ORIGINAL ARTICLE

Psychometric validation of a healthcare professionals' attitude assessment scale toward maternal vaccination: A rasch model analysis

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ABSTRACT

Introduction: Maternal vaccination is a proven strategy to protect newborns from vaccine-preventable diseases, yet its success depends heavily on healthcare professionals' attitudes and recommendations. In Malaysia, a validated and culturally appropriate tool to measure these attitudes is lacking. This study aimed to develop and validate a culturally relevant, reliable tool to assess healthcare professionals' attitudes toward maternal vaccination

Materials and Methods: The items were initially developed based on an extensive review of literature, vaccination guidelines, and expert reviews, followed by content and face validity involving nine and 30 reviewers, respectively. A pilot study was conducted on 196 respondents, and the reliability and validity were assessed using Rasch analysis (RA).

Results: Initially, 26 items were developed. However, only half of the items passed the content validity phase, with another two items removed post face validation. Eleven items were piloted for assessment of reliability and validity. Three items were removed due to concerns over their fit indices, and one item for redundancy. The final refined questionnaire consisted of seven items, demonstrating good reliability (person reliability = 0.80, separation index = 1.98), unidimensionality, and appropriate rating scale functioning, confirming its suitability for assessing healthcare professionals' attitudes toward maternal vaccination.

Conclusion; This study presents a psychometrically sound tool to measure healthcare professionals' attitudes toward maternal vaccination.

KEYWORDS:
Attitude, questionnaire, reliability, validity, maternal vaccination, Rasch analysis

INTRODUCTION

Infections that are self-limiting in adults can potentially cause life-threatening problems to newborns due to immaturity of the immune system.[1,2] One example can be seen in pertussis, a highly contagious respiratory disease caused by the bacterium Bordetella pertussis which often presents as a mild upper respiratory tract infection in adults but possess a significant risk to infants under two months of age.[3] Protecting infants from infection can be achieved through passive immunity via transplacental transfer of antibodies from mother.[1,2] Therefore maternal vaccination offers a tangible intervention, as they have been shown to reduce morbidity and mortality rates in both mothers and infants.[4]

The Ministry of Health Malaysia has taken an important step by integrating maternal vaccinations—such as tetanus-diphtheria-acellular pertussis (Tdap) and influenza vaccines—into the existing antenatal care framework. However, vaccine hesitancy remains a potential barrier to the success of this cost-effective public health intervention.[4] Healthcare professionals play a critical role in recommending and administering maternal vaccines, and their attitude have a profound influence on pregnant women's willingness to accept vaccination.[5] In settings where provider recommendation is a key determinant of vaccine uptake, understanding the attitudes of healthcare professionals is crucial for designing effective strategies to improve maternal immunisation coverage.[6] To facilitate this, there is a pressing need for a reliable, validated, and culturally appropriate instrument to accurately measure healthcare professionals' attitudes toward maternal vaccination, particularly in the Malaysian context where vaccine hesitancy may be shaped by diverse social and cultural factors.[7]

Traditional survey methods may not capture the perspectives of healthcare professionals accurately. By employing a robust psychometric analysis technique like Rasch model, a precise and reliable scale to measure latent traits, such as attitude can be developed.[8] In Malaysia, where maternal vaccinations are being considered for national implementation, no validated, culturally appropriate instrument currently exists to assess provider attitudes. Without such a tool, efforts to identify knowledge gaps, address hesitancy, or tailor interventions remain limited. Accordingly, this study aims to develop and validate a reliable questionnaire to assess the attitudes of healthcare professionals in Malaysia towards maternal vaccination uptake.

