knowledge gaps and guide targeted interventions.

Given the high burden of dengue in Indonesia, the low uptake of vaccination, and the lack of a Rasch-validated tool, this study aimed to develop and psychometrically validate a dengue vaccination knowledge questionnaire using Rasch analysis among the Indonesian general population. The resulting instrument is intended to support pharmacists, public health practitioners, and researchers in assessing community knowledge, informing educational strategies, and strengthening future immunisation programs.

2. METHOD

This study followed the methodological framework described by Zamanzadeh et al. (2015) [15] for questionnaire development and psychometric testing. The framework comprises a two-step process of development and judgment; however, the present study focused on the development phase (domain determination, item generation, and instrument formation) and the subsequent Rasch-based psychometric evaluation, without formal face and content validity assessment.

The questionnaire was developed through a three-step process of determining the content domain, sampling from content, and instrument formation. The content domain was identified by reviewing existing literature on dengue fever and its vaccination, and items were adapted from previous studies [9], [10], [11], [16] as well as from dengue vaccination reports published by the World Health Organization and the Centers for Disease Control and Prevention [5], [17], [18]. The final instrument consists of three sections: an informed consent statement, a section collecting demographic characteristics of respondents, and a knowledge section comprising 23 dichotomous (true/false) items across three domains of transmission (K1-K4), prevention (K5-K10), and vaccination (K11-K23).

A cross-sectional survey design was used, with the target population being communities across all 34 provinces in Indonesia. Inclusion criteria were Indonesian citizens aged 15 to 64 years who were able to use and understand the Google Form platform, could read well, and were willing to provide informed consent. Participation was voluntary. A convenience sampling approach was used to obtain a diverse pool of participants, supplemented by snowball sampling whereby participants were encouraged to share the questionnaire within their personal networks. A sample size of 250 to 500 respondents is sufficient for Rasch analysis to produce stable estimates of item locations [14], [19]. Data were collected over eight weeks from December 16, 2025, to February 16, 2026. The Google Form questionnaire link was distributed via the WhatsApp social media platform and through snowball sampling within community networks [20]. Respondents' data were extracted from Google Forms, coded, and entered into SPSS version 26.0 (IBM Corp., Armonk, NY, USA) before being exported to Winsteps software version 5.2.1.0 for Rasch analysis.

Psychometric properties were evaluated using the Rasch measurement model, analyzed with Winsteps software using a logit scale and the Joint Maximum Likelihood Estimation (JMLE) equation. Rasch analysis was used to assess the measurement and structural characteristics of the scale, including item difficulty, person ability, and model fit [21].

Reliability was assessed using person and item reliability, separation indices, and Cronbach's alpha. A person or item reliability of ≥ 0.6 and a separation index of ≥ 1.5 indicate good internal consistency [14], [22], and Cronbach's alpha ≥ 0.6 was also considered acceptable [22].

Fit statistics, including infit and outfit mean square (MNSQ) and Z-standardized (ZSTD) values, were used to determine how well the data fit the Rasch model. Ideal MNSQ values are 1.0, with values between 0.5 and 1.5 considered acceptable [23]. Infit and outfit ZSTD values between -2 and $+2$ were regarded as acceptable [24], along with point measure correlations between 0.4 and 0.85 [23], [25]. Infit (inlier-pattern-sensitive fit statistic) is sensitive to unexpected response patterns on items targeting the respondent's ability level, while outfit (outlier-sensitive fit statistic) is sensitive to unexpected responses on items that are relatively easy or difficult for the respondent [14].

The Wright map was used to illustrate the distribution of item difficulty and person ability on the same logit scale, examining how well the difficulty of items matched the ability level of respondents. A difference of 0 logits between mean person ability and mean item difficulty indicates a perfect match, whereas a difference greater than 1 logit suggests that the items are too difficult for the sample [14], [23], [26].

