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Development and psychometric validation of a maternal competency assessment tool for family-based child health care

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ABSTRACT

Maternal competency plays a crucial role in ensuring optimal child health outcomes, yet comprehensive instruments for assessing maternal competency within family-based child health care remain limited. This study aimed to develop and psychometrically validate a maternal competency assessment tool for family-based child health care among mothers with infants and toddlers. A research and development design with a quantitative approach was employed. The instrument was developed through construct identification, item generation, expert validation, pilot testing, and field testing. Data were collected from March to June 2025 using an online questionnaire completed by 250 mothers in the Special Region of Yogyakarta, Indonesia, who were recruited through purposive sampling and met predefined eligibility criteria. Content validity was evaluated using the Content Validity Index with established psychometric criteria for item retention, while construct validity was examined using Exploratory Factor Analysis with a minimum factor loading of 0.40. Reliability was assessed using Cronbach's alpha coefficient. The instrument demonstrated strong content validity (S-CVI/Ave = 0.92), a five-factor structure comprising 35 retained items that explained 68.47% of the total variance, and excellent internal consistency (Cronbach's α = 0.93). The findings indicate that the developed instrument is a valid and reliable tool for assessing maternal competency in family-based child health care and may support educational evaluation, research, and maternal-child health programs.



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Introduction

Maternal competency in child health care plays a pivotal role in ensuring optimal growth, development, and survival among infants and toddlers (Becker et al., 2022; Indrio et al., 2022). Within the family setting, mothers are directly involved in daily caregiving activities (Dlamini et al., 2023; Gaidhane et al., 2022), including nutritional management, hygiene practices, developmental stimulation, immunization compliance, early detection of illness, and health-related decision-making (Polizzi et al., 2022). Adequate maternal competency contributes significantly to improving children's physical and psychosocial well-being (Peixoto et al., 2023), while inadequate caregiving competency is associated with increased risks of malnutrition, developmental delays, infectious diseases, and preventable health complications (Rao et al., 2022; César-Santos et al., 2024). In

many developing countries, family-centered child care remains the primary foundation of children's health maintenance (Pekel-Uludağı, 2024;Massi et al., 2023), making maternal competency an essential component of community health strengthening efforts (Tognasso et al., 2022;Erdemir, 2022). The increasing complexity of child health challenges in contemporary family environments also requires mothers to possess not only health knowledge but also practical caregiving skills, confidence, and adaptive decision-making abilities in responding to children's health needs (Schuijers et al., 2024;Pan et al., 2024).

Reliable assessment of maternal competency has become increasingly important for evaluating maternal and child health education, identifying educational needs, and measuring the effectiveness of family-centered intervention programs (Silva et al., 2024). Psychometrically sound assessment instruments enable researchers, educators, and healthcare professionals to generate valid evidence for educational evaluation, intervention planning, and policy development(Izah et al., 2024;Swan et al., 2023;Dragostinov et al., 2022). Existing assessment practices, however, frequently rely on fragmented measures that evaluate individual aspects of parenting rather than maternal competency as an integrated construct within child health care. Consequently, important domains such as practical caregiving behaviors, health-related decision-making, and family participation are often assessed separately, limiting comprehensive evaluation and reducing comparability across studies (Mirzaki et al., 2022). These limitations highlight the need for a multidimensional assessment framework capable of capturing maternal competency as a holistic construct within family-based child health care.

