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Adaptation and Preliminary Pilot Testing of the WULANDARI Model for Family Health and Disaster Preparedness

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Abstract. Families are central to disaster preparedness, especially households that include children, older adults, pregnant women, and persons with disabilities with specific health needs during emergencies. This study developed the WULANDARI Model (Whole Update of famiLY heAlth aNd DisAster Risk reduction), an integrated framework combining household disaster preparedness with family health preparedness, and conducted preliminary pilot testing of its assessment instrument. The model integrates five KATANA disaster preparedness dimensions and five KESTANA family health domains. Experts appraised the model's conceptual and practical relevance, followed by pilot testing involving 25 families residing near Universitas Pembangunan Nasional "Veteran" Jawa Timur, Surabaya, Indonesia. Item performance was evaluated using corrected item-total correlations, while internal consistency was assessed using Cronbach's alpha. All 80 items exceeded the critical correlation coefficient of 0.396, with corrected item-total correlations ranging from 0.418 to 0.813. Cronbach's alpha coefficients ranged from 0.74 to 0.94 across domains, indicating acceptable to high internal consistency. The profiles showed that 36% of families were ready or very ready for disasters, while 48% were alert or highly alert regarding family health. These preliminary findings support the model's feasibility. However, larger and more diverse samples are needed to evaluate factor structure, construct validity, test-retest reliability, and broader applicability.

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1 Background

Indonesia is highly exposed to natural hazards because of its geographical and tectonic setting. Earthquakes, volcanic eruptions, tsunamis, floods, and landslides occur across many parts of the country and can cause substantial human, social, and economic losses [1,2]. Beyond damage to homes and public infrastructure, disasters can interrupt access to healthcare, livelihoods, communication, and other essential services [3]. Their effects may also persist after the emergency phase through physical injury, psychological distress, displacement, and disruption of family roles [3,4].

The consequences are particularly important at the household level. Families are often the first source of protection and support during emergencies, yet their ability to respond may be limited when they include children, older adults, pregnant women, persons with disabilities, or family members with chronic health conditions. These groups may require medications, assistive devices, specific nutrition, mobility support, or continuous access to health services during evacuation and recovery [5]. Disaster preparedness at the family level therefore needs to address not only evacuation and physical safety but also the health needs of individual family members.

Several disaster-preparedness frameworks have been developed to support risk reduction. The Egg Model illustrates disaster risk management through interconnected stages of responsibility, risk assessment, and risk treatment [6]. In Indonesia, the National Disaster Management Agency (BNPB) has developed instruments for assessing disaster resilience at village and community levels [7]. The Disaster-Resilient Family or KATANA framework further emphasizes five areas of household preparedness: understanding disaster risks, recognizing safe housing, developing preparedness plans, accessing early warning systems, and conducting independent evacuation [9].

These frameworks provide an important basis for disaster preparedness, but family health needs are not always assessed alongside household preparedness within the same instrument. This distinction becomes particularly important when households include members who require different forms of health support during an emergency. Existing public-health guidance addresses general family preparedness, children, pregnant women, older adults, and persons with disabilities [10-14], but these health considerations are generally presented separately from household disaster-preparedness assessment.

The present study therefore developed the WULANDARI Model (Whole Update of famiLy heAlth aNd DisAster Risk reduction) by integrating the disaster-preparedness components of KATANA with family-health components referred to as KESTANA. Rather than establishing definitive psychometric validation at this stage, the study was designed as a preliminary pilot assessment of the model and its accompanying instrument. The objectives were to develop and refine the integrated framework, obtain expert feedback on its conceptual and practical relevance, and examine preliminary item performance and internal consistency in a small community sample. The findings are intended to inform further refinement and larger-scale psychometric evaluation of the instrument.

2 Methods

2.1 Research Design

This study used a developmental design followed by preliminary pilot testing. The work was conducted in two main phases. The first phase involved development and refinement of the WULANDARI Model and its assessment instrument by integrating disaster-preparedness and family-health components. The second phase involved pilot administration of the instrument to examine item performance, internal consistency, and the distribution of family preparedness and health scores. The pilot phase was intended to provide initial information on the feasibility and performance of the instrument. Given the limited sample size, the analysis was not intended to establish the structural validity of the ten-pillar framework.

