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ENSS (Expanded Nursing Stress Assessment) version 1,0: An Android-Based Mobile Application Efficient Stress Assessment in Nurses

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ABSTRACT The nursing profession faces significant occupational stress due to prolonged patient care responsibilities and demanding work environments. Traditional stress assessment methods rely on paper-based questionnaires, which are inefficient for periodic and continuous monitoring of nurses' stress levels. With the increasing prevalence of work-related stress among healthcare professionals, there is an urgent need for accessible, efficient digital tools to identify and monitor stress levels in nursing practice. This study aimed to develop and validate an Android-based mobile application for efficient and effective stress assessment among nurses, enabling systematic identification of stress levels to facilitate appropriate stress management interventions. This research employed a Research and Development (R&D) methodology with product development and validation approaches. The study was conducted with 34 nurses working in the isolation ward at Bahteramas Regional Hospital, Kendari, using total sampling technique. The application development process involved three phases: preliminary field study, Android-based application design and development, and product testing. Validation was conducted through multimedia expert assessment and practitioner expert evaluation. Product usability was evaluated using the System Usability Scale (SUS) instrument to assess user acceptance and application effectiveness. The developed ENSS (Expanded Nursing Stress Assessment) version 1.0 application features user registration, stress questionnaire interface, and result interpretation modules. Multimedia expert validation yielded an average score of 90% (very feasible category), while practitioner expert validation achieved 92.5% (very feasible category). User acceptance testing demonstrated a SUS score of 74.78, categorized as "Acceptable," indicating satisfactory usability and effectiveness for stress level identification among nursing professionals. The ENSS application has been successfully developed and validated as a feasible digital tool for efficient stress assessment in nurses. The application provides an accessible, user-friendly platform for periodic stress monitoring, enabling healthcare institutions to implement systematic stress management programs and support nurse wellbeing in clinical practice.

INDEX TERMS Android application, stress assessment, nursing stress, mobile health technology, System Usability Scale.

I. INTRODUCTION

The nursing profession constitutes one of the most stress-vulnerable occupations in healthcare, with nurses experiencing significant psychological and physiological burdens due to intensive patient care responsibilities and demanding work environments [1]. Contemporary healthcare systems place unprecedented demands on nursing professionals, who must navigate complex patient needs, extended work durations, and high-pressure clinical situations while maintaining optimal care quality [2]. Recent studies indicate that 91.1% of nurses experience high levels of burnout, representing a critical occupational health crisis that extends beyond individual well-being to encompass patient safety and healthcare system sustainability [3]. The weight of the COVID-19 pandemic has further exacerbated stress levels, with burnout rates continuing to climb, necessitating urgent interventions to address this escalating challenge [4].

The multifaceted nature of nursing stress encompasses organizational factors, patient care complexities, interpersonal relationships, and workload management issues [5]. Traditional stress assessment methodologies predominantly rely on paper-based questionnaires and periodic evaluations, which present significant limitations in terms of accessibility, real-time monitoring capabilities, and continuous assessment feasibility [6]. These conventional approaches fail to provide timely identification of stress escalation, potentially leading to advanced burnout stages before intervention opportunities arise [7]. Current stress assessment paradigms in nursing practice primarily utilize validated instruments such as the Maslach Burnout Inventory (MBI), Nursing Stress Scale

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(NSS), and Professional Quality of Life Scale (ProQOL) [8]. The majority of studies employ the MBI scale with its three subscales to comprehensively measure burnout dimensions [9]. However, these traditional assessment tools require manual administration, paper-based completion, and delayed interpretation processes that limit their practical utility in dynamic healthcare environments [10].