The development of this questionnaire was guided by the Theory of Planned Behaviour (TPB). According to TPB, an individual's intention to perform a behaviour is influenced by three key constructs: attitude toward the behaviour,

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subjective norms (perceived social pressures), and perceived behavioural control (perceived ease or difficulty of performing the behaviour). In the context of maternal vaccination, healthcare providers' recommendations are shaped by their attitudes toward vaccines, their perception of expectations from peers and institutions, and their confidence in discussing or offering vaccines.[9] These constructs informed the generation and structuring of questionnaire items, ensuring theoretical alignment with the determinants of provider behaviour. The Rasch analysis was subsequently used to refine item performance and ensure unidimensionality of the attitude construct. However, this study only focuses on the attitude component and does not measure subjective norms or perceived behavioural control, as these aspects cannot yet be assessed since the vaccination program has not started.

MATERIALS AND METHODS

This study employed a cross-sectional design to develop and validate a questionnaire assessing healthcare professionals' attitudes toward maternal vaccination.

Stage 1: Item Generation

To inform item development, a structured literature search was conducted across PubMed, Cochrane Library, Epistemonikos, and CINAHL to identify existing instruments and conceptual domains related to healthcare professionals' attitudes toward maternal vaccination. Structured search strategy using Boolean operators (AND/OR) was used to combine population terms ("healthcare providers," "midwives," "nurses," "doctors"), construct terms ("attitude," "beliefs," "perception," "acceptance," "hesitancy"), intervention terms ("maternal vaccination," "antenatal vaccine," "pertussis vaccine," "influenza vaccine"), and instrument terms ("questionnaire," "survey," "scale," "tool," "psychometric validation"). The aim was to capture the multifaceted nature of attitudes as conceptualized by the TPB.

Stage 2: Content and Face Validity

The preliminary items underwent content validation by a panel of five experts in public health, obstetrics, and psychometrics. Each expert independently assessed the relevance and clarity of each item using a 4-point Likert scale. The Content Validity Index (CVI) was calculated for each item, and items with a CVI below 0.78 were revised or removed, ensuring that the questionnaire items were both representative and comprehensible.[9,10] For face validity, the revised questionnaire was tested on 30 healthcare workers in Kelantan who care for pregnant women. Participants rated item clarity and comprehensibility using a four-point Likert scale, and written feedback was collected. Items with a face validity index (I-FVI) of at least 0.83 were retained in the final questionnaire.[11]

Stage 3: Sampling and Data Collection

The finalised questionnaire was distributed to a convenience sample of 196 healthcare professionals who provide antenatal and maternal care across various healthcare settings, including government clinics, teaching hospitals, private general practices, and private hospitals in Kuantan, Pahang. The sample encompassed a diverse group of professionals, such as midwives, nurses, medical officers, and obstetric specialists. Participation was voluntary, and informed consent was obtained from all respondents. The survey was conducted online using a self-administered questionnaire with no time constraints. The questionnaire consisted of two sections: sociodemographic and clinical background, and attitudes toward maternal vaccination.

Stage 4: Rasch Analysis

Rasch analysis, performed using Winsteps 3.72.1, assessed reliability (person reliability and separation indices), validity (item fit, polarity, and discrimination index), item redundancy, and dimensionality.[12] The Wright Map was used to evaluate the scale's ability to differentiate between positive and negative attitudes toward maternal vaccination.[13]

Dimensionality was examined through principal component analysis (PCA) of residuals, comparing explained variance to unexplained variance from the first contrast. The rating scale's functioning was assessed based on response distribution, monotonicity, threshold calibration, category probability curves, and Outfit MNSQ statistics (14, 15). Table I summarizes the statistical criteria for reliability and validity using the Rasch Model.

RESULTS

Item generation

Through the literature review, we identified four key domains related to attitudes: vaccine efficacy, safety, necessity, and communication. These domains served as the foundation for our item development process. However, since no validated tool was available in Malaysia, we developed a new set of 22 items to comprehensively assess healthcare professionals' attitudes toward maternal vaccination.

