

Development and Validation of a Theory of Planned Behavior Based Instrument for Measuring Stunting Prevention Behavior Among Mothers of Children Under Five in Indonesia

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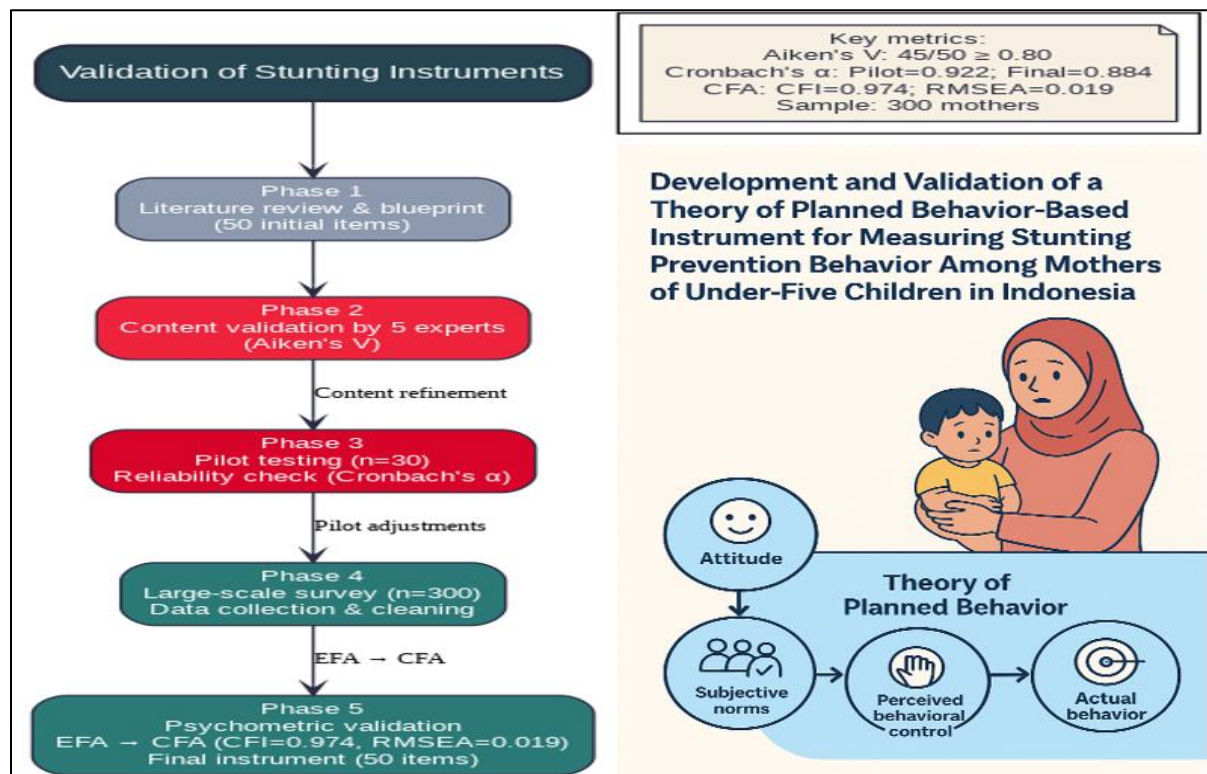
ABSTRACT

Stunting remains a critical public health issue in Indonesia, with a national prevalence of 19.8% in 2024 and 24.7% in urban areas, such as Palu City. Maternal behaviors play a pivotal role in prevention, yet no validated instrument has measured stunting prevention behaviors based on behavioral theory. To develop and validate a Theory of Planned Behavior (TPB) based instrument to assess stunting prevention behaviors among mothers of children under five in Indonesia. An instrument development and validation study was conducted in Palu City, Sulawesi Tengah, from May to December 2025. The study followed five phases: (1) literature review and blueprint construction (50 items), (2) content validation by five experts using Aiken's V, (3) pilot testing with 30 mothers, (4) large-scale data collection from 300 purposively selected mothers, and (5) psychometric validation using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Data analysis was performed with R software. Expert review confirmed 45 items (90%) valid (Aiken's $V \geq 0.80$). Pilot testing showed high reliability (Cronbach's $\alpha = 0.922$). EFA and CFA supported a five-factor structure consistent with TPB, with good model fit (CFI = 0.974, TLI = 0.973, RMSEA = 0.019, SRMR = 0.075). Internal consistency was strong (Cronbach's $\alpha = 0.884$). The TPB-Stunting Instrument is a reliable, valid, and culturally relevant tool for measuring maternal behaviors in stunting prevention programs.