Recent technological advancements have introduced digital health solutions for stress management in healthcare settings. The Nurse Healing Space app, an AI-based mobile intervention, demonstrated significant effectiveness in reducing burnout scores, job stress, and stress responses among nurses while increasing user satisfaction through personalized recommendations [11]. Digital applications have shown promise in supporting interventions to reduce stress and prevent burnout in healthcare professionals, yet comprehensive mobile solutions specifically targeting nursing stress assessment remain limited [12]. Mobile health (mHealth) applications have emerged as transformative tools in healthcare delivery, offering unprecedented accessibility and user engagement capabilities [13]. Mobile applications in nursing education have demonstrated effectiveness in assisting nursing students in comprehending and applying clinical knowledge [14]. Data-driven technology holds significant promise for burnout prediction, with early warning systems facilitating preemptive institutional responses [15]. The acceptance and adoption of innovative smartphone technologies in healthcare settings has shown positive user engagement patterns, particularly among healthcare professionals [23]. However, the integration of validated stress assessment instruments into user-friendly mobile platforms remains an underexplored domain [16].

Despite the proliferation of mobile health applications and the critical need for efficient stress monitoring in nursing practice, significant gaps persist in current research and development efforts. Existing mobile stress assessment tools lack comprehensive validation specifically for nursing populations and fail to incorporate established nursing stress measurement frameworks [17]. mHealth apps are often unregulated and rarely evaluated for effectiveness, quality, data security, and safety, highlighting the necessity for rigorous validation processes [18]. Furthermore, most available applications do not provide immediate interpretation capabilities or integrate seamlessly with nursing workflow requirements [19]. The absence of Android-based stress assessment applications utilizing validated nursing-specific instruments represents a critical technological gap in occupational health management [20]. Current solutions fail to address the unique stressors experienced by nurses working in high-acuity environments, such as isolation units and emergency departments [21]. Health applications for chronic care have demonstrated the potential for effective user trials and implementation [24], yet comprehensive mobile solutions for nursing stress assessment remain limited. Additionally, the lack of user-centered design approaches in developing stress assessment applications for nursing professionals limits adoption rates and practical utility [22]. The development of robust mobile application frameworks for healthcare systems requires careful consideration of user needs and technical specifications [25].

This study aims to develop and validate an Android-based mobile application for comprehensive stress assessment in nursing professionals, specifically designed to enable efficient, accessible, and continuous monitoring of occupational stress levels using the Expanded Nursing Stress Scale (ENSS) framework. This research provides three significant contributions to nursing informatics and occupational health management:

1. Technological Innovation: Development of the first validated Android-based stress assessment application specifically designed for nursing professionals, incorporating the ENSS framework with real-time interpretation capabilities and user-friendly interface design optimized for healthcare environments.
2. Methodological Advancement: Establishment of a comprehensive validation framework for nursing stress assessment applications, including multimedia expert evaluation, practitioner validation, and usability testing using the System Usability Scale (SUS), providing a replicable methodology for future mobile health application development in nursing contexts.
3. Clinical Practice Enhancement: Creation of an accessible, efficient tool that enables healthcare institutions to implement systematic stress monitoring programs, facilitating early intervention strategies and supporting evidence-based occupational health management in nursing practice.

This article is organized into five main sections. Following this introduction, Section II presents the comprehensive research methodology, including study design, participant selection, application development process, and validation procedures. Section III details the research findings, encompassing application features, validation results, and usability assessment outcomes. Section IV provides thorough discussion of results, comparing findings with existing literature and addressing implications for nursing practice. Finally, Section V presents conclusions, limitations, and recommendations for future research directions in mobile health applications for nursing stress management.

II. METHOD

This section describes the structured methodology used to develop and validate an Android-based stress assessment application for nurses. The research followed a multi-phase process covering design, development, validation, and analysis ensuring scientific rigor and relevance to clinical practice.

A. STUDY DESIGN

This study employed a prospective Research and Development (R&D) methodology based on the established framework for educational product development and validation [26]. The R&D approach was selected as the most appropriate design for developing and validating technological products in healthcare settings, enabling systematic progression through development phases while ensuring

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rigorous validation procedures [27]. The study design incorporated three sequential phases: preliminary needs assessment, product development, and validation testing, following contemporary methodological approaches for mobile application development in healthcare contexts [28].