The study was approved by the Health Research Ethics Committee of Universitas Harapan Bangsa, Indonesia (B. LPPMUHB/1323/12/2025) in December 2025. All participants were informed about the research

and provided digital informed consent before proceeding to answer the questionnaire. Participant anonymity was maintained throughout the study.

3. RESULTS AND DISCUSSION

A total of 330 participants from 34 provinces in Indonesia completed the questionnaire. The demographic characteristics of the participants are presented in **Table 1**. The majority of participants were female (61.5%), aged between 17 and 24 years (67.3%), and resided in the Western Indonesia Time zone (WIB, 57.9%). Most participants were single (74.8%), held a bachelor’s degree (51.2%), and had a monthly salary of less than Rp 2,500,000 (46.4%).

Table 1. Demographic characteristics of the participants (N = 330).

Baseline characteristics	n	%
Sex		
Male	127	38.5
Female	203	61.5
Age		
< 17 year	31	9.4
17-24 year	222	67.3
> 24 year	77	23.3
Region		
WIB	191	57.9
WITA	103	31.2
WIT	36	10.9
Marital		
Single	247	74.8
Married	83	25.2
Educational Level		
Elementary School	43	13
Middle/Senior School	109	33
Bachelor	169	51.2
Doctoral	9	2.7
Salary		
< Rp 2,500,000	153	46.4
Rp 2,500,000 - Rp 5,000,000	137	41.5
> Rp 5,000,000	40	12.1

The psychometric properties of the 23-item dengue knowledge questionnaire were evaluated using the Rasch measurement model. The summary statistics for both persons and items are presented in **Table 2**. The mean infit and outfit mean square (MNSQ) values for persons were 0.99 and 1.01, respectively, while those for items were 1.00 and 1.01, respectively, indicating acceptable fit to the Rasch model. The corresponding Z-standardized (ZSTD) values were 0 for both persons and items, further supporting model fit.

Person reliability was 0.77 with a separation coefficient of 1.81, indicating that the sample size was adequate to distinguish between participants with different levels of knowledge. Item reliability was 0.98 with a separation coefficient of 9.03, demonstrating that the item difficulty hierarchy was well defined and the sample size was sufficient to confirm the continuum of item difficulty. Cronbach’s alpha was 0.78, reflecting acceptable internal consistency.

Regarding unidimensionality, the raw variance explained by the measure was 35.30%, while the unexplained variance in the first contrast was 4.50%. These values indicate that the instrument meets the assumption of unidimensionality, a fundamental requirement for Rasch analysis.

Table 2. The summary statistics of Rasch parameters.

Criteria	Person	Item (Question)
N	330	23
Mean		
Infit MNSQ	0.99	1
Infit ZSTD	0	0
Outfit MNSQ	1.01	1.01
Outfit ZSTD	0	0
Reliability (Rasch)	0.77	0.98
Reliability (Cronbach’s alpha)	0.78	
Separation coefficient	1.81	9.03
Unidimensionality		

Criteria	Person	Item (Question)
Raw variance by measure	35.30%	
Unexplained variance in 1st contrast	4.50%	

Item fit was assessed using infit and outfit MNSQ values, with an acceptable range of 0.5 to 1.5, and ZSTD values between -2 and +2. Point measure correlation values between 0.4 and 0.85 were considered indicative of acceptable item discrimination. **Table 3** presents the fit indices for all 23 items.

Most items demonstrated acceptable infit and outfit MNSQ values within the 0.5-1.5 range. However, several items exhibited borderline or suboptimal fit characteristics. Items K1 and K2 showed outfit MNSQ values of 1.31 and 1.28, which remain within the acceptable range, but their point measure correlations were below 0.4 (0.30 and 0.26, respectively), suggesting weaker discrimination. Item K3 also had a point measure correlation of 0.38, slightly below the recommended threshold.