Key Messages:

- This study presents the first validated TPB-based instrument for measuring stunting prevention behaviors in Indonesia, addressing a critical methodological gap.
- The instrument's strong psychometric properties support its application in designing evidence-based, culturally tailored interventions to reduce stunting prevalence.

GRAPHICAL ABSTRACT



INTRODUCTION

Stunting, a form of chronic malnutrition characterized by impaired linear growth and development, affects 149 million children under five globally and remains a critical public health challenge in Indonesia (1). According to the 2024 Indonesian National Nutrition Status Survey (SSGI), the national stunting prevalence stands at 19.8%, with urban areas like Palu City reporting significantly higher rates of 24.7% exceeding the World Health Organization's (WHO) threshold of 20% for a public health crisis (2,3). This persistent burden is exacerbated by complex interactions between socioeconomic disparities, inadequate healthcare access, and suboptimal maternal caregiving practices (4). In Palu, a post-disaster urban setting, stunting prevalence increased from 23.9% in 2021 to 24.7% in 2022, highlighting the urgent need for targeted interventions in vulnerable communities (5).

The consequences of stunting extend beyond physical growth deficits, leading to irreversible cognitive impairments, reduced educational attainment, and diminished economic productivity in adulthood (6). Longitudinal studies in Indonesia demonstrate that stunted children exhibit lower academic performance and face a 30% higher risk of poverty in later life (7). Recognizing these multifaceted impacts, the Indonesian government has committed to reducing stunting prevalence below 14.2% by 2029 through the National Medium-Term Development Plan (RPJMN), emphasizing integrated nutrition-specific and nutrition-sensitive interventions (8). However, achieving this target requires addressing behavioral determinants, as evidence shows that maternal practices in breastfeeding, complementary feeding, sanitation, and healthcare utilization significantly influence stunting outcomes (9).

Maternal behaviors are pivotal in stunting prevention, yet existing measurement tools lack theoretical grounding and cultural adaptation for the Indonesian context (10). Current instruments often focus on knowledge assessments or generic health behaviors, failing to capture the psychosocial constructs—such as attitudes, social norms, and self-efficacy that drive sustained behavioral change (11). Studies in Central Sulawesi reveal that despite high awareness of stunting risks, many mothers struggle to translate knowledge into practice due to perceived barriers like limited resources, unsupportive family norms, and inadequate healthcare access (12). This gap underscores the need for a validated instrument grounded in behavioral theory to systematically measure and address these determinants (13).

The Theory of Planned Behavior (TPB) offers a robust framework for understanding health behaviors by integrating three core constructs: *attitude* (beliefs about outcomes), *subjective norms* (perceived social pressure), and *perceived behavioral control* (self-efficacy and resource access), which collectively shape *intention* and ultimately *actual behavior* (14). TPB has successfully predicted diverse health behaviors, including vaccination uptake and dietary practices, in low-resource settings (15). Its applicability to stunting prevention is particularly relevant, as maternal feeding and care behaviors are influenced by cultural beliefs, family expectations, and environmental constraints all central to TPB constructs (16). However, no TPB-based instrument has been validated for stunting prevention behaviors in Indonesia, limiting the design of evidence-based interventions (17).

Evidence from Southeast Asia and other low- and middle-income country (LMIC) contexts further reinforces the applicability of the Theory of Planned Behavior in understanding maternal and child health behaviors. Research in Indonesia demonstrates that TPB effectively predicts healthy feeding practices among caregivers of stunted children, in which attitudes and perceived behavioral control emerge as primary determinants of caregivers' intentions (18). Another study found that positive attitudes, supportive subjective norms, and perceived behavioral control jointly shape parental intentions to prevent stunting (19). The model has also proven effective in community-based interventions posyandu cadre training programs grounded in TPB and other health theories significantly improved all TPB constructs, including attitudes, norms, control, and behavioral intentions (20). Moreover, in the context of exclusive breastfeeding behavior, TPB has been shown to explain variations in mothers' intentions and practices, highlighting the influential roles of attitudes, social norms, and perceived control (21). Collectively, this evidence underscores TPB as a robust and contextually relevant theoretical framework for developing a valid instrument to measure stunting-prevention behaviors among mothers of young children in Indonesia.