2.2 Population and Pilot Sample

The study population comprised families living in the area surrounding Universitas Pembangunan Nasional “Veteran” Jawa Timur, Surabaya, Indonesia. The preliminary pilot involved 25 families who met the eligibility criteria. Families were eligible when they permanently resided in the study area and were able to read and complete the questionnaire. Families were excluded when the questionnaire was not completed in full.

2.3 Development of the WULANDARI Model

2.3.1 Literature Review and Conceptual Development

A literature review identified concepts and recommendations relevant to household disaster preparedness and family health. Particular attention was given to the KATANA framework developed by BNPB [9] and to health-preparedness guidance addressing families and vulnerable household members [10-14]. The review informed the initial selection of dimensions, indicators, and questionnaire items included in the WULANDARI Model.

2.3.2 Expert Consultation and Model Refinement

The initial model was discussed with experts and practitioners in disaster management. Consultation focused on the relevance of the proposed dimensions, their applicability at the household level, and the feasibility of integrating family-health indicators into the disaster-preparedness framework. Feedback was used to refine the structure and content of the model. Additional expert appraisal was subsequently obtained from specialists affiliated with BNPB, Indonesia, and the University of West London, United Kingdom.

2.3.3 Instrument Structure

The WULANDARI instrument integrates two main components: KATANA, representing household disaster preparedness, and KESTANA, representing family-health preparedness. The KATANA component was adapted from the Disaster-Resilient Family framework developed by BNPB [9] and covers five dimensions:

1. Understanding disaster threats and risks;
2. Safe housing;
3. Disaster preparedness planning;
4. Early warning systems; and
5. Independent evacuation.

The KESTANA component addresses five health domains:

1. General family health [10];
2. Child health [11];
3. Maternal health [12];
4. Health of older adults [13]; and
5. Health of persons with disabilities [14].

The complete instrument consists of 80 items. Forty items assess the five KATANA dimensions, while the remaining 40 items assess the five KESTANA domains, with eight items assigned to each health domain. Each item uses a binary “yes/no” response format. A “yes” response is scored as 1, indicating that the corresponding preparedness indicator is fulfilled, whereas a “no” response is scored as 0. The total score is calculated using the following formula:

$$\text{Score} = (\text{obtained score} / \text{maximum possible score}) \times 100 \quad (1)$$

The resulting scores are classified according to the preparedness categories adapted from Rustam et al. [8]. Scores below 40 are classified as *not ready/not alert*, scores of 40–54 as *not quite ready/not quite alert*, scores of 55–64 as *almost ready/almost alert*, scores of 65–79 as *ready/alert*, and scores of 80–100 as *very ready/highly alert*.

2.4 Pilot Administration

The WULANDARI instrument was administered to 25 participating families using an online questionnaire. Completed responses were reviewed for completeness before statistical analysis. The pilot administration was conducted to identify potential problems in item performance, obtain preliminary estimates of internal consistency, and describe the distribution of disaster preparedness and family-health scores among participating families. Because the sample was small relative to the number of instrument items, the pilot was not intended to confirm the dimensional or factor structure of the instrument.

2.5 Preliminary Item Analysis and Internal Consistency

Statistical analyses were conducted using SPSS version 25. Preliminary item performance was evaluated using corrected item-total correlations. For the sample of 25 families, item correlations were compared with a critical correlation value of $r = 0.396$ at the 5% significance level. Items with corrected item-total correlations below this value were considered to require further review. Internal consistency was assessed using Cronbach’s alpha (α) for KATANA and each KESTANA health domain. The analysis provided preliminary evidence of internal consistency rather than definitive evidence of instrument reliability or construct validity. Factor analysis was not performed because the pilot sample was insufficient to evaluate the structural validity of an 80-item instrument. Further psychometric assessment using a substantially larger and more diverse sample is therefore required.

3 Results and Discussion

3.1 Development of the WULANDARI Model

The WULANDARI Model was developed as an integrated framework combining household disaster preparedness and family-health preparedness. The disaster component was adapted

from the KATANA framework developed by the Indonesian National Disaster Management Agency (BNPB) [9], while the health component incorporated preparedness guidance for general family health and the needs of vulnerable household members [10-14]. As illustrated in Figure 1, the model consists of two complementary components. KATANA addresses five areas of disaster preparedness: understanding disaster risks, safe housing, disaster preparedness planning, early warning systems, and independent evacuation. KESTANA extends the assessment to five health domains: general family health, child health, elderly health, maternal health, and the health needs of persons with disabilities.