Items K18 and K19 demonstrated infit ZSTD values of 1.4 and 1.9, respectively, and outfit ZSTD values of 1.0 and 1.3, respectively, with point measure correlations of 0.35 and 0.28. These values indicate that K18 and K19 may have suboptimal fit and discrimination. Items K4, K5, K11, K13, and K22 showed good fit across all indices, with point measure correlations exceeding 0.40 and MNSQ values close to 1.0. The item fit analysis suggests that while the majority of items perform adequately, a small number of items may require further evaluation or revision in future iterations of the instrument.

Table 3. Items fit and misfit indices.

Item	Infit MNSQ	ZSTD	Outfit MNSQ	ZSTD	Point Correlation	Measure
K1	1.00	0.0	1.31	1.4	0.3	
K2	1.10	1.0	1.28	1.4	0.26	
K3	1.00	0.0	0.99	0.0	0.38	
K4	0.93	-0.8	0.84	-0.8	0.42	
K5	0.91	-1.3	0.87	-0.9	0.47	
K6	1.04	0.7	0.98	-0.1	0.38	
K7	1.00	0.0	1.14	1.2	0.4	
K8	0.99	-0.2	0.96	-0.4	0.45	
K9	1.02	0.3	0.99	-0.1	0.43	
K10	0.99	-0.1	0.96	-0.4	0.45	
K11	0.93	-1.5	0.94	-0.8	0.5	
K12	1.02	0.4	1.06	0.8	0.43	
K13	0.92	-1.6	0.89	-1.6	0.51	
K14	1.01	0.1	1.00	0.1	0.44	
K15	1.00	0.0	0.99	-0.1	0.45	
K16	1.04	0.9	1.06	0.8	0.41	
K17	1.00	0.1	1.03	0.3	0.42	
K18	1.09	1.4	1.12	1.0	0.35	
K19	1.15	1.9	1.20	1.3	0.28	
K20	1.00	0.1	0.94	-0.4	0.42	
K21	0.95	-0.6	0.85	-1.0	0.44	
K22	0.90	-1.2	0.88	-0.7	0.46	
K23	0.95	-0.4	0.91	-0.4	0.4	

The Wright map (**Figure 1**) illustrates the distribution of person ability (left side) and item difficulty (right side) on the same logit scale. On the left, each “#” represents three participants, while each “.” represents one or two participants. On the right, each “#” represents three items, and each “.” represents one or two items. This map allows a direct comparison between the knowledge level of the participants and the difficulty of the questionnaire items. The mean person ability (indicated by “M” on the left side) is positioned higher than the mean item difficulty (indicated by “M” on the right side). This indicates that, on average, participants’ knowledge level exceeded the average difficulty of the items, suggesting that the sample was relatively knowledgeable about dengue fever and its vaccination.

The items are ordered from easiest at the bottom to most difficult at the top. The easiest item was K1, while the most difficult item was K23. Examination of the left side shows that most of the “#” symbols are concentrated below the mean person ability (“M”), indicating that a substantial proportion of participants had knowledge levels below the average for the sample. This spread in person abilities, combined with the range of item difficulties from easy to hard, demonstrates that the instrument can distinguish between individuals with different knowledge levels. The Wright map confirms that the instrument is appropriately targeted for this

population, with a reasonable match between the difficulty of items and the ability of participants, though there is a slight skew with more participants clustering below the mean.