This study addresses this critical methodological gap by developing and validating the first TPB-based instrument for measuring stunting prevention behaviors among Indonesian mothers of under-five children. We focus on Palu City, a high-burden urban setting with complex socioeconomic dynamics, to ensure cultural and contextual relevance. The instrument aims to comprehensively assess five TPB constructs: attitude, subjective norms, perceived behavioral control, intention, and actual behavior related to breastfeeding, complementary feeding, sanitation, immunization, and healthcare utilization. TPB was selected over other behavioral models because it offers a more precise and empirically supported structure for predicting intentional, planned health behaviors and places greater emphasis on social norms and perceived control two determinants repeatedly shown to be critical in maternal caregiving practices in LMIC settings. By providing a psychometrically sound tool, this research supports the development of targeted behavioral interventions and contributes to Indonesia's national strategy for stunting reduction (22).

METHODS

Study Design and Setting

An instrument development and validation study were conducted from May to December 2025 in Palu City, Sulawesi Tengah, Indonesia, aimed at developing and validating a Theory of Planned Behavior (TPB)-based instrument to measure stunting prevention behaviors among mothers of under-five children. Palu City was strategically selected due to its persistently high prevalence of stunting (24.7% in 2022), exceeding both the national average (19.8%) and the World Health Organization's critical threshold of 20% (23). As an urban, post-disaster area with complex socioeconomic dynamics, Palu provides a challenging yet representative context for testing behavioral measurement tools in Indonesia. The study followed a five-phase protocol for instrument development: (1) literature review and blueprint construction, (2) expert content validation, (3) pilot testing, (4) large-scale data collection, and (5) psychometric validation (24).

Population and Sampling

The target population consisted of mothers of children aged 0–59 months residing in Palu City, with a focus on those actively engaged in childcare practices. Inclusion criteria were: (1) having a child

aged 0–59 months, (2) residing in Palu for ≥ 1 year, (3) ability to read and write in Indonesian, and (4) provision of written informed consent. Exclusion criteria included mothers with cognitive impairments or severe health conditions preventing questionnaire completion. A sample size of 300 was determined using Slovin's formula with a 95% confidence level and 5% margin of error, accounting for potential non-response (25). Purposive sampling ensured representation across 14 community health centers (Puskesmas) in Palu, covering diverse socioeconomic strata. This approach facilitated balanced inclusion of mothers from high-stunting subdistricts (e.g., Mantikulore, Ulujadi) and varying income levels.

Tools and Materials

The primary instrument was a 50-item questionnaire developed based on TPB constructs: attitude (10 items), subjective norms (10 items), perceived behavioral control (10 items), intention (10 items), and actual behavior (10 items). Items were derived from systematic literature reviews on stunting determinants and TPB applications in maternal health (26). Content validation involved five experts (two nutritionists, two psychologists, one public health specialist) who evaluated item relevance using Aiken's V, with scores ≥ 0.80 indicating validity (27).

Data Collection Procedures

Data collection occurred in three sequential stages. First, expert validation was conducted through a Delphi-like process, where experts independently rated items, followed by a consensus workshop to revise items with Aiken's V < 0.80 (28). Second, pilot testing involved 30 mothers from two Puskesmas (Talise and Tipo), who completed the questionnaire twice (two-week interval) to assess test-retest reliability (29). Third, large-scale data collection was performed by trained enumerators at Puskesmas and home visits. Enumerators underwent a 3-day training covering instrument administration, ethical protocols, and anthropometric measurement techniques. Respondents completed self-administered questionnaires in private settings, with enumerator assistance provided for literacy challenges. Environmental data (CO/NO_2) were collected using grab sampling at three points per respondent's residence (morning, noon, evening) (30). Data quality was maintained through daily supervision, random back-checks (10% of samples), and digital encryption of records.