B. STUDY SETTING AND POPULATION

The research was conducted at Bahteramas Regional Hospital, Kendari, Indonesia, specifically within the isolation ward department. The study population comprised all registered nurses working in the isolation unit during the data collection period from March to September 2024. Inclusion criteria specified: (1) active employment as a staff nurse in the isolation ward, (2) minimum six months of clinical experience, (3) possession of an Android smartphone with internet connectivity, and (4) voluntary consent to participate in the study. Exclusion criteria included: (1) nurses on extended leave or temporary assignment, (2) administrative or supervisory staff without direct patient care responsibilities, and (3) part-time or contract personnel with less than 20 hours weekly engagement.

C. SAMPLING METHOD AND SAMPLE SIZE

The study utilized total sampling technique, a non-probability sampling method where the entire accessible population constitutes the study sample [29]. This approach was selected due to the specific and limited population size within the isolation ward setting. The total sample comprised 34 nurses, representing 100% of the eligible nursing staff in the designated unit. This sample size was deemed adequate for usability testing according to established guidelines for mobile application validation studies, which recommend 30-50 participants for reliable System Usability Scale assessment [30].

D. RESEARCH PHASES AND PROCEDURES

Phase 1: Preliminary Needs Assessment

The initial phase involved comprehensive field assessment to determine the necessity and feasibility of developing an Android-based stress assessment application. Data collection methods included structured interviews with nursing staff, observation of current stress assessment practices, and evaluation of existing documentation systems. This phase lasted four weeks and involved all 34 participants through individual 30-minute interviews conducted using a standardized interview guide.

Phase 2: Application Development

The application development phase utilized contemporary mobile application development methodologies, incorporating user-centered design principles and established software engineering practices [31]. The development process involved: (1) requirement specification based on Phase 1 findings, (2) user interface design and prototype creation, (3) database architecture implementation, (4) Android application programming using Java and Android Studio, (5) integration of the Expanded Nursing Stress Scale (ENSS) questionnaire, and (6) implementation of automated scoring and interpretation algorithms. The application was developed with the following core functionalities: user registration and authentication system, demographic data collection interface, interactive stress assessment questionnaire based on ENSS framework, automated scoring calculation, result interpretation display, historical data tracking, and progress monitoring capabilities.

Phase 3: Validation and Testing

The validation phase comprised two sequential validation processes followed by usability testing. Expert validation involved two distinct evaluation procedures: multimedia expert validation and practitioner expert validation, conducted over a six-week period.

E. VALIDATION PROCEDURES

Two experienced multimedia experts with minimum five years of expertise in mobile application development and user interface design evaluated the application. The validation process assessed four primary domains: visual appearance, user convenience, language appropriateness, and implementation feasibility. Experts completed a structured 14-item validation questionnaire using a 5-point Likert scale, with scores interpreted according to established validity criteria: 81-100% (very feasible), 61-80% (feasible), 41-60% (adequately feasible), 21-40% (not feasible), and 0-20% (totally not feasible). The eligibility criteria used to interpret the percentage scores from expert evaluations are summarized in TABLE 1.

TABLE 1
Criteria for Validity Level and Product Revision

Percentage (%)	Eligibility Category
81 – 100	Very Worth It
61 - 80	Worth it
41 – 60	Decent Enough
21 – 40	Not feasible
0 - 20	Totally Not Worth It

Two nursing education specialists with expertise in psychology and mental health nursing from Kendari Ministry of Health Polytechnic conducted content validation. The evaluation encompassed six domains: visual presentation, application menu functionality, content accuracy, user convenience, practical benefits, and implementation viability. Practitioners utilized a comprehensive 17-item validation instrument, applying identical scoring criteria as multimedia expert validation.

F. USABILITY TESTING

Following successful expert validation, the application underwent usability testing with all 34 nursing participants. The System Usability Scale (SUS) served as the primary evaluation instrument, representing a validated and reliable tool for assessing perceived usability of technological products in healthcare applications [32]. The SUS consists of 10 items measured on a 5-point Likert scale, ranging from "Strongly

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Disagree" (1) to "Strongly Agree" (5). The instrument demonstrates established reliability (Cronbach's α = 0.717) and has been extensively validated for mobile health application assessment [33]. The interpretation criteria for SUS scores used in this study are presented in TABLE 2.