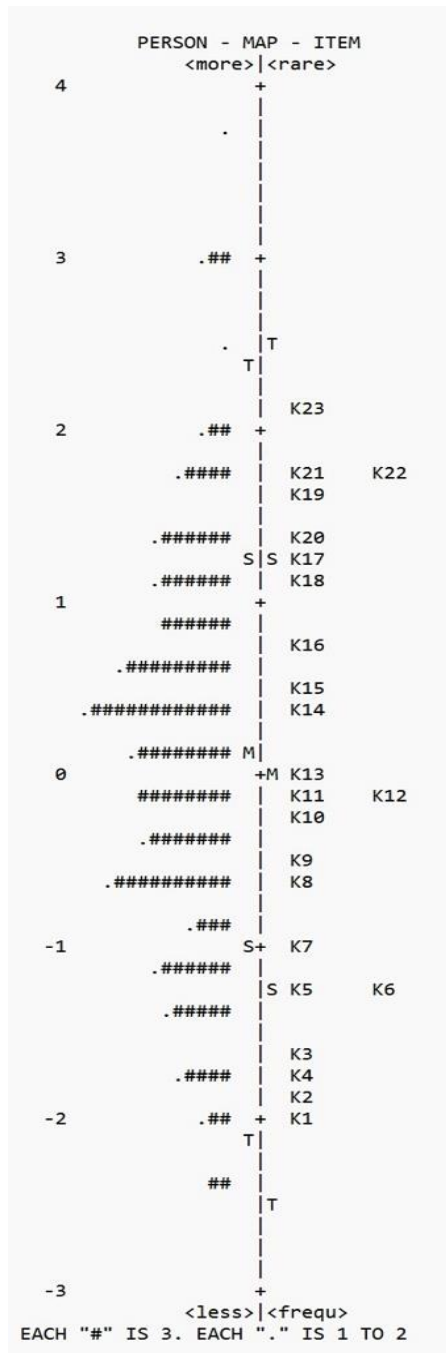


Figure 1. Wright Map of instruments representing a direct comparison of person dispersion and item distribution. To the best of our knowledge, this is the first study to develop and psychometrically validate a dengue knowledge questionnaire using Rasch analysis in the Indonesian population. The instrument, comprising 23 items across three domains (transmission, prevention, and vaccination), demonstrated acceptable reliability, unidimensionality, and overall fit to the Rasch model. These findings provide a robust foundation for using this tool in clinical pharmacy practice, public health research, and community-based educational interventions.

This study yielded person reliability of 0.77 and item reliability of 0.98, with corresponding separation indices of 1.81 and 9.03, respectively. The person separation index of 1.81 indicates that the instrument is capable of distinguishing participants into at least two distinct levels of knowledge, a finding that aligns with the recommended threshold of ≥ 1.5 for adequate stratification [14]. The item separation index of 9.03 is exceptionally high, demonstrating that the 23 items span a wide continuum of difficulty and can reliably rank participants across the knowledge spectrum. This level of item separation is particularly valuable for identifying specific knowledge gaps that can be targeted by pharmacists and public health educators. Cronbach's alpha of 0.78 further supports the internal consistency of the scale, which is comparable to other validated health literacy instruments in Southeast Asian settings [9], [11].

Unidimensionality, a fundamental assumption of the Rasch model, was confirmed by the raw variance explained by the measure (35.3%) and the unexplained variance in the first contrast (4.5%). These values exceed the commonly accepted thresholds of $\geq 30\%$ for variance explained by the measure and $\leq 5-10\%$ for unexplained variance in the first contrast [20], [27]. This finding confirms that the instrument measures a single latent construct knowledge of dengue fever and its vaccination without significant multidimensional interference. Unidimensionality ensures that total scores accurately reflect overall knowledge, allowing pharmacists to confidently interpret aggregate scores and identify areas for targeted counselling.

Examination of item fit statistics revealed that most items demonstrated acceptable infit and outfit MNSQ values within the 0.5-1.5 range [23], with ZSTD values between -2 and +2 [14], [23]. However, several items exhibited suboptimal psychometric properties. Items K1 and K2 showed point measure correlations below 0.4 (0.30 and 0.26, respectively), suggesting that these items may not discriminate effectively between participants with high and low knowledge levels [14], [25]. Items K18 and K19 displayed borderline infit ZSTD values (1.4 and 1.9, respectively) and point measure correlations of 0.35 and 0.28, indicating potential misfit. A review of the content of these items is warranted. If K1 and K2 pertained to basic transmission facts that are widely known, their low discrimination may reflect ceiling effects rather than poor construction. Items K18 and K19 may address more nuanced aspects of vaccination or prevention that are less commonly understood, leading to inconsistent response patterns. While these items may be retained for content coverage, future iterations of the instrument should consider revising or replacing them to enhance overall measurement precision.