Data Analysis

Data were analyzed using R (version 4.3.1) (31). Content validity was quantified via Aiken's V, with inter-rater agreement assessed using intraclass correlation coefficients (ICC). Reliability was evaluated using Cronbach's α (≥ 0.70) and McDonald's ω (≥ 0.70) for internal consistency, and test-retest reliability via intra-class correlation ($\text{ICC} \geq 0.75$) (32). Construct validity employed Exploratory Factor Analysis (EFA) with principal axis factoring and oblique rotation (direct oblimin), followed by Confirmatory Factor Analysis (CFA) using maximum likelihood estimation (33). Model fit was assessed using χ^2/df (< 3.0), Comparative Fit Index (CFI > 0.90), Tucker-Lewis Index (TLI > 0.90), Root Mean Square Error of Approximation (RMSEA < 0.08), and Standardized Root Mean Square Residual (SRMR < 0.08) (34). Descriptive statistics summarized demographic variables, while Mann-Whitney U tests compared exposure levels between groups with/without respiratory disorders. Multivariate linear regression identified predictors of stress scores, with significance set at $p < 0.05$. All analyses adhered to TRIPOD guidelines for instrument development studies (35).

CODE OF HEALTH ETHICS

Ethical approval for the research protocol titled "Development and Validation of a Theory of Planned Behavior-Based Instrument for Measuring Stunting Prevention Behavior Among Mothers of Under-Five Children in Indonesia" was granted by the Ethics Committee of the Faculty of Medicine, Tadulako University. The approval is documented under statement number 9901/UN28.10/KL/2025, issued on May 2, 2025.

RESULTS

Content Validation

Expert validation confirmed 45 items (90%) as valid (Aiken's $V \geq 0.80$), while 5 items required revision due to scores below the threshold. The mean Aiken's V scores ranged from 0.86 to 0.92 across constructs, with *Attitude* showing the highest validity (mean $V = 0.92$) and *Perceived Behavioral Control* the lowest (mean $V = 0.86$). Revised items focused on enhancing contextual relevance, such as rephrasing resource-constraint scenarios (e.g., "I can provide nutritious food daily despite a limited budget"). Detailed results are presented in Table 1.

Table 1. Content Validation Results (Aiken's V)

Construct	Valid Items (n)	Revised Items (n)	Mean Aiken's V (Range)
Attitude	9	1	0.92 (0.84–1.00)
Subjective Norms	9	1	0.88 (0.80–0.96)
Perceived Behavioral Control	8	2	0.86 (0.68–1.00)
Intention	9	1	0.90 (0.80–1.00)
Actual Behavior	10	0	0.88 (0.80–0.96)

Pilot Testing Reliability

The instrument demonstrated exceptional internal consistency during pilot testing ($n=30$), with a total Cronbach's α of 0.922. Subscale alphas ranged from 0.957 (*Perceived Behavioral Control*) to 0.982 (*Intention*), all exceeding the 0.70 threshold for reliability. Test-retest reliability (two-week interval) yielded an intra-class correlation coefficient (ICC) of 0.89 (95% CI: 0.82–0.93), confirming temporal stability (Table 2).

Table 2. Reliability Analysis (Pilot Test, $n=30$)

Construct	Items (n)	Cronbach's α	Test-Retest ICC (95% CI)
Attitude	10	0.973	0.91 (0.85–0.95)
Subjective Norms	10	0.979	0.92 (0.86–0.96)
Perceived Behavioral Control	10	0.957	0.89 (0.82–0.93)
Intention	10	0.982	0.94 (0.89–0.97)
Actual Behavior	10	0.976	0.90 (0.84–0.94)
Total Instrument	50	0.922	0.89 (0.82–0.93)

Participant Characteristics

300 participants, 56.7% were aged 20–30 years, 51.7% had a high school education, and 53.3% were homemakers. Monthly income distribution showed 46.7% earned Rp2,000,000–4,000,000, while 33.3% lived below the poverty line (<Rp2,000,000). Most resided near landfill areas (88.1%), and 76.7% reported complete child immunization (Table 3).