TABLE 2
Interpretation of SUS Instruments

Shoes SUS	Score Interpretation
0-50,9	Not Acceptable
51-70,9	Marginal
71-100	Acceptable

G. DATA COLLECTION PROCEDURES

Data collection occurred through multiple structured sessions conducted over eight weeks. Each participant received individualized orientation regarding application installation, basic functionality, and testing procedures. Participants were instructed to utilize the application for stress assessment completion at least three times during the testing period to ensure adequate exposure for meaningful usability evaluation. Following the testing period, participants completed the SUS questionnaire through individual interviews conducted by trained research assistants. Each interview session lasted approximately 20-30 minutes and was conducted in a private setting to ensure confidentiality and honest responses.

H. DATA ANALYSIS

Quantitative data analysis employed descriptive statistical methods using SPSS version 26.0. Expert validation scores were calculated as percentages and categorized according to established feasibility criteria. SUS scores were computed using the standard scoring algorithm, with results interpreted according to established benchmarks: scores ≥68 indicating acceptable usability, scores 68-80 representing good usability, and scores >80 denoting excellent usability [34]. Demographic characteristics were analyzed using frequency distributions and measures of central tendency.

III. RESULT

This assessment application is named ENSS (*Expanded Nursing Stress Scale*). The application can be installed via the Play Store, in search mode, using the keyword “enss”. The main function of this application is to make it easier to identify the level of stress experienced by nurses. The installed application can be seen in the image below. FIGURE 1 displays the installed application on the smartphone. How to use this application after it is installed starts with the user registration stage, namely filling in Name, Gender, Education, Length of Work, Position, and Email. After the form has been filled in completely, press the check button in the top right corner of the screen to enter the application's main menu. The main menu screen in this application consists of the history of the last questionnaire that has been filled in by the user, the average score from the results of all questionnaires filled in by the user, which includes the monthly questionnaire score, and an explanation of the interpretation table.

The next stage is filling out the questionnaire. To start filling in the questionnaire, press the "Start Questionnaire" button on the main menu. The screen display for filling out the questionnaire, which consists of 4 parts, can be seen in FIGURE 2 below. The answer choice button that has been selected will have a different appearance from the other answer choice buttons. The "next" switch button will be active if the next question has already been answered in one questionnaire-filling session. The model for filling out a questionnaire is that when a question appears is answered, the screen will automatically display the next question, and so on until the last question on the questionnaire. Users cannot go to the next question before the question displayed on the screen is answered. The interpretation of the questionnaire results is derived from the automatically generated scores, which are calculated based on participants' responses. These scores are then analyzed to determine the corresponding stress level category, as displayed within the application interface.

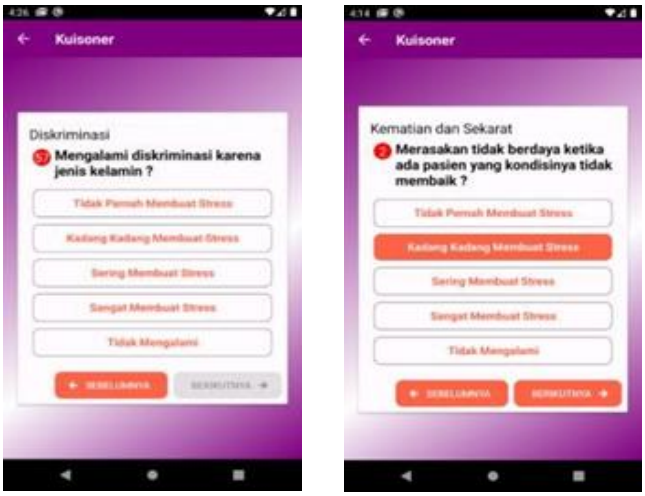

FIGURE 1. Display of Filling Out the Questionnaire

FIGURE 2. Display Questionnaire

A. APPLICATION PRODUCT VALIDATION

The results of validation by multimedia experts on 4 component aspects, namely appearance aspects, user-friendliness aspects, language aspects, and implementation