Integrating these two components was intended to address a practical limitation in household disaster-preparedness assessment. A family may understand local hazards and have an evacuation plan but remain vulnerable if routine medications, health records, mobility aids, child-specific supplies, or maternal-health needs have not been considered. The WULANDARI Model therefore approaches household resilience through both disaster preparedness and health preparedness rather than treating these dimensions separately. In addition to producing preparedness and health scores, the model was designed to support recommendations and educational interventions based on the identified needs of each family. At this stage, however, the model should be regarded as a preliminary framework requiring further evaluation before broader implementation.

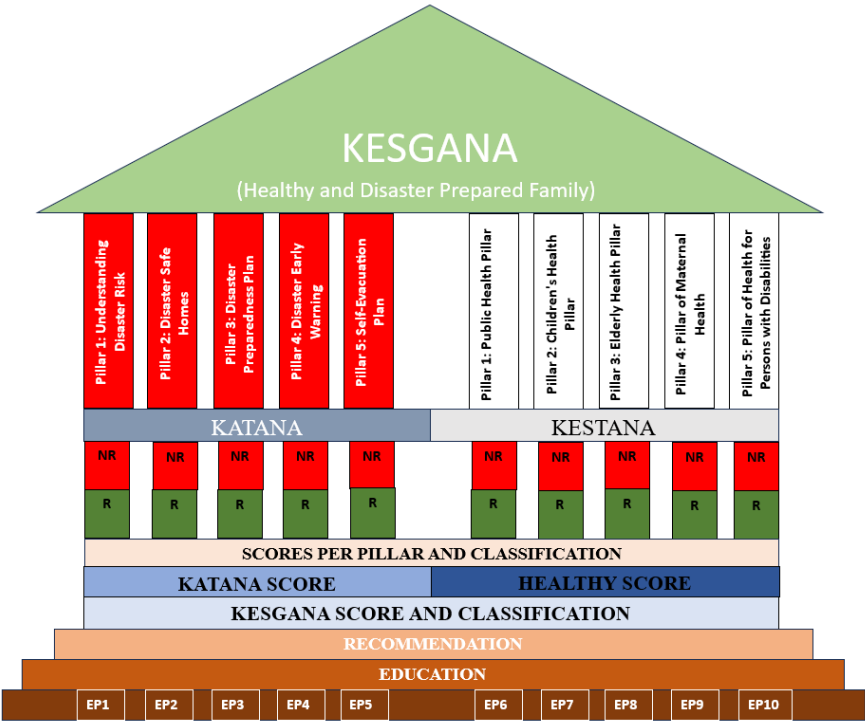


Fig. 1. WULANDARI Model: A Model for Family Health and Disaster Preparedness

3.2 Expert Appraisal of the WULANDARI Model

The WULANDARI Model was appraised by experts from the National Disaster Management Agency (BNPB), Indonesia, and the University of West London, United Kingdom. The purpose of this appraisal was to obtain feedback on the conceptual relevance, practical

applicability, and potential use of the integrated model. Table 1 presents the main findings of the expert appraisal.

Table 1. Expert Validation Results of the WULANDARI Model

Validator	Institution	Key Validation Findings	Recommendation
Expert 1	National Disaster Management Agency (BNPB), Indonesia	The WULANDARI Model effectively integrates the KATANA and KESTANA approaches into a comprehensive family-centered disaster preparedness framework. The model strengthens household resilience through community engagement, preparedness planning, and disaster risk reduction activities.	The model is suitable for implementation in community-based disaster preparedness programs and may support disaster risk reduction initiatives at the household level.
Expert 2	University of West London, United Kingdom	The model aligns with international disaster risk reduction frameworks, including the Sendai Framework and WHO Health Emergency and Disaster Risk Management (Health-EDRM). The model demonstrates potential to enhance preparedness among vulnerable populations and strengthen disaster resilience.	Further implementation and evaluation in different community settings are recommended to assess effectiveness and scalability.