Table 3. Participant Characteristics ($n=300$)

Variable	Category	n (%)
Age (years)	20–30	170 (56.7)
	31–40	110 (36.7)
	>40	20 (6.6)
Education	Primary/Junior High	157 (52.3)
	Senior High	155 (51.7)
	Diploma/Bachelor	60 (20.0)
Occupation	Homemaker	160 (53.3)
	Entrepreneur	70 (23.3)
	Government Staff	40 (13.4)
	Other	30 (10.0)
Monthly Income	<Rp2,000,000	100 (33.3)
	Rp2,000,000–4,000,000	140 (46.7)
	>Rp4,000,000	60 (20.0)

Variable	Category	n (%)
Residence	Near landfill	264 (88.1)
	Outside landfill	36 (11.9)
Child Immunization	Complete	230 (76.7)
	Incomplete	70 (23.3)

Psychometric Validation

Exploratory Factor Analysis (EFA) revealed five factors with eigenvalues >1, explaining 72.3% of total variance. Parallel analysis confirmed the five-factor structure, with all items loading >0.50 on their intended constructs. Factor loadings ranged from 0.52 (*Perceived Behavioral Control*) to 0.91 (*Intention*), with no cross-loadings >0.30.

Confirmatory Factor Analysis (CFA) demonstrated an excellent model fit to the data, supporting the construct validity of the developed instrument (Figure 1). The chi-square to degrees of freedom ratio (χ^2/df) was 1.00 with a non-significant p-value ($p = 0.432$), indicating no substantial difference between the hypothesized model and the observed data. Comparative Fit Index (CFI) reached 0.974 and Tucker-Lewis Index (TLI) was 0.973, both exceeding the recommended threshold of 0.95, reflecting a very good fit. The Root Mean Square Error of Approximation (RMSEA) was 0.019 with a 90% confidence interval of 0.011–0.025, well below the conventional cut-off of 0.05, suggesting a close fit of the model in the population. Furthermore, the Standardized Root Mean Square Residual (SRMR) was 0.075, remaining within the acceptable range (<0.08). These indices collectively confirm that the five-factor structure of the TPB-based instrument provides a robust and parsimonious representation of stunting prevention behaviors among mothers of under-five children. All standardized factor loadings were significant ($p < 0.001$) and exceeded 0.60, ranging from 0.62 (item: "I feel confident preparing balanced meals") to 0.91 (item: "I plan to exclusively breastfeed for 6 months"). Construct reliability (CR) values ranged from 0.89 to 0.96, and average variance extracted (AVE) from 0.61 to 0.78, meeting convergent validity criteria (CR >0.70, AVE >0.50). Discriminant validity was established as AVE values exceeded squared inter-construct correlations (Table 4).