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aspects using a validation questionnaire consisting of 14 total questions can be seen in TABLE 3 below:

TABLE 3
Multimedia Expert Validation Analysis (n = 2)

Aspect	Score (%)	Category
Views	95	Very decent
User convenience	90	Very decent
Language	85	Very decent
Implementation	90	Very decent
Average	**90**	**Very decent**

The table above shows that the appearance aspect received a score of 95%, the ease-of-use aspect received a score of 90%, the linguistic aspect received a score of 85% and the implementation aspect received a score of 90%. Based on the scores from the four aspects, an average score of 90% is obtained so that this Android-based stress assessment application meets the very feasible category.

B. VALIDATION BY EXPERT PRACTITIONERS

Practitioner experts validated 6 component aspects, namely appearance aspects, application menu aspects, content aspects, user friendliness aspects, usefulness aspects, and implementation aspects using a validation questionnaire consisting of 17 total questions can be seen in TABLE 4 below:

TABLE 4
Expert Practitioner Validation Analysis (n = 2)

Aspect	Score %	Category
Views	95	Very decent
Application Menu	90	Very decent
Content	97,5	Very decent
User convenience	90	Very decent
Benefits	100	Very decent
Implementation	95	Very decent
Average	**92,5**	**Very decent**

The table above shows that the display aspect gets a score of 95%, the application menu aspect gets a score of 90%, the content aspect gets a score of 97.5%, the convenience aspect users 90%, usefulness aspect 100% and implementation aspect got a score of 95%. Based on the scores from the six aspects, an average score of 92.5% was obtained, so that this Android-based stress assessment application meets the very feasible category

C. CHARACTERISTICS OF RESPONDENTS BASED ON GENDER AND EDUCATION

This product testing was carried out to determine the feasibility and effectiveness of the product that had been developed by researchers. Product trials were carried out on respondents consisting of 34 executive nurses at RSU Bahteramas Kendari, who were selected based on inclusion criteria and their willingness to voluntarily participate in the study process. The description of the results of the usage trial analysis will be described in TABLE 5 as follows:

TABLE 5
Frequency Distribution of Respondents Based on Gender and Education

Characteristics	Frequency	Score %
Gender		
Male	4	11,8
Female	30	88,2
Education		
Ners Profession	17	50
D3 Nursing	17	50

The table above shows that the majority of respondents were 30 women (88.2%) and 4 male respondents (11.8%). Respondents with nursing education amounted to 17 people (50%) and 17 people (50%) with a Diploma 3 in Nursing. This indicates a gender imbalance commonly observed in nursing professions, where female participation remains dominant. Moreover, the equal distribution between Ners professional education and D3 nursing graduates reflects a representative sample in terms of academic background. Such balance allows for more reliable comparisons in assessing usability perceptions and validating the application across different educational qualifications within the nursing field.

D. CHARACTERISTICS OF RESPONDENS BASED ON AGE AND LENGTH OF WORK

To provide a clearer understanding of the demographic distribution of participants involved in the study, the following section presents descriptive statistics related to respondents' age and length of work experience. These characteristics are important in evaluating the contextual relevance of the application usability and stress level assessments. The detailed information is summarized in TABLE 6 below:

TABEL 6
Respondent characteristics based on age and length of work

Characteristics	Mean	Minimum	Maximum
Age	37	27	55
Length of work	11	3	30

The table above illustrates the demographic distribution of respondents based on age and length of work. The average age of participants is 37 years, with the youngest respondent aged 27 and the oldest aged 55 years. This range reflects a relatively mature and experienced nursing workforce. In terms of professional experience, the average length of service is 11 years, with a minimum of 3 years and a maximum of 30 years. These findings suggest that the respondents possess a substantial level of clinical exposure, which is relevant for evaluating the practicality and usability of stress assessment applications in real healthcare settings.