Sociodemographic and Clinical Experiences

We recruited 196 respondents in the pilot study. The mean age (standard deviation [sd]) were 40.5 (5.8) years with an average of 15.9 (6.3) years of working experience. The majority 71 (36.2%) were community nurses, followed by staff nurses 49 (25.0%), doctors 48 (24.5%) and midwifes 28 (14.3%). Most respondents, 182 (92.9%) were working in government facilities. Educational levels varied, with 76 (38.8%) holding a Diploma or less and 13 (6.6%) having a postgraduate degree. Almost half of the respondents fell into the B40 income group (earning less than RM 5250.00 per month). 171 (87.2%) of respondents had experience administering anti-tetanus toxoid (ATT) to pregnant women. 180 (91.8%) had received influenza vaccine, with a small proportion reporting personal 20 (10.2%) and family 13 (6.6%) negative vaccination experiences. The characteristics of the respondents is presented in table II.

Face and Content Validity

Content validity was evaluated by a panel of nine experts in infectious diseases, obstetrics, family medicine, and public health. The overall S-CVI was 0.83, indicating good content relevance. Of the 22 items, 14 (64%) were rated as relevant or highly relevant, achieving an I-CVI of at least 0.78. Eight items had lower I-CVI scores (0.4–0.7) and were excluded

Table I: Criteria for reliability and validity using the Rasch Model

Criteria	Statistics	Acceptable value
Reliability	Person reliability*	> 0.63
	Person separation*	> 1.25
Validity	Item polarity based on point measurement correlation (PT-MEA CORR)	> 0.30
	Item fit based on mean square infit and outfit value	0.6 – 1.4
	Discrimination	Close to 1.0
Unidimensionality assessed using principal component analysis (PCA) of the residuals.	Raw variance explained by the model	> 40%
	Unexplained variance in the first contrast	Less than 2.0 eigenvalue or less than 10.0% AND less than 1/3 of raw variance explained by items.
	First contrast disattenuated correlations	> 0.6
Rating scale functionality assessment	Number per category, (d) distinct probability curve graph on each response category, and (e)	> 10 per category
	Distribution of frequencies across categories	Regular distributions (i.e. uniform, normal, bimodal or slightly skewed
	Monotonicity of average measures across rating scale categories	Trend of average measures should increase monotonically
	Spacing between step calibrations (thresholds)	Threshold distances range from 1.4 to 5.0 logits,
	Characteristics of Category Probability Curve (CPC)	Each category should have a clear peak and distinct.
	Outfit MNSQ value of each category	0.6 – 1.4

from face validation. The remaining 14 items were tested for face validity among healthcare workers involved in antenatal care in Kelantan. Three items had I-FVI scores below 0.83 and were removed, leaving 11 items in the final questionnaire.

Reliability and Validity

The questionnaire's reliability and validity were assessed using Rasch Analysis. Initially, the 11-item version showed a person reliability of 0.76 and a separation index of 1.77, but some items had fit and redundancy issues. Items 4, 6, and 11 had MNSQ values above 1.4, while items 9 and 10 showed high redundancy. After removing items 4, 6, 10, and 11, the refined 7-item version improved to 0.80 reliability and a 1.98 separation index, demonstrating good internal consistency and the ability to distinguish between two attitude levels. All remaining items had point-measure correlations above 0.30, MNSQ values within 0.6–1.4, and no redundancy (residual correlations <0.7), confirming a good fit to the Rasch model. Table III presents the full item analysis while the Wright map (Figure 1) visualised the position of items and persons based on their ability and difficulty respectively on the same scale.

Principal Component Analysis (PCA) and Dimensionality

The dimensionality of the questionnaire was assessed using Principal Component Analysis (PCA) of residuals. The PCA showed that the raw variance explained by the measures was 11.1 (61.3%), indicating that most of the variance was captured by the main construct. The unexplained variance in the first contrast was 1.8 eigenvalue, which was about one-third of the raw variance explained by the items (4.5 eigenvalue). This suggests that the questionnaire primarily measures a single construct, with no strong secondary dimension in the residuals, supporting its unidimensionality.[12]

Rating Scale Category Functioning

The rating scale's validity was assessed using Rasch analysis, focusing on key parameters. Each category had at least 10 responses, ensuring stable estimation. Responses were slightly skewed toward higher categories, reflecting a positive attitude trend. The average measures increased progressively, confirming monotonicity, while threshold calibration distances (1.4–5.0 logits) were within the acceptable range for category separation. Category probability curves showed distinct peaks, though minor overlap was observed between Categories 2 and 3, indicating some interpretability concerns. Outfit MNSQ values were mostly within the acceptable range, except for Category 1 (MNSQ = 1.75), suggesting potential misfit. Given the narrow threshold calibration distance between Categories 1 and 2, merging them would likely improve scale effectiveness. Figure 1 illustrates the Category Probability Curve (CPC).