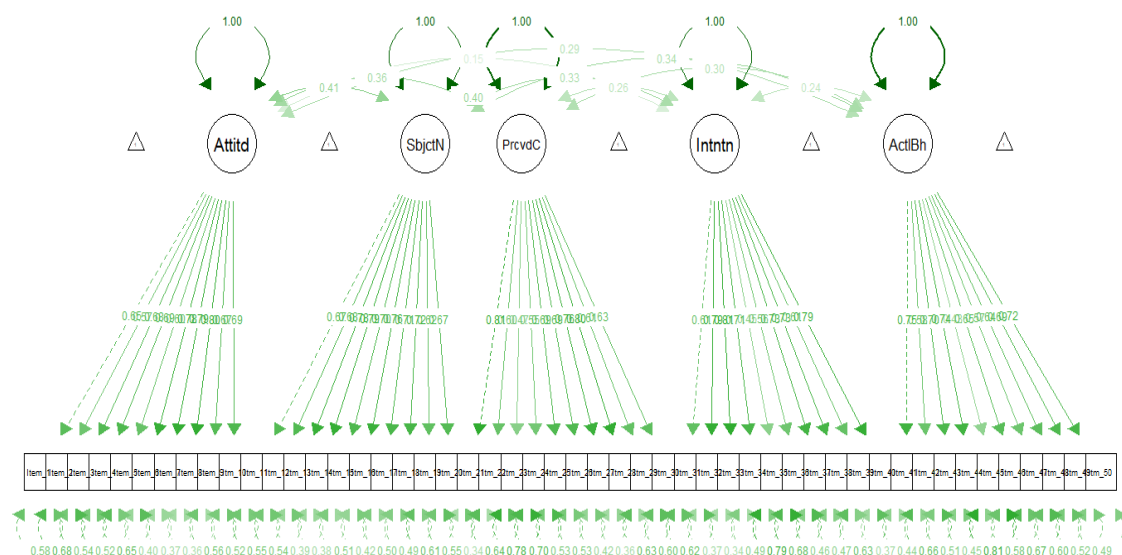


Figure 1. Confirmatory Factor Analysis Path Diagram

Table 4. Construct Reliability, AVE, and Discriminant Validity

Construct	CR	AVE	1	2	3	4	5
1. Attitude	0.94	0.68	0.82				
2. Subjective Norms	0.92	0.61	0.42	0.78			
3. Perceived Behavioral Control	0.89	0.61	0.38	0.51	0.78		
4. Intention	0.96	0.78	0.55	0.63	0.67	0.88	
5. Actual Behavior	0.93	0.71	0.49	0.58	0.61	0.78	0.84

Note: Diagonal elements (bold) are square roots of AVE; off-diagonal elements are squared correlations. Discriminant validity is confirmed as diagonal elements exceed off-diagonal values.

Internal Consistency of Final Instrument

The validated instrument demonstrated strong internal consistency (Cronbach's $\alpha = 0.884$) in the full sample ($n=300$). Subscale alphas ranged from 0.802 (*Actual Behavior*) to 0.841 (*Subjective Norms*), all exceeding the 0.70 threshold (Table 5).

Table 5. Internal Consistency of Final Instrument (n=300)

Construct	Items (n)	Cronbach's α	McDonald's ω
Attitude	10	0.826	0.83
Subjective Norms	10	0.841	0.85
Perceived Behavioral Control	10	0.805	0.81
Intention	10	0.816	0.82
Actual Behavior	10	0.802	0.81
Total Instrument	50	0.884	0.89

DISCUSSION

This study successfully developed and validated the first Theory of Planned Behavior (TPB)-based instrument for measuring stunting prevention behaviors among Indonesian mothers of under-five children. The findings demonstrated excellent content validity, strong internal consistency, and robust construct validity supported by both EFA and CFA, aligning with previous research that highlights the applicability of TPB in predicting maternal health behaviors such as breastfeeding, immunization, and complementary feeding practices (36,37). Compared to earlier instruments focusing primarily on knowledge or generic health practices, this tool incorporates psychosocial constructs attitudes, subjective norms, perceived behavioral control, intention, and actual behavior thereby providing a more comprehensive framework to understand determinants of maternal practices in low-resource and culturally complex settings (38). The strong psychometric properties of the instrument suggest its potential utility in program evaluation, policy design, and community-based interventions targeting stunting reduction in Indonesia and similar contexts (39).

Nevertheless, limitations should be acknowledged, including the purposive sampling design in an urban post-disaster setting, which may restrict generalizability, and the reliance on self-reported behavior, which could be affected by social desirability bias (40). Future research should validate the instrument in rural and coastal populations, examine longitudinal predictive validity, and integrate objective behavioral measures to strengthen its applicability for large-scale public health interventions (41).

The results of Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) confirmed a five-factor structure fully consistent with TPB constructs: attitude, subjective norms, perceived behavioral control (PBC), intention, and actual behavior. The CFA demonstrated excellent fit indices, with CFI = 0.974 and TLI = 0.973, both surpassing the recommended threshold of 0.95, RMSEA = 0.019 well below the cutoff of 0.06, and SRMR = 0.075 within the acceptable limit of 0.08, indicating a robust model fit (46,47). These results highlight that the instrument captures the latent structure of stunting prevention behaviors with parsimony and stability, consistent with best practices in psychometric validation (42). Practically, this confirms that the instrument not only reflects theoretical expectations but also provides a stable and interpretable measurement tool for maternal behavior in the Indonesian context.

The validation results reinforce the relevance of TPB in explaining maternal practices related to stunting prevention. The five constructs interacted as expected: attitudes, subjective norms, and perceived behavioral control significantly contributed to intention, which in turn predicted actual behavior, consistent with TPB's causal assumptions (43). This supports evidence that intention acts as a central mediating variable between cognitive, normative, and control-related determinants of health behavior (38). By demonstrating applicability in stunting prevention, this study extends TPB's generalizability from domains such as immunization and dietary practices to maternal and child nutrition in Indonesia (44). Thus, the findings provide theoretical support for using TPB as a framework to understand and influence health-related behaviors in complex socio-cultural environments.