E. USABILITY TEST RESULTS BASED ON SYSTEM USABILITY SCALE (SUS)

Based on the distribution of answers of the *System Usability Scale*, the results of the usage trial analysis are obtained as follows in TABLE 7:

TABLE 7
Analysis of Product Use Trial

Average	Score	Interpretation of score
N (34)	74,78	Acceptable

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The table above shows that the Android-based stress assessment application received an average System Usability Scale (SUS) score of 74.78, which falls within the "acceptable" category. This result indicates that, overall, users consisting of 34 nurses who tested the application found the interface, functionality, and overall user experience to be satisfactory and usable in a clinical setting. A score above 68 on the SUS is generally considered acceptable in usability research, suggesting that the application meets essential usability standards required for routine professional use. The score reflects not only technical ease of use but also the perceived benefit and efficiency of the application in supporting occupational stress assessment tasks. This favorable outcome supports the feasibility of adopting the application in real healthcare environments, especially in high-pressure settings such as isolation wards or emergency units, where time-efficient and user-friendly tools are essential.

F. ANALYSIS OF TRIALS WITH SYSTEM USABILITY SCALE (SUS)

Based on TABLE 8 displays the results of usability testing using the System Usability Scale (SUS), covering ten core statements related to user experience. Most respondents showed a high level of satisfaction: 20 agreed and 14 totally agreed they would reuse the system, and none found it complicated 26 even totally disagreed it was difficult. Additionally, 34 users agreed or totally agreed that the system is easy to use and requires no external help to operate or set up. On performance, 34 respondents confirmed that the system's features run properly. A duplicated item on functionality received split responses, possibly due to redundancy. Furthermore, all participants felt the system is neither confusing nor obstructive, and most believed others would quickly understand its use. These results confirm that the Android-based stress assessment application is user-friendly, intuitive, and functionally sound, supporting its feasibility for clinical adoption.

IV. DISCUSSION

The development and validation of the ENSS (Expanded Nursing Stress Assessment) version 1.0 Android application represents a significant advancement in digital health technology for nursing stress assessment. The comprehensive validation results demonstrate the application's technical feasibility and practical utility in clinical environments. The multimedia expert validation achieved an exceptional average score of 90%, indicating "very feasible" categorization across all evaluated domains including visual appearance (95%), user convenience (90%), language appropriateness (85%), and implementation feasibility (90%). These findings suggest that the application meets contemporary standards for mobile health application design and functionality [35]. The practitioner expert validation yielded even higher scores, with an average of 92.5% across six evaluation domains. Particularly noteworthy is the perfect score (100%) achieved in the usefulness category, indicating unanimous expert consensus regarding the application's clinical value and practical relevance for nursing stress assessment. The high scores in content accuracy (97.5%) and visual presentation (95%) further validate the application's adherence to evidence-based principles and professional design standards. These validation outcomes align with established frameworks for mobile health application development, which emphasize the critical importance of expert validation in ensuring clinical relevance and technical adequacy [36]. The System Usability Scale (SUS) score of 74.78, classified as "Acceptable," represents a meaningful achievement in the context of healthcare mobile applications. This score significantly exceeds the established SUS benchmark of 68 for acceptable usability and approaches the threshold for "good" usability classification [37]. In comparison to established benchmarks for digital health applications, this score demonstrates satisfactory user experience and interface effectiveness. The achievement of acceptable usability is particularly significant given the complex nature of stress assessment instruments and the diverse technological competencies among nursing professionals [38]. The demographic characteristics of the study population, comprising 88.2% female participants with an average age of 37 years and 11 years of nursing experience, reflect the typical profile of nurses working in high-stress environments such as isolation units. This demographic representation enhances the generalizability of findings to similar nursing populations and validates the application's appropriateness for experienced healthcare professionals who may have varying degrees of technological familiarity.