Several validated instruments have assessed constructs related to maternal caregiving, including the Parenting Sense of Competence Scale, the Maternal Self-Efficacy Scale, the Karitane Parenting Confidence Scale, and other parenting self-efficacy measures. Although these instruments have demonstrated satisfactory psychometric properties, they were primarily designed to evaluate parenting confidence, self-efficacy, or specific caregiving behaviors rather than maternal competency as an integrated construct for child health care. Similarly, studies focusing on maternal knowledge, feeding behavior, or preventive health practices have generally examined these domains independently, resulting in conceptually fragmented assessment frameworks (Seneadza et al., 2022;Schneider-Worthington et al., 2022;Mekonnen et al., 2025). Existing instruments also provide limited representation of family involvement and health-related decision-making within routine child health care, while several studies report only partial psychometric evaluation, particularly regarding multidimensional construct validation(Wang et al., 2025;Chen et al., 2022). These conceptual and methodological limitations indicate the need for an assessment tool that integrates cognitive, behavioral, and family-contextual dimensions into a single psychometrically validated framework suitable for educational evaluation and community-based maternal and child health programs.

In this study, the term *family-based child health care* refers to maternal competency demonstrated through routine caregiving activities performed within the family environment, where mothers integrate child health knowledge, practical caregiving skills, health-related decision-making, self-efficacy, and collaboration with family members to maintain children's health and well-being. Guided by this conceptual perspective, this study aimed to develop and psychometrically validate a maternal competency assessment tool for family-based child health care among mothers with infants and toddlers. The study examined the instrument's content validity, construct validity, and internal consistency reliability to establish its psychometric adequacy for research and educational evaluation. The resulting instrument is expected to provide a standardized multidimensional framework for assessing maternal competency and to support educational evaluation, family-centered intervention programs, maternal and child health research, and evidence-informed policy development.

Method

This study employed a research and development design with a quantitative psychometric approach to develop and validate a maternal competency assessment tool for family-based child health care. The study consisted of five sequential stages, including construct identification, item generation, expert validation, pilot testing, and psychometric evaluation.

Instrument Development Procedure

The operational definitions of these dimensions guided the development of measurable indicators and questionnaire items. Each dimension was conceptualized to represent a distinct aspect of maternal competency while collectively reflecting the multidimensional nature of family-based child health care.

Table 1. Preliminary Dimensions of Maternal Competency in Child Health Care

Dimensions	Operational Focus
Child health knowledge	Understanding of child nutrition, hygiene, immunization, illness prevention, and developmental needs
Caregiving and health maintenance skills	Practical ability to provide daily child care and health maintenance
Maternal self-efficacy	Confidence in managing child health and caregiving responsibilities
Health decision-making ability	Ability to recognize health problems and make appropriate health-related decisions
Family involvement in child care	Participation and support of family members in child caregiving activities

Based on these dimensions, an initial pool of instrument items was generated using simple, clear, and contextually appropriate language suitable for mothers with infants and toddlers. The instrument employed a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The preliminary version consisted of 42 items distributed proportionally across the identified dimensions. Negatively worded items were minimized to reduce response bias and misunderstanding among respondents.

Content Validity

The content validity process involved evaluation by five experts consisting of specialists in maternal and child health, pediatric healthcare, public health, and educational evaluation. Each expert assessed the relevance, clarity, representativeness, and appropriateness of the items using a four-point relevance scale ranging from not relevant to highly relevant. The expert panel composition is presented in Table 2.

Table 2. Composition of Expert Validators

Expert Areas	Number of Experts
Midwifery and maternal-child health	2
Pediatric healthcare	1
Public health	1
Educational evaluation	1

The Content Validity Index (CVI) was calculated at both item level (I-CVI) and scale level (S-CVI/Ave). Items with I-CVI values below 0.78 were revised or removed based on expert recommendations. Qualitative suggestions provided by the experts were also incorporated to improve wording clarity, contextual suitability, and conceptual alignment of the instrument items.

Participants and Sampling

The target population of this study consisted of mothers with infants and toddlers aged 0–5 years who were actively involved in daily child caregiving activities. Participants were recruited from several maternal and child health communities in the Special Region of Yogyakarta. A purposive sampling technique was employed to ensure that respondents met the characteristics relevant to the objectives of the study. The inclusion criteria included mothers aged above 18 years, having at least one child aged 0–5 years, being directly involved in child caregiving activities, and being willing to participate in the study. Respondents who submitted incomplete questionnaires were excluded from the final analysis.