Both experts considered the integration of disaster preparedness and family health to be conceptually relevant. The BNPB expert emphasized the potential application of the model in family- and community-based preparedness activities, while the international expert highlighted its relevance to broader disaster risk reduction perspectives and recommended further testing in different community settings. The expert appraisal therefore supported continuation to the pilot-testing stage. Nevertheless, expert agreement should be interpreted as evidence of conceptual and practical relevance rather than as confirmation of the psychometric validity of the instrument. Further evaluation using larger and more diverse populations remains necessary.

3.3 Preliminary Item Analysis and Internal Consistency

Preliminary item analysis was conducted using responses from 25 families. Corrected item-total correlations were used to examine the relationship between individual items and the overall score of their respective domains. For the pilot sample, the coefficients were compared with a critical value of $r = 0.396$. All 80 items had corrected item-total correlations above the predefined critical value. The coefficients ranged from 0.421 to 0.782 for KATANA, 0.548 to 0.813 for KESTANA-General, 0.471 to 0.796 for KESTANA-Children, 0.418 to 0.791 for KESTANA-Elderly, 0.452 to 0.806 for KESTANA-Pregnant Women, and

0.438 to 0.798 for KESTANA-Persons with Disabilities. No item fell below the critical value of 0.396. Internal consistency was examined using Cronbach’s alpha. The coefficients ranged from 0.74 to 0.94 across the six domains. KATANA showed the highest internal consistency ($\alpha = 0.94$), followed by KESTANA-General ($\alpha = 0.88$), KESTANA-Children ($\alpha = 0.85$), KESTANA-Elderly ($\alpha = 0.83$), KESTANA-Pregnant Women ($\alpha = 0.81$), and KESTANA-Persons with Disabilities ($\alpha = 0.74$).

Table 2. Preliminary Item Analysis and Internal Consistency of the WULANDARI Instrument

Pillar/Domain	Items	Corrected item-total r (range)	Items below rcrit = 0.396	Cronbach
KATANA	40	0.421 – 0.782	0	0.94
KESTANA – General	8	0.548 – 0.813	0	0.88
KESTANA – Children	8	0.471 – 0.796	0	0.85
KESTANA – Elderly	8	0.418 – 0.791	0	0.83
KESTANA – Pregnant Women	8	0.452 – 0.806	0	0.81
KESTANA – Persons with Disabilities	8	0.438 – 0.798	0	0.74

These findings provide preliminary evidence that the items functioned consistently within their respective domains in this pilot sample. The internal-consistency coefficients were acceptable to high, although the coefficient for KESTANA-Persons with Disabilities was lower than those of the other domains. Nevertheless, interpret the results cautiously. The pilot involved only 25 families for an 80-item instrument, which is insufficient for comprehensive psychometric validation or analysis of the proposed factor structure. Consequently, the present results indicate preliminary item performance and internal consistency rather than definitive evidence of construct validity.

3.4 Family Health and Disaster Preparedness Profile

The distribution of disaster preparedness and family-health classifications among the 25 pilot families is presented separately in Figure 2 to facilitate interpretation. For disaster preparedness, 8% of families were classified as *not ready*, 24% as *not quite ready*, 32% as *almost ready*, 28% as *ready*, and 8% as *very ready*. Thus, the largest proportion of families was classified as almost ready, while 36% were categorized as either ready or very ready. For family health, 4% of families were classified as *not alert*, 20% as *not quite alert*, 28% as *almost alert*, 36% as *alert*, and 12% as *highly alert*. In this domain, 48% of participating families were classified as alert or highly alert.

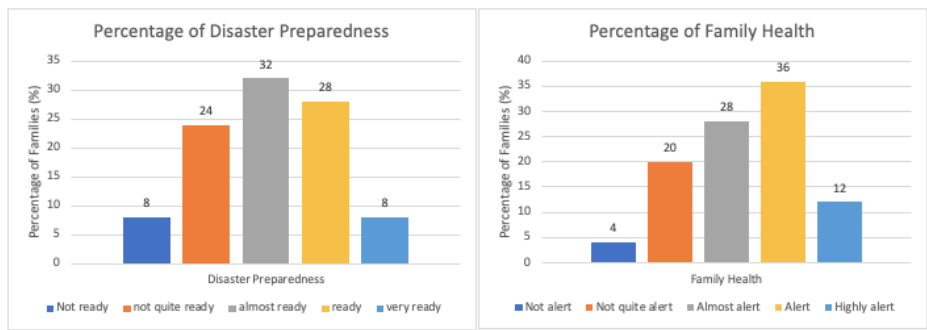


Fig. 2. Distribution of Disaster Preparedness and Family Health among 25 Pilot Families