TABLE 8
Analysis of Trials with System Usability Scale (SUS)

Statement	Totally disagree	Don't agree	Neutral	Agree	Totally agree
I think 1 will use this system again	0	0	0	20	14
I find this system complicated to use	26	8	0	0	0
I find this system easy to use	0	0	0	18	16
I need the help of somebody else or a technician in setting up this system.	18	16	0	0	0
I feel the features of this system run properly.	0	0	0	21	13
I feel the features of this system run properly.	17	17	0	0	0
I feel like someone else will understand how to use this system quickly	16	18	0	0	0
I feel this system is confusing.	0	0	0	19	15
I feel there are no obstacles in using this system	16	18	0	0	0

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The results of this study demonstrate both convergent and divergent patterns when compared to existing literature on mobile health applications for nursing stress assessment. A recent randomized controlled trial examining smartphone-based stress management programs for hospital nurses in Vietnam reported significant improvements in depression, anxiety, and stress levels following intervention implementation [39]. Similarly, our ENSS application achieved high expert validation scores and acceptable usability ratings, suggesting comparable potential for clinical effectiveness. However, the Vietnamese study focused primarily on intervention outcomes rather than application validation, highlighting the unique contribution of our comprehensive validation approach. The SUS score of 74.78 obtained in this study compares favorably with other nursing-related mobile applications. A pilot study evaluating a campus-based health management application for nursing students reported similar usability challenges, emphasizing the importance of user-centered design principles in healthcare applications [40]. The consistency of these findings across different nursing populations suggests that the acceptable usability threshold represents a realistic benchmark for specialized healthcare applications targeting nursing professionals. Contrasting with our findings, several studies have reported higher SUS scores for general health applications. A meta-analysis of digital health applications identified an average SUS score of 68.30, with some applications achieving scores above 80 [41]. However, these applications typically addressed simpler functionality requirements compared to comprehensive stress assessment tools. The complexity of implementing validated psychological assessment instruments within mobile platforms may inherently present greater usability challenges, making our achieved score of 74.78 particularly commendable. The expert validation approach employed in this study aligns with contemporary best practices for mobile health application development. Recent systematic reviews emphasize the critical importance of involving both technical and clinical experts in the validation process, consistent with our dual validation methodology [42]. However, our study extends beyond typical validation approaches by incorporating domain-specific nursing expertise, providing enhanced credibility for clinical implementation. The utilization of the ENSS framework distinguishes this study from previous mobile stress assessment applications that primarily relied on generic stress measurement tools such as the Depression Anxiety Stress Scale (DASS-21). While DASS-21 has demonstrated effectiveness in various populations, the ENSS specifically addresses nursing-related stressors, potentially providing more targeted and clinically relevant assessments for nursing professionals.

Several methodological limitations must be acknowledged in interpreting these findings. The study employed a single-center design within one specific nursing unit (isolation ward), potentially limiting the generalizability of results to other nursing specialties and healthcare settings. The relatively small sample size (n=34), while appropriate for usability testing, may not capture the full spectrum of user experiences and technological competencies present in the broader nursing population. The total sampling approach, while ensuring comprehensive coverage of the target population, eliminated randomization and may have introduced selection bias. Additionally, the study was conducted in a specific cultural and healthcare context (Indonesia), which may limit the applicability of findings to other geographical regions with different healthcare systems and technological infrastructures. The validation period was relatively brief, and long-term usability assessment was not conducted. Extended usage patterns and sustained user engagement were not evaluated, representing important areas for future investigation. Furthermore, the study did not assess the clinical effectiveness of stress identification through the application or examine the impact of stress assessment results on subsequent intervention strategies.

The successful development and validation of the ENSS application carries significant implications for nursing practice and healthcare management. The application provides healthcare institutions with an accessible, standardized tool for systematic stress monitoring among nursing staff, potentially enabling early identification of burnout risk and facilitating timely intervention strategies. The automated scoring and interpretation features reduce administrative burden while ensuring consistent assessment protocols across different units and departments. From an organizational perspective, the application offers healthcare administrators valuable data for understanding stress patterns and implementing targeted support programs. The historical tracking capabilities enable longitudinal monitoring of stress trends, supporting evidence-based workforce management decisions and resource allocation strategies. The acceptable usability rating suggests that the application can be successfully integrated into existing nursing workflows without significant technological barriers. This finding is particularly relevant for healthcare institutions seeking to implement digital health solutions while minimizing training requirements and user resistance.