The sample size was determined based on psychometric testing recommendations suggesting a minimum of five to ten respondents per item for exploratory factor analysis procedures. Considering that the preliminary instrument consisted of 42 items, a minimum sample size of 210 respondents was required. A total of 250 valid responses were ultimately included in the analysis, indicating that the sample size was adequate for construct validation and reliability testing. Participant characteristics collected in this study included maternal age, educational background, occupation, number of children, and caregiving experience.

Data Collection Procedure

Data collection was conducted from March to June 2025 using an online survey approach through Google Forms. Prior to the main data collection process, the preliminary version of the instrument underwent pilot testing involving 30 mothers with infants and toddlers to evaluate item readability, sentence clarity, and response consistency. Feedback obtained during the pilot phase was used to revise several items to improve comprehensibility and contextual appropriateness.

The revised questionnaire was subsequently distributed online through maternal and child health community networks, parenting groups, and family health service communication platforms in the Special Region of Yogyakarta. Eligible participants received information regarding the objectives and procedures of the study

before accessing the questionnaire link. Participation was voluntary, and respondents provided informed consent electronically before completing the survey.

The online questionnaire required approximately 15–20 minutes to complete. Respondents were encouraged to answer all items independently based on their caregiving experiences and perceptions related to child health care practices within the family setting. Submitted responses were reviewed to ensure completeness and consistency prior to analysis. Questionnaires containing substantial missing data or incomplete responses were excluded from the final dataset.

Data Analysis

Descriptive statistics were used to summarize participant demographic characteristics. Means, standard deviations, frequencies, and percentages were calculated using statistical software. All statistical analyses were performed using SPSS version 26.0. Construct validity was examined using Exploratory Factor Analysis (EFA) with Principal Component Analysis and Varimax rotation to identify the underlying factor structure of the instrument. Several assumptions were evaluated prior to factor extraction, including Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, Bartlett's Test of Sphericity, communalities, and factor loading values. The criteria used in the construct validity analysis are presented in Table 3.

Table 3. Criteria for Construct Validity Assessment

Indicators	Acceptance Criteria
Kaiser-Meyer-Olkin (KMO)	> 0.50
Bartlett's Test of Sphericity	$p < 0.05$
Communalities	> 0.40
Factor loading	> 0.40

Items with low communalities, insufficient factor loadings, or cross-loadings across multiple factors were considered for revision or removal during the factor analysis process. Internal consistency reliability was assessed using Cronbach's alpha coefficient for both the overall instrument and each identified factor. Reliability coefficients greater than or equal to 0.70 were considered acceptable. Corrected item-total correlation values were also examined to evaluate item discrimination quality and improve internal consistency.

Results and Discussions

A total of 250 mothers participated in the study and completed the questionnaire adequately for psychometric analysis. The respondents represented mothers with infants and toddlers who were actively involved in daily child caregiving activities within the family setting. Participant characteristics included maternal age, educational background, occupation, number of children, and caregiving experience. The demographic characteristics of the respondents are presented in Table 1.

Table 4. Demographic Characteristics of Participants (n = 250)

Characteristics	Frequency (n)	Percentage (%)
Age		
< 25 years	48	19.2
25–35 years	146	58.4
> 35 years	56	22.4
Educational background		
Primary education	39	15.6
Secondary education	151	60.4
Higher education	60	24.0
Occupation		
Housewife	132	52.8
Private employee	54	21.6
Self-employed	38	15.2
Others	26	10.4
Number of children		
One child	97	38.8
Two children	103	41.2
More than two children	50	20.0

Most participants were within the productive maternal age group of 25–35 years and had secondary-level educational backgrounds. More than half of the respondents were housewives who reported being actively involved in daily caregiving practices for their children. The preliminary version of the instrument consisted of 42 items distributed across five dimensions of maternal competency in child health care. Content validity evaluation was conducted by five experts from relevant disciplines, including maternal-child health, pediatric healthcare, public health, and educational evaluation. The results of the Content Validity Index (CVI) analysis indicated that most items demonstrated acceptable relevance and representativeness. The I-CVI values ranged from 0.80 to 1.00, while the overall S-CVI/Ave value was 0.92, indicating strong content validity of the instrument. A summary of the content validity results is presented in Table 2.

