

ORIGINAL ARTICLE

Mobile Health App to Empower Parents of Premature Infants through Targeted Educational Resources

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ABSTRACT

OBJECTIVE: This study aimed to develop a mobile health application to educate mothers of premature infants.

METHODOLOGY: This study employed qualitative research methods, specifically semi-structured interviews and focus group discussions. This study was conducted from April to August 2025 at PKU Muhammadiyah Gombong and Banyumas Medika Siaga Hospital. A purposive sampling method was used to collect samples. This investigation was conducted in two phases. In the first phase, focus groups were used to determine the information needs of nurses (n=9) and mothers (n=12) through in-depth interviews. Based on the findings from the first stage, a prototype of a mobile health application was created in the second stage. Finally, a standard questionnaire was used to assess the application. This study used NVivo software.

RESULTS: The findings showed that nurses highlighted critical areas, including premature infant care, home preparation, and the need for ongoing education and digital media resources. Key themes from the mothers' interviews included the emotional complexity of having a premature infant, challenges faced in care, and the importance of family support. A mobile health application was developed to deliver educational materials, reflecting the findings that mobile-based education is preferred for its accessibility and effectiveness. This research underscores the importance of tailored educational interventions to enhance parental competence in caring for premature infants, thereby improving health outcomes.

CONCLUSION: The findings support the use of a mobile health application as an effective tool to enhance parental education and reduce stress, with a high content validity score (V = 0.81).

KEYWORDS: Mobile health application, Premature infants, Parental education, Information needs, Emotional support

INTRODUCTION

Premature babies are those born before the 37th week of gestation. Premature babies have several physical, emotional, and psychological problems in comparison to normal babies ¹. In developing nations, the prevalence of premature babies ranges from 10% to 12% ². According to research, 50% of premature babies born with low birth weight will experience developmental problems, such as intellectual retardation, cerebral palsy, blindness, deafness, epilepsy, and severe disabilities ³.

Numerous studies have been conducted in Indonesia on the information needs of the parents of premature infants ⁴. Statistical reports show that premature births in Indonesia range from 10% to 15% ⁵. However, this prevalence continues to increase, and premature infants must be treated specifically to receive intensive care ⁶ and mothers of premature infants are fully responsible for caring for them after they leave the hospital ⁷.

Effective preterm infant care and early detection are crucial as they can help reduce preterm infant mortality, morbidity, and disability ⁸. To achieve this goal, providing health education to mothers plays a pivotal role in improving preterm infant care ⁹. The literature indicates that one of the most critical factors affecting infant growth is the quality of the interactions between mothers and preterm infants ¹⁰. In fact, these mothers have to care for preterm infants beyond the routine care of normal infants ¹¹.

The rapid adoption of mobile health apps is crucial for improving preterm mother education, as mothers face distinct physical, emotional, and psychological challenges associated with preterm birth. Research shows that while current mobile health apps often disseminate general health information, they frequently lack the personalization and interactivity needed to support mothers of preterm infants effectively ¹². Tailored mobile health app interventions have been shown to increase parenting confidence and reduce stress levels, demonstrating their potential to meet the unique needs of these mothers ^{13,14}.

This study aimed to develop a mobile app specifically designed to meet the unique educational needs of mothers with premature babies. This innovative approach focuses on delivering tailored information and emotional support to address gaps in existing health education tools. The app will feature real-time interaction capabilities, enabling mothers to connect with healthcare professionals and peer support networks to deepen their understanding of infant care.

METHODOLOGY

Stage One: Needs Assessment

Research Design

This study employed a qualitative research design utilizing semi-structured interviews and focus group discussions. This approach enabled researchers to collect more in-depth data regarding the information needs of mothers with premature infants. This study was conducted at two locations: Banyumas Medika Siaga Hospital and PKU Muhammadiyah Gombong Hospital, from April to August 2025.

The choice of semi-structured interviews and focus group discussions in this study was motivated by the desire to capture nuanced, context-specific insights into the information needs of mothers of premature babies. Semi-structured interviews facilitated adaptive dialogue, allowing participants to freely express their experiences and concerns while simultaneously guiding the conversation toward specific themes relevant to the research.

Sampling Techniques

A purposive sampling method was used to collect samples. This allowed for a more selective selection of participants based on their knowledge and experience in premature infant care. This sampling method resulted in 12 mothers and 9 healthcare workers (nurses and midwives). Two groups of participants were selected for comprehensive data collection.

The inclusion criteria for mothers included previous experience caring for premature babies, ensuring that their perspectives reflected informed insight. Likewise, health workers were selected based on their professional qualifications and direct experience in the field of neonatology, especially as nurses or midwives.