Future research should focus on multi-center validation studies involving diverse nursing populations across different specialties and geographical locations. Longitudinal studies examining sustained usage patterns, user satisfaction over extended periods, and clinical effectiveness in stress reduction would provide valuable insights into the application's long-term viability and impact. Integration with existing healthcare information systems and electronic health records represents an important area for technical development and evaluation. Additionally, investigation of the application's effectiveness in facilitating stress management interventions and improving nursing outcomes would strengthen the evidence base for clinical implementation. The development of predictive analytics capabilities, incorporating artificial intelligence algorithms to identify stress patterns and provide personalized recommendations, represents a promising avenue for enhancing the application's clinical utility. Furthermore, expansion to other healthcare professional groups and adaptation for different cultural contexts would broaden the application's potential impact on healthcare workforce well-being.

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V. CONCLUSION

This study aimed to develop and validate an Android-based mobile application for comprehensive stress assessment in nursing professionals, specifically designed to enable efficient, accessible, and continuous monitoring of occupational stress levels using the Expanded Nursing Stress Scale (ENSS) framework. The research successfully achieved this objective through systematic development and rigorous validation procedures, resulting in the creation of ENSS version 1.0, a fully functional Android application with integrated stress assessment capabilities. The comprehensive validation process demonstrated exceptional technical and clinical feasibility, with multimedia expert validation achieving an average score of 90% across four evaluation domains (visual appearance: 95%, user convenience: 90%, language appropriateness: 85%, implementation feasibility: 90%), indicating "very feasible" categorization. Practitioner expert validation yielded superior results with an average score of 92.5% across six domains, including perfect scores (100%) in the usefulness category and high ratings in content accuracy (97.5%) and visual presentation (95%). The System Usability Scale assessment, conducted with 34 nursing professionals from the isolation ward at Bahteramas Regional Hospital, produced a mean score of 74.78, classified as "Acceptable" according to established usability benchmarks, significantly exceeding the minimum threshold of 68 for acceptable digital health applications. The study population, comprising predominantly female nurses (88.2%) with an average age of 37 years and 11 years of clinical experience, demonstrated successful engagement with the application across diverse technological competency levels. These quantitative findings establish the ENSS application as a validated, user-friendly digital tool capable of facilitating systematic stress monitoring in nursing practice environments. Future research endeavors should prioritize multi-center validation studies involving diverse nursing specialties and geographical contexts to enhance generalizability and clinical applicability. Longitudinal investigations examining sustained usage patterns, long-term user satisfaction, and clinical effectiveness in stress reduction interventions represent critical areas for advancing the evidence base. Additionally, integration with existing healthcare information systems, development of predictive analytics capabilities utilizing artificial intelligence algorithms, and expansion to other healthcare professional groups warrant systematic exploration. The successful development and validation of the ENSS application contributes significantly to the digital health landscape for nursing professionals, providing healthcare institutions with an evidence-based tool for implementing comprehensive stress monitoring programs and supporting workforce well-being initiatives in clinical practice settings.

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DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

Lena Atoy was responsible for the study design, conceptual framework, and supervised the entire research process, including the development and integration of the ENSS instrument into the Android application. Dewi Sartiya Rini coordinated participant recruitment, conducted usability testing sessions, and contributed to expert validation data collection and tabulation. Rusna Tahir carried out the statistical analysis, interpreted quantitative findings from validation and SUS instruments, and assisted in the formulation of discussion and conclusions. Dewi Nurviana Suharto led the literature review, drafted the manuscript, managed reference formatting, and ensured adherence to journal submission standards. All authors collaboratively reviewed, revised, and approved the final version of the manuscript and agreed to be accountable for all aspects of the work, including the integrity and accuracy of the data and findings.

DECLARATIONS

ETHICAL APPROVAL

Ethical approval is not available.

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants.

COMPETING INTERESTS

The authors declare no competing interests.

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