The separate distributions show that family health readiness and disaster preparedness do not necessarily develop at the same level. Although almost half of the participating families were classified as alert or highly alert in relation to family health, a smaller proportion reached the ready or very ready categories for disaster preparedness. This pattern suggests that households may possess adequate health-related resources while still requiring improvement in areas such as preparedness planning, evacuation readiness, or recognition of disaster risks.

Previous Indonesian evidence has also indicated an association between household knowledge and disaster preparedness [15]. This supports the importance of continued education, preparedness exercises, and family-level planning. Within the WULANDARI framework, such interventions can be directed toward the specific preparedness or health dimensions in which a household shows lower scores. However, these distributions are descriptive results from a small pilot sample and should not be interpreted as estimates of preparedness among families in Surabaya or Indonesia more broadly.

3.5 Study Limitations

Several limitations should be considered when interpreting the findings. First, the preliminary pilot included only 25 families from a single geographical setting. This sample is substantially smaller than typically required for comprehensive psychometric validation of an 80-item instrument and was insufficient for factor analysis of the proposed structure. Second, the instrument uses a binary yes/no response format. Although this approach makes the questionnaire relatively simple to administer, it may reduce sensitivity to intermediate levels of preparedness. Families that have partially fulfilled a preparedness indicator are classified in the same way as families that have not fulfilled it at all. Third, reliability in this study was assessed only through internal consistency using Cronbach’s alpha. Test-retest reliability was not evaluated, and the stability of scores over time therefore remains unknown. Additional reliability testing should be considered in future studies. Finally, the pilot was conducted within one community setting near Universitas Pembangunan Nasional “Veteran” Jawa Timur. The results cannot therefore be generalized to households in other regions with different socioeconomic characteristics, healthcare access, or disaster-risk profiles. A larger and more diverse sample will be required to evaluate the factor structure, construct validity, test-retest reliability, responsiveness, and broader applicability of the WULANDARI instrument.

4 Conclusion

The WULANDARI Model integrates household disaster preparedness with family-health considerations, including the needs of children, older adults, pregnant women, and persons with disabilities. Expert appraisal supported the conceptual relevance and practical potential of this integrated approach, while preliminary pilot testing among 25 families provided initial evidence regarding item performance and internal consistency. All 80 items showed corrected item-total correlations above the critical value of 0.396. Cronbach's alpha coefficients ranged from 0.74 to 0.94 across the assessed domains, indicating acceptable to high internal consistency in this pilot sample. These findings support the feasibility of the WULANDARI Model for further development but should not be interpreted as definitive psychometric validation. The small, single-site sample and binary response format limit the generalizability and measurement sensitivity of the current findings. Further studies involving larger and more diverse populations are needed to evaluate factor structure, construct validity, test-retest reliability, and broader applicability. At this stage, the WULANDARI Model should be considered a promising family-centered framework for continued refinement and evaluation before recommendations for wider implementation are made.

5 Declarations

Ethics Approval

This study was approved by the Research Ethics Committee of Universitas Pembangunan Nasional "Veteran" Jawa Timur (Approval Number: 661/UN63.8/TU/2025).

Informed Consent

Informed consent was obtained from all participants prior to their participation in the study.

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Author Contributions

Conceptualization: RY; Methodology: RY, ZF; Investigation: RY, ZF; Data curation: AWW, CKA, ABPZ; Formal analysis: RY, ZF, HTAK; Writing—original draft: RY, ZF; Writing—review and editing: RY, ZF, ETP, AHP, TAC, YNM, HTAK; Supervision: ETP, AHP, TAC, YNM, HTAK. All authors have read and approved the final manuscript.

Declaration on the Use of AI Tools

An AI-assisted language tool was used during manuscript revision to support language editing, grammar, and clarity. All scientific content, statistical results, interpretation of findings, and final manuscript content were reviewed and verified by the authors. The authors take full responsibility for the accuracy and integrity of the manuscript.

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