DISCUSSION

Attitude is a strong determinant of intention and practice as explained by the theory of planned behaviour.[16,17] This causal relationship can be explained by the theory of planned behaviour by Ajzen and Fishbein, which states that attitude, along with 'perceived behavioural control' and 'subjective norm', are factors that shape the intention to behave in a certain way.[18] Healthcare professional with positive attitudes toward maternal vaccination are more likely to introduce and persuade their patients to get vaccinated (Gauld et al., 2022). In previous studies, recommendation from healthcare professionals have been found to be a major driving factors for maternal vaccine uptake.[19,20] This study is highly relevant in the context of Malaysia's ongoing efforts to strengthen maternal immunisation programmes, particularly with the anticipated national rollout of antenatal pertussis and influenza vaccines. As healthcare professionals are often the most trusted source of vaccine information for pregnant

Table II: Characteristics of Respondents in the Pilot Study

Variables	Frequency, n (%)
Age (years)	40.5 (5.8)*
Work Experience (years)	15.9 (6.3)*
Work position	196 (100.0)
Community Nurse	71 (36.2)
Staff nurse	49 (25.0)
Midwife	28 (14.3)
Medical Officer	39 (19.9)
Specialist	9 (4.6)
Workplace	196 (100.0)
Maternal and Child Health Clinic	154 (78.6)
Maternity clinic (Government Hospital)	25 (12.8)
Maternity clinic (Private Hospital)	8 (4.0)
General practices	9 (4.6)
Employer	196 (100.0)
Government	182 (92.9)
Private	11 (5.6)
Self-employed	3 (1.5)
Highest Level of Education	196 (100.0)
Diploma	76 (38.8)
Sarjana Muda (First degree)	39 (19.9)
Sarjana (Postgraduate)	13 (6.6)
Others	68 (34.7)
Household Income	196 (100.0)
< RM 5250.00	85 (43.4)
RM 5250 - 11,819	87 (44.4)
> RM 11,820	24 (12.2)
Experience Administering Anti-Tetanus Toxoid (ATT) to Pregnant Women	196 (100.0)
Yes	171 (87.2)
No	25 (12.8)
Has Taken Influenza Vaccine	196 (100.0)
Yes	180 (91.8)
No	16 (8.2)
Personal Bad Vaccination Experience	196 (100.0)
Yes	20 (10.2)
No	176 (89.8)
Bad Vaccination Experience in Family	196 (100.0)
Yes	13 (6.6)
No	183 (93.4)

* mean (sd)

Table III: Rasch analysis of items in the attitude questionnaire

Item	Infit		Outfit		PT-MEA CORR	Discrim.
	MNSQ	ZSTD	MNSQ	ZSTD		
1	0.86	-1.2	0.82	-1.5	0.80	1.22
2	0.69	-2.9	0.75	-1.1	0.75	1.27
3	0.80	-1.8	0.78	-1.6	0.78	1.16
5	1.12	1.0	0.64	-0.4	0.64	0.96
7	1.22	1.9	1.21	1.8	0.78	0.81
8	0.81	-1.7	0.76	-2.1	0.82	1.23
9	1.40	3.4	1.59	4.4	0.73	0.43
Mean (SD)	0.99 (0.24)	-0.2 (2.1)	0.98 (0.29)	-0.1 (2.2)	0.76 (0.06)	1.01 (0.31)

MNSQ = mean square, ZSTD = Z-standard score, PT-MEA CORR = Point measurement correlation, Discrim = descrimination index

women, accurately assessing their attitudes is critical for designing effective interventions, training programmes, and policy responses aimed at improving maternal vaccine uptake.