Table 5. Summary of Content Validity Results

Indicator	Result
Number of initial items	42
Number of experts	5
Range of I-CVI values	0.80–1.00
S-CVI/Ave	0.92
Items revised	6
Items removed	3

Several items underwent revisions based on expert recommendations, particularly regarding sentence clarity, contextual appropriateness, and wording simplification. Three items were removed because they were considered conceptually overlapping with other items or insufficiently representative of the intended construct dimensions. Construct validity was examined using Exploratory Factor Analysis (EFA). Prior to factor extraction, assumption testing demonstrated that the dataset met the requirements for factor analysis. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.91, indicating excellent sampling adequacy, while Bartlett's Test of Sphericity showed statistically significant results ($\chi^2 = 4217.56$; $p < 0.001$). The results of the assumption testing are presented in Table 3.

Table 6. Assumption Testing for Exploratory Factor Analysis

Indicator	Result	Indicator
Kaiser-Meyer-Olkin (KMO)	0.91	Kaiser-Meyer-Olkin (KMO)
Bartlett's Test of Sphericity	$\chi^2 = 4217.56$; $p < 0.001$	Bartlett's Test of Sphericity

The EFA results identified five factors consistent with the conceptual framework of the instrument. Four items with factor loading values below 0.40 or cross-loading patterns across multiple factors were removed during the analysis process. The final instrument consisted of 35 items distributed across five dimensions. The extracted factors explained 68.47% of the total variance. Factor loading values ranged from 0.53 to 0.84, indicating acceptable construct representation and satisfactory item contribution to each factor. A summary of the factor structure is presented in Table 4.

Table 7. Summary of Factor Structure

Factor	Number of Items	Factor Loading Range
Child health knowledge	8	0.58–0.82
Caregiving and health maintenance skills	9	0.55–0.84
Maternal self-efficacy	7	0.53–0.79
Health decision-making ability	6	0.57–0.81
Family involvement in child care	5	0.56–0.80

The factor analysis results indicated that the instrument possessed a stable multidimensional structure aligned with the theoretical framework of maternal competency in child health care. Internal consistency reliability testing demonstrated satisfactory reliability coefficients for the overall instrument and each identified factor. The overall Cronbach's alpha coefficient of the instrument was 0.93, indicating excellent internal consistency. The reliability results for each factor are presented in Table 5.

Table 8. Reliability Coefficients of the Instrument

Factor	Cronbach's Alpha
Child health knowledge	0.87
Caregiving and health maintenance skills	0.90
Maternal self-efficacy	0.85

Factor	Cronbach's Alpha
Health decision-making ability	0.84
Family involvement in child care	0.82
Overall instrument	0.93

Corrected item-total correlation values ranged from 0.46 to 0.78, indicating acceptable item discrimination performance across all retained items. The findings demonstrated that the developed instrument had strong internal consistency and adequate psychometric properties for assessing maternal competency in child health care within family-based settings.