The Wright map provided critical insights into the alignment between item difficulty and person ability [28]. The easiest item was K1 ("Dengue is caused by a virus"), which reflects a fundamental fact that is widely understood. The most difficult item was K23 ("The dengue vaccine can be administered to pregnant women"), a more nuanced and less commonly known fact. The position of K23 at the top of the difficulty hierarchy suggests that it assesses a relatively advanced aspect of dengue vaccination, likely related to specific safety considerations or contraindications. From a pharmacy practice perspective, this finding highlights a specific knowledge gap that should be prioritised in patient education and counselling. This heterogeneity has important public health implications: while the average community member may possess adequate knowledge, a significant subgroup remains vulnerable due to insufficient understanding of dengue transmission, prevention, or vaccination.

Comparisons with previous studies reinforce the value of this instrument. Existing dengue knowledge scales, such as those developed by study from Indonesia before [9], have typically relied on classical test theory approaches, which are sample-dependent and do not provide interval-level measurement. The application of Rasch analysis in this study offers several advantages over classical methods: it produces item difficulty calibrations that are independent of the sample, provides person ability estimates that are independent of the specific items administered, and enables direct comparison between person ability and item difficulty on a common logit scale [29], [30]. In the field of social and clinical pharmacy, Rasch modeling is increasingly recognized as the gold standard for instrument development because it ensures that the measurement properties are robust and that scores can be meaningfully interpreted across different populations and settings [14], [23]. This study thus contributes a culturally adapted, Rasch-validated tool that addresses a critical gap in the Indonesian context, where locally validated instruments for dengue knowledge remain scarce.

The implications of this study extend across clinical pharmacy, public health, and research. For pharmacists, the instrument provides a practical, evidence-based tool to assess community knowledge before implementing educational interventions or supporting dengue vaccination campaigns. The identification of difficult items (particularly K23) enables pharmacists to tailor counselling to address specific misconceptions or knowledge deficits. For public health practitioners, the instrument can be used to identify subgroups with low knowledge (e.g., based on age, education, or geographic region) and to design targeted health promotion strategies that address the unique needs of these populations. For researchers, this validated tool opens avenues

for future studies on the relationship between knowledge and vaccine acceptance, the effectiveness of educational interventions, and the evaluation of knowledge-attitude-practice (KAP) dynamics in dengue prevention.

Several limitations should be acknowledged. Although the non-probability sampling strategy enabled broad geographic participation across all 34 provinces, it carries an inherent potential for selection bias. The use of convenience and snowball sampling via WhatsApp introduced selection bias, as the sample was disproportionately young, female, and higher-educated, limiting generalizability. Formal face and content validity assessments were not conducted prior to data collection, and differential item functioning (DIF) and test-retest reliability were not evaluated. Additionally, further validation is needed in more diverse populations and cross-cultural settings. Future research should prioritise revising the few misfitting items, conducting DIF analyses, and assessing predictive validity in relation to vaccine uptake and preventive behaviours.

4. CONCLUSION

This study successfully developed and psychometrically validated a 23-item dengue vaccination knowledge questionnaire using Rasch analysis, demonstrating robust reliability (person reliability 0.77; item reliability 0.98), strong unidimensionality (35.3% raw variance explained), and a well-defined hierarchy of item difficulty that distinguishes varying knowledge levels among the Indonesian general population. The instrument provides a valid and reliable tool for assessing community knowledge gaps, enabling pharmacists, public health practitioners, and policymakers to deliver targeted education and design evidence-based vaccination strategies that address specific misconceptions particularly regarding the most difficult items such as K23. Future research should focus on refining the few items with suboptimal fit, conducting differential item functioning analyses across demographic groups, and further validating the tool in broader populations to enhance its generalizability and support dengue prevention efforts both nationally and in other endemic settings.

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