In this study, we employed RA due to its superior diagnostic ability in validating and assessing the reliability of the developed questionnaire, rather than the commonly employed, CTT.[8] In RA, each item is treated individually, where the probability of response to an item is independent from responses to other items and has equal contribution to the total score (additive conjoint measurement).[12] This attribute allows us to examine each item in detail including how they function across different levels of attitude and determine its fit with the overall scale. Problematic items can be removed or modified accordingly.[12] RA also produces invariant measurement, where the estimation of item difficulty is independent of the estimation of respondents'

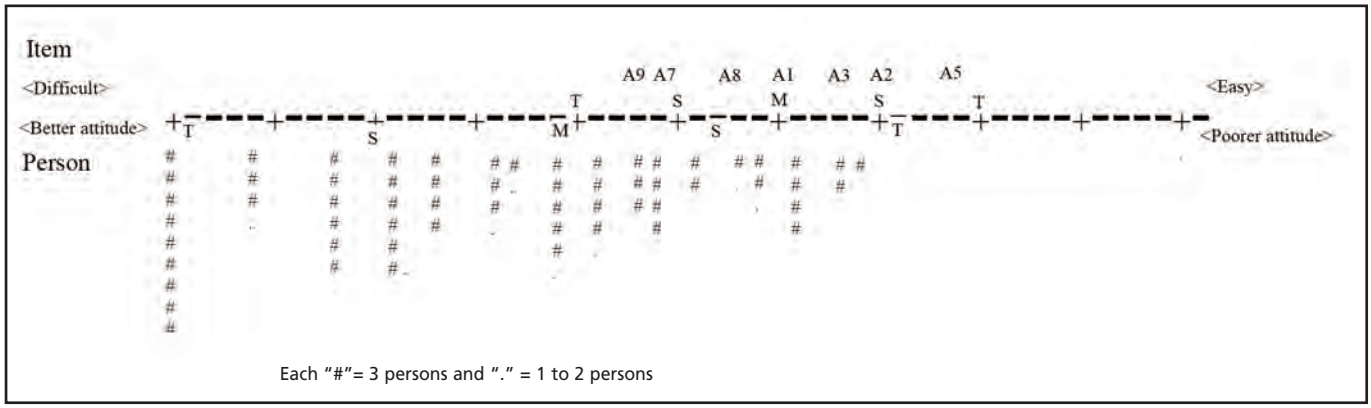

Fig. 1: Wright Map of Person and Item Distribution
The Wright Map shows the alignment of persons (attitudes) and items (difficulty levels) on a shared scale. Respondents with better attitudes are on the left, while those with poorer attitudes are on the right. Items on the right are easier to endorse, while those on the left are more difficult.