The validated instrument has significant potential for practical application in public health programs. It can be employed by health workers at community health centers (Puskesmas), the Ministry of Health, and the National Population and Family Planning Board (BKKBN) to systematically monitor maternal behaviors related to stunting prevention. By identifying low scores in specific constructs such as subjective norms, targeted community-based interventions can be designed to strengthen family and peer support networks (45). Furthermore, the instrument contributes directly to achieving Indonesia's National Medium-Term Development Plan (RPJMN) 2025–2029, which aims to reduce stunting prevalence below 14.2% (46). Its evidence-based foundation ensures that interventions are both culturally tailored and behaviorally informed, increasing their likelihood of long-term effectiveness.

Conducting the study in Palu City provides unique insights, as this urban post-disaster area faces complex socioeconomic challenges and persistently high stunting prevalence (24.7% in 2022). The successful validation of the instrument in such a difficult setting demonstrates its contextual robustness and applicability in environments with compounded vulnerabilities (47). However, while Palu offers a representative urban case, further testing is required to ensure generalizability in rural and coastal areas, where cultural norms, resource constraints, and health service accessibility may differ substantially (48). This contextual lens highlights the adaptability of the instrument while underscoring the importance of future validation in diverse geographical and cultural settings.

Several strengths underpin this study. First, the sample size of 300 participants met and exceeded methodological recommendations for CFA, ensuring stable parameter estimation (49). Second, the study applied a systematic multi-phase validation process, including expert review, pilot testing, and multi-step psychometric analysis, which strengthened both content and construct validity (50). Third, unlike many previous tools focusing solely on knowledge, this instrument is grounded in a robust theoretical framework (TPB), capturing cognitive, normative, and control dimensions of maternal behavior that are crucial for sustainable stunting prevention (51). These methodological and theoretical strengths enhance the credibility and utility of the instrument for future research and policy application.

Despite its strengths, this study has several limitations. Data were collected exclusively in Palu City, an urban post-disaster setting, which may limit the generalizability of findings to rural or coastal populations where socioeconomic and cultural contexts differ (52). Additionally, the reliance on self-reported questionnaires introduces potential biases, particularly social desirability bias, which may cause mothers to overreport positive health behaviors (53). Finally, the instrument has not yet been tested for responsiveness, meaning its ability to detect behavioral changes following interventions remains unknown. These limitations should be addressed in future research to enhance the instrument's robustness and applicability.

Future research should focus on expanding the validation of this instrument to rural, coastal, and indigenous populations to assess its cross-cultural adaptability. Applying the tool in longitudinal intervention studies will also enable the evaluation of its predictive validity and responsiveness to behavior change over time (54). Moreover, integration of the instrument into national monitoring systems such as e-PPGBM (Community-Based Nutrition Monitoring) could enhance surveillance and intervention planning at scale (50). Such steps will ensure that the instrument not only advances academic knowledge but also contributes directly to national strategies for reducing stunting prevalence in Indonesia.

CONCLUSION

This study successfully developed and validated the first Theory of Planned Behavior (TPB)-based instrument to measure stunting prevention behaviors among mothers of under-five children in Indonesia. The TPB-Stunting Instrument demonstrated excellent content validity, strong internal consistency, and robust construct validity, supported by both Exploratory and Confirmatory Factor Analyses. The five-factor structure attitude, subjective norms, perceived behavioral control, intention, and actual behavior accurately captures maternal behavioral determinants relevant to stunting prevention.

The instrument is culturally appropriate, psychometrically sound, and practical for use in both research and public health programs. It provides a reliable tool for health professionals, policymakers, and community health workers to assess maternal behaviors, identify areas requiring intervention, and design targeted strategies to reduce stunting prevalence in urban and similar high-risk settings in Indonesia. Future research should extend validation to rural and coastal populations and evaluate the instrument's responsiveness in longitudinal intervention studies.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest related to this study. All research activities, data collection, analysis, and reporting were conducted independently and objectively, without any financial or personal relationships that could influence the outcomes of this research.

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