The present study developed and psychometrically validated a family-based assessment tool for measuring maternal competency in child health care among mothers with infants and toddlers. The findings demonstrated that the developed instrument possessed strong content validity, satisfactory construct validity, and high internal consistency reliability. The psychometric performance of the instrument indicates its potential utility as a comprehensive measurement tool for evaluating maternal competency within family-centered child health contexts. The content validity findings showed that the instrument achieved high relevance and representativeness across all assessed dimensions. The S-CVI/Ave value of 0.92 reflected strong agreement among experts regarding the suitability of the developed items in representing maternal competency constructs. The expert review process also contributed substantially to improving item clarity, contextual appropriateness, and conceptual consistency. These findings indicate that the instrument adequately captures multidimensional aspects of maternal competency, including knowledge, caregiving skills, self-efficacy, decision-making ability, and family involvement in child care. Previous studies have emphasized that comprehensive assessment tools are essential for accurately evaluating caregiving competency because maternal competency extends beyond cognitive understanding and includes behavioral and psychosocial dimensions (Kyle et al., 2026).

The content validity achieved in the present study compares favorably with previously developed maternal and parenting assessment instruments reported in the international literature. Earlier validation studies commonly reported scale-level Content Validity Index values ranging from 0.85 to 0.91 following expert evaluation, indicating acceptable content representativeness. The S-CVI/Ave value of 0.92 obtained in this study therefore reflects a high level of expert agreement regarding the relevance and comprehensiveness of the proposed dimensions. This finding suggests that integrating child health knowledge, caregiving skills, maternal self-efficacy, health decision-making, and family involvement provides a conceptually coherent framework for assessing maternal competency within family-based child health care.

The construct validity analysis further demonstrated that the instrument had a stable multidimensional structure. The KMO value of 0.91 and significant Bartlett's Test of Sphericity confirmed that the dataset was appropriate for factor analysis procedures. Exploratory Factor Analysis identified five factors consistent with the conceptual framework established during the instrument development stage. The factor loading values ranging from 0.53 to 0.84 indicated satisfactory item representation within each factor. The total explained variance of 68.47% also suggested that the extracted factors adequately represented the underlying construct of maternal competency in child health care. These findings support previous psychometric studies indicating that multidimensional caregiving competency instruments should demonstrate clear factor structures and sufficient explained variance to ensure construct stability (Brekke et al., 2022).

The identified dimensions reflect the complexity of maternal roles in family-based child health care. Child health knowledge remains a fundamental component because mothers are expected to understand essential aspects of nutrition, hygiene, immunization, illness prevention, and child development. Caregiving and health maintenance skills are equally important because practical caregiving behaviors directly influence children's daily health conditions. Maternal self-efficacy emerged as another important dimension, reflecting mothers' confidence in managing child health situations and caregiving responsibilities. Earlier studies have shown that maternal confidence significantly influences caregiving consistency (Kadiroğlu & Güdücü Tüfekci, 2022), health-seeking behavior (Anagaw et al., 2023), and adherence to child health recommendations (Rees et al., 2023). The dimensions of health decision-making ability and family involvement also highlight the importance of family-centered approaches in promoting child health outcomes within household environments (Bele & Santana, 2025).

Unlike several widely used parenting assessment instruments, including the Parenting Sense of Competence Scale, the Maternal Self-Efficacy Scale, and the Karitane Parenting Confidence Scale, the present instrument was specifically developed to assess maternal competency within the context of family-based child health care. Existing instruments primarily evaluate parenting confidence, self-efficacy, or selected caregiving behaviors, whereas the current instrument integrates child health knowledge, caregiving and health maintenance skills, maternal self-efficacy, health decision-making ability, and family involvement into a unified multidimensional

framework. This broader conceptualization enables a more comprehensive evaluation of maternal competency and better reflects the complex responsibilities undertaken by mothers in maintaining children's health within everyday family environments.

The inclusion of family involvement as an independent dimension also represents an important conceptual contribution. Previous parenting assessment instruments have predominantly emphasized maternal attributes while providing limited attention to the collaborative role of family members in supporting child health care. In many developing countries, childcare responsibilities frequently extend beyond the mother to include fathers, grandparents, and other household members. Therefore, assessing maternal competency within a family-based context provides a more ecologically valid representation of routine caregiving practices and offers greater utility for evaluating family-centered educational interventions and community maternal-child health programs.