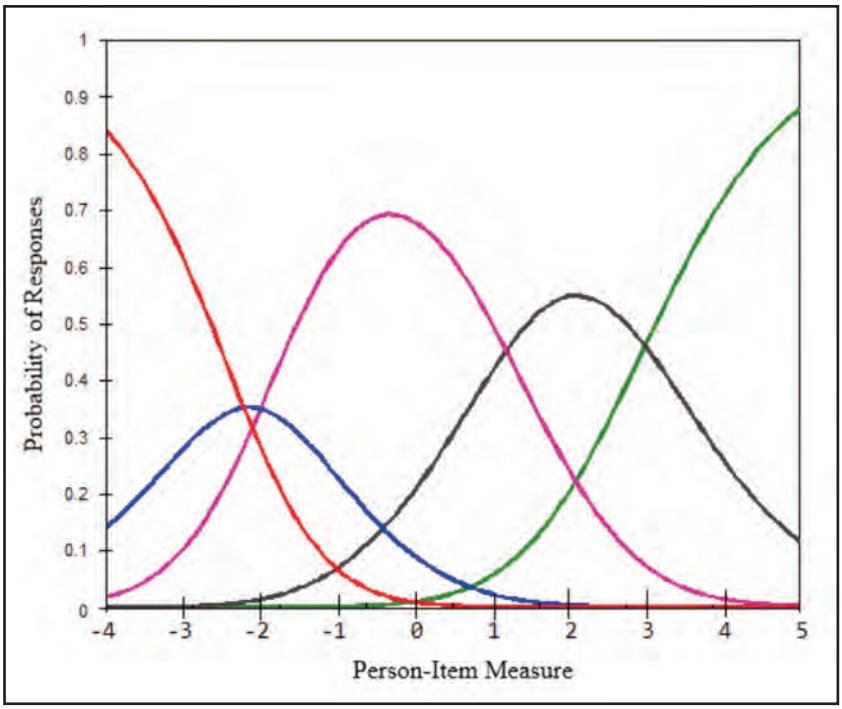

Fig. 2: Category Probability Curves from Rasch Analysis
The figure illustrates the probability of selecting each response category across different levels of the measured construct. Each category shows a distinct peak, confirming meaningful differentiation, while intersections indicate category transition points. Some overlap, particularly between the second and third categories, suggests minor ambiguity. Extreme categories dominate at the scale's ends, reflecting clear respondent tendencies. Overall, the curves indicate a well-functioning rating scale with minor areas for potential refinement.

attitude. This ensures that the item difficulty remains consistent regardless of the sample tested, making the new scale's reliability more stable when being used in different setting or populations.[8,12]

Despite a relatively small sample size, our newly developed questionnaire achieved a reliability of 80% which was sufficient to differentiate individuals with two distinct levels of attitudes: positive and negative. Reliability values between 70% and 80% are acceptable when measuring affective traits such as attitude, as these variables are not as stable as cognitive abilities.[12] Furthermore, since the questionnaire aims to categorise respondents into two attitude strata (positive and negative), the minimum person reliability and separation index required were 0.63 and 1.25, respectively. This is based on the Rasch separation index and Rasch reliability coefficient formulas:[21]

$$\text{Separation index, } G = \frac{(3x-1)}{4}$$

$$\text{Reliability, } R = \frac{G^2}{1+G^2}$$

Where x represents the number of discernible strata within the data

Our findings are consistent with previous validation studies on provider attitude tools, which also demonstrated the value of Rasch-based refinements in improving measurement precision. Unlike many earlier tools that were adapted cross-culturally without thorough psychometric testing, this questionnaire was developed from the ground up for a specific cultural and healthcare context.

A more robust assessment of validity can be achieved with a larger sample size and more random sampling. Despite using non-randomised sampling, the inclusion of healthcare providers from diverse clinical roles and hierarchies from both public and private sectors, improve the representativeness of the sample. The approach also provides a replicable framework for other low- and middle-income countries (LMICs) aiming to develop culturally grounded tools for assessing healthcare worker perceptions—an often overlooked but critical component of implementation science. Furthermore, by using Malay language and validated through Rasch analysis, the questionnaire holds promise for generalisability in Malaysia healthcare setting and potentially across other Southeast Asian countries with comparable healthcare systems and sociocultural contexts.

While person misfit analysis is a standard step in RA, we prioritised ensuring scale robustness across a diverse respondent pool. Removing misfitting individuals could lead to a loss of real-world variations in healthcare professionals' attitudes.[22,23] Instead, we focused on evaluating item fit, unidimensionality, and rating scale validity to confirm the tool's psychometric properties. Given the nature of attitude measurement, variations in responses are expected and do not necessarily indicate data errors. Additionally, given our sample size of 196, removing participants would have further reduced statistical power, potentially leading to unstable item estimates. While sensitivity analysis was not performed, the overall Rasch fit statistics confirmed that the refined scale functions reliably, supporting our decision to retain all respondents for analysis.[23]

Although the PCA indicated that the first contrast explained only 9.8% of the variance with an eigenvalue of less than 2.0, the subsequent contrasts explain progressively smaller portions of variance with decreasing eigenvalues (1.3, 1.2, 1.0, and 0.8). This pattern suggests an absence of strong secondary dimensions.[24] The unidimensionality of the scale was further supported by the fit of each item to the Rasch model. All seven items in the final scale had infit and outfit MNSQ values between 0.6 and 1.4 where values below 0.6 indicate overfit (predictable responses) and values above 1.4 indicate underfit.[8] Additionally, the polarity of all items which indicates the correlation between the item's score and the overall measure (or trait) being assessed, were positive and had values of more than 0.3.[12] All these findings confirm the unidimensionality of the questionnaire.

The Wright Map findings confirm that the scale effectively differentiates healthcare professionals based on their attitudes toward maternal vaccination. While the item distribution does not cover extreme attitude levels, this is not a limitation given the study's objectives.[25] The primary goal of this scale is not to finely rank respondents across multiple strata but to broadly classify them into key attitude groups (e.g., favourable vs. less favourable attitudes). Since this is not a high-stakes examination or competency test, such differentiation is sufficient for identifying general trends and informing public health interventions.[25] This makes the tool particularly useful for programmatic use by public health agencies, where the focus is more on identifying priority groups for training and support rather than precise measurement of individual scores.

Future work should consider longitudinal testing of the tool's responsiveness to change following educational interventions or policy shifts. Further cross-cultural validation in multilingual populations, particularly in regions with similar vaccine rollout plans, could expand its utility. Additionally, linking attitude scores with actual provider behaviours (e.g., vaccine recommendation rates) would further establish the scale's predictive validity. The scale provides a practical and meaningful classification, ensuring its applicability in real-world public health settings where targeted interventions are needed rather than precise ranking of individuals.

LIMITATIONS

This study used a non-random, convenience sampling method, which may limit the generalizability of the findings. While efforts were made to include participants from diverse professional backgrounds and healthcare settings, the lack of random sampling introduces the potential for selection bias. Therefore, the attitudes captured by this tool may not fully represent all healthcare professionals involved in maternal care across Malaysia. Future studies should consider employing random sampling strategies with larger sample sizes to further validate the scale and enhance its external validity.

CONCLUSIONS

Since healthcare workers' attitude towards maternal vaccination plays an important determining factor for a successful vaccination program, a valid tool that can accurately measure attitude is important. The newly developed questionnaire demonstrates good psychometric properties with acceptable reliability, allowing for an accurate assessment of the attitude. Through Rasch analysis, a questionnaire with unidimensional construct capable of discriminating those with negative and positive attitudes was produced. Despite the used of non-randomised sampling and a relatively small number of respondents, we were able to achieve a high overall item reliability and a good degree of generalisability. Future study with larger sample size and more diverse respondents could further improve the validity of this questionnaire.

REFERENCES

1. Albrecht M, Arck, Petra Clara. Vertically transferred immunity in neonates: mothers, mechanisms and mediators. Front. Immunol. 2020; 11: 555.
2. Kamath GD, Kukreja S, Mukherjee P, Kolhapure S, Sathyanarayanan S. Maternal immunization: trends in South and Southeast Asian countries. The Journal of Maternal-Fetal &