The reliability analysis demonstrated excellent internal consistency for the overall instrument and acceptable reliability across all dimensions. The overall Cronbach's alpha coefficient of 0.93 indicated strong homogeneity among the retained items. Corrected item-total correlation values also confirmed that the retained items contributed adequately to the overall construct measurement. High reliability coefficients are important because they indicate the stability and consistency of the instrument in measuring maternal competency across different respondents and contexts (Revicki, 2023). The findings suggest that the developed instrument may be reliably applied in future maternal and child health research as well as educational evaluation programs (Mengmei et al., 2022).

The development of this instrument also contributes to the growing emphasis on family-centered care in maternal and child health services. Family environments strongly influence caregiving practices, child health behaviors, and parental decision-making processes (Roman et al., 2025; Determeijer et al., 2024). Instruments that focus solely on maternal knowledge may fail to capture the broader caregiving dynamics occurring within family contexts. The present instrument addresses this limitation by incorporating dimensions related to practical caregiving behavior, confidence, family support, and health-related decision-making. This multidimensional approach may provide a more comprehensive understanding of maternal competency in child health care and support the development of targeted educational interventions.

From a theoretical perspective, the proposed instrument extends existing maternal competency assessment by integrating concepts derived from family-centered care, parenting competency, and maternal self-efficacy into a single multidimensional measurement framework. Rather than conceptualizing maternal competency solely as confidence or parenting efficacy, the present framework recognizes that effective child health care requires the interaction of cognitive knowledge, practical caregiving behaviors, adaptive decision-making, psychological confidence, and supportive family involvement. This integrated perspective provides a broader conceptual foundation for evaluating maternal competency within educational and community health settings and may facilitate the design of more comprehensive family-centered intervention programs.

Several practical implications may be drawn from this study. The instrument may serve as an evaluation tool for maternal and child health education programs implemented by healthcare professionals, community health centers, and educational institutions. The instrument may also assist researchers in identifying maternal competency gaps that require intervention in family-based child health promotion programs. In addition, the tool may support policymakers in designing evidence-based strategies aimed at strengthening maternal caregiving competency and improving child health outcomes in community settings. Despite these encouraging findings, several limitations should be acknowledged. First, the study employed purposive sampling and online data collection through Google Forms, which may have limited participation among mothers with restricted internet access or lower digital literacy, thereby affecting the representativeness of the sample. Second, the instrument was validated using respondents from a single geographical region in Indonesia, and caution should therefore be exercised when generalizing the findings to populations with different cultural, socioeconomic, or healthcare characteristics. Third, the psychometric evaluation focused on exploratory factor analysis and internal consistency reliability. Future studies should perform confirmatory factor analysis using an independent sample, examine test-retest reliability to evaluate temporal stability, and conduct cross-cultural validation to further strengthen the psychometric robustness and international applicability of the instrument.

Overall, the findings indicate that the developed family-based assessment tool possesses satisfactory psychometric properties and may serve as a reliable and valid instrument for measuring maternal competency in child health care. The multidimensional structure of the instrument provides a comprehensive framework for evaluating maternal caregiving competency within family-centered child health contexts and may contribute to the advancement of educational evaluation and maternal-child health research.

Conclusions

This study developed and psychometrically validated a multidimensional assessment tool for measuring maternal competency in family-based child health care among mothers with infants and toddlers. The instrument demonstrated adequate evidence of content validity, construct validity, and internal consistency, supporting its application as a standardized measure of maternal competency. The resulting five-factor framework integrates child health knowledge, caregiving and health maintenance skills, maternal self-efficacy, health-related decision-making, and family involvement into a single assessment model, providing a structured approach for evaluating maternal competency within routine family-based child health care. The instrument offers practical value for educational evaluation, maternal and child health research, and the assessment of family-centered educational interventions. Future studies should extend its validation through confirmatory factor analysis, longitudinal reliability testing, and cross-cultural evaluation across diverse populations.

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