Neonatal Medicine,J Matern -Fetal Neonatal Med 2022; 35(25): 8372- 81.
3. Mansor J, Ismail H, Ismail N. Determinants of Pertussis among Young Children in Selangor, Malaysia. Sains Malays 2021; 50(2): 437-47.
4. Filip G, Sala A, Modolo V, Arnoldo L, Brunelli L, Driul L. Vaccination: Adherence and Hesitancy among Pregnant Women for COVID-19, Pertussis, and Influenza Vaccines. Vaccines 2024; 12(4): 427.
5. Chander S, Gonzalez-Casanova I, Chaves SS, Otieno NA, Widdowson M-A, Verani J, et al. Antenatal care providers' attitudes and beliefs towards maternal vaccination in Kenya. Gates Open Res 2021; 4(19):1-12.
6. Akinsola KO, Bakare AA, Gobbo E, King C, Hanson C, Falade A, et al. A systematic review of measures of healthcare workers' vaccine confidence. Hum Vaccin Immunothers. 2024; 20(1): 2322796.
7. Padmanabhanunni A, Pretorius TB, Isaacs SA. Validation of the vaccination attitudes examination scale in a South African context in relation to the COVID-19 vaccine: quantifying dimensionality with bifactor indices. BMC Public Health. 2023; 23(1): 1872.
8. Zamora-Araya JA, Smith-Castro V, Montero-Rojas E, Moreira-Mora TE. Advantages of the Rasch model for analysis and interpretation of attitudes: The case of the benevolent sexism subscale. Evaluar. 2018; 18(3):1-13
9. Gray PH, Flenady VJ, Charles BG, Steer PA, Caffeine Collaborative Study G. Caffeine citrate for very preterm infants: effects on development, temperament and behaviour. J Paediatr Child Health. 2011; 47(4): 167-72.
10. Yusoff MSB. ABC of content validation and content validity index calculation. J Educ Res 2019; 11(2): 49-54.
11. Yusoff MSB. ABC of response process validation and face validity index calculation. J Educ Res 2019; 11(3): 55-61.
12. Noor Lide AK. The Rasch Model for Psychometric Testing Rater-Mediated Assessment and Standard Setting. Gombak: IIUM Press; 2024.
13. Lunz ME. Using the Very Useful Wright Map: Measurement Research Associates, Inc; 2010 [Available from: https://www.rasch.org/mra/mra-01-10.htm].
14. Rosnah Ismail RI, Mohd Zali M, Noor Hassim Ismail NHI, Azmi Mohd Tamil AMT. A tale of two construct validation analysis: Rasch model and exploratory factor analysis approach for Three–Factor Eating Questionnaire (TFEQ–R21) among Malaysian male workers. Med J Malaysia. 2015; 70(3): 169-76.
15. Linacre JMJJoam. Optimizing rating scale category effectiveness. 2002; 3(1): 85-106.
16. Greyson D, Dubé È, Fisher WA, Cook J, Sadarangani M, Bettinger JA. Understanding influenza vaccination during pregnancy in Canada: attitudes, norms, intentions, and vaccine uptake. Health Educ Behav 2021; 48(5): 680-9.
17. Yang L, Yang G, Wang Q, Cui T, Shi N, Xiu S, et al. Understanding drivers of influenza vaccine hesitancy among pregnant women in China: evidence from an extended theory of planned behavior. Expert Rev Vaccines 2022; 21(11): 1655-65.
18. Muhd Helmi MA, Nor MZM, Ismail TAT, Hasan TH. Development and validation of knowledge and intention to breastfeed during pandemic questionnaire using exploratory factor analysis and Rasch model. Malays J Public Health Med 2022; 22(2): 16-26.
19. Cordina M, Lauri MA. Attitudes towards COVID-19 vaccination, vaccine hesitancy and intention to take the vaccine. J Pharm Pract 2021; 19(1): 2317.
20. Gauld N, Martin S, Sinclair O, Petousis-Harris H, Dumble F, Grant CC. Influences on pregnant women's and health care professionals' behaviour regarding maternal vaccinations: a qualitative interview study. Vaccines 2022; 10(1): 76.
21. Linacre J. Help for Winsteps Rasch Measurement and Rasch Analysis Software 2018 [Available from: https://www.winsteps.com/winman/table3_1.htm].
22. Curtis DDJIEJ. Person misfit in attitude surveys: influences, impacts and implications. 2004; 5(2): 125-43.
23. Linacre JM. When to stop removing items and persons in Rasch misfit analysis? Rasch Measurement Transactions. 2009; 23(4): 1241.
24. Linacre J. Dimensionality and Structural Validity investigation - an example 2021 [Available from: https://www.winsteps.com/winman/multidimensionality.htm].
25. Boone WJ. Rasch Analysis for Instrument Development: Why, When, and How? 2016; 15(4): rm4: 1-7.