Interview Guidelines

Two interview guides were used to collect information. The first guideline for healthcare professionals covered challenges within families, common misconceptions, and crucial knowledge gaps. The second guideline for mothers covered their support systems, how information was conveyed, and how their guidance needs were met. In this qualitative study, eight key questions were developed to address specific research objectives related to the information needs of mothers of preterm infants and the perspectives of healthcare professionals. The probing techniques included open-ended follow-up questions and prompts to encourage depth and clarity in responses. Each participant's engagement in semi-structured interviews lasted approximately 30 to 60 minutes, and focus group discussions ranged from 60 to 90 minutes. Data collection tools included audio recorders for focus group discussion (FGD) sessions and transcripts for individual interviews to ensure accurate documentation. The final document was a comprehensive transcript, systematically analyzed to identify recurring themes and insights, thereby contributing to a broader understanding of participants' experiences and challenges in preterm infant care.

The primary purpose of the interview guide for healthcare workers was to identify the educational needs and challenges related to premature babies. The purpose of these questions was to gather information on specific nursing issues that arise in hospitals and homes. Healthcare workers play a role in educating mothers and discussing their information needs and the challenges they face in providing this education.

Focus Group Discussions

The FGD sessions were recorded using an audio recorder to ensure the accurate processing and

analysis of the information presented. Participants' practices, observations, and experiences were continuously explored to obtain clear and in-depth information on the same. In this study, the focus group discussions (FGDs) comprised mothers of premature babies and healthcare professionals, such as nurses and midwives. The purpose of the FGDs was to gather in-depth information on mothers' information needs regarding premature baby care, the challenges they face, common misconceptions, and knowledge gaps, from the perspectives of both mothers and healthcare professionals. By involving both groups, the researchers aimed to gain a more comprehensive understanding of the experiences and challenges of caring for premature infants. This method allowed for a broader exploration of practices, observations, and experiences, and provided depth to the discussions on these issues.

In-Depth Interviews

The interviews were conducted openly, creating a more intimate environment and encouraging participants to share their experiences. The results of these interviews were systematically analyzed and transcribed.

In this study, an in-depth thematic analysis was conducted. This method enabled researchers to identify, analyze, and report the key themes emerging from the interview transcripts and focus group discussions (FGDs). Content analysis was used to analyze data from the FGDs. Content analysis enabled the systematic categorization and interpretation of conversational content, identifying themes and concepts that emerged in the dialogue between mothers and health workers.

Stage Two: Application Development

Application Design

The aim of developing this application was to meet the needs of mothers with premature babies during the care process. The app designed to support mothers of premature babies was developed through a collaborative approach involving internal and external stakeholders. Internal resources included a development team comprising healthcare professionals, such as perinatology nurses, maternity nurses, and pediatricians, who ensured that the app was clinically relevant and user-friendly. Additionally, external partners, including information systems and linguistics experts, were engaged to validate the app's instructional content, ensuring accuracy and user comprehension.

Expert Validation of Content

Content Validity Assessment

Expert validation was conducted during the initial application development process to determine the validity of the content and suitability of the application. Several experts were involved in this process, including information systems and linguistics experts, perinatology nurses, maternity nurses, and pediatricians. This team was tasked with assessing the app's instructional content to ensure its relevance, accuracy, and ease of use.

Experts were systematically selected to assess the content validity of the app. Experts were chosen based on their specialized knowledge and experience in related fields, including information systems, linguistics, perinatology, maternity nursing, and paediatrics.

Validation Procedures

Content validity testing, including usability, ease of navigation, perceived benefits, visual appeal, and clarity of the information presented, was conducted using a structured framework evaluation. All components were assessed by experts on a scale of 1-4.

Aiken's V Formula

Aiken's V formula was used to assess the level of content validity achieved through expert

evaluations. This formula was used because it can combine expert assessments and facilitate the preparation of a validity index. The index ranges from 0 to 1, with values close to 1 indicating a high level of agreement among the experts.

User-Centered Evaluation

User Testing with Mothers

Validity testing in the second phase involved 20 mothers of premature babies. This is important because these mothers are the target audience of the app. Their input can influence the final outcome of the app. Participants were also asked to rate its advantages, ease of use, aesthetics, and understanding on a scale of 1-4.

Qualitative Feedback

Qualitative feedback is also highly recommended for participants to allow mothers to share their experiences regarding user engagement, clarity of information, and technical difficulties encountered.

Analysis of Usability Testing

Both quantitative and qualitative data were used during the testing and analysis of the collected data. To establish a baseline for overall user satisfaction, the average score for each usability criterion was calculated. For the qualitative thematic analysis, feedback from all participants was used.

RESULTS

The research sample showed that the nurses were aged 29-47 years, and the majority had more than 5 years of work experience. **Table I** lists the participants' demographic details, and the study's findings revealed seven themes through interview transcripts and focus group discussions (FGDs).

Table I: Demographic Data

Participant	Age (Years)	Education level	Hospital work experience (Years)	NICU experience (Years)	Current position	Additional Training
P1	35	Bachelor	13	5	Primary nurse	Neonatal resuscitation
P2	43	Diploma	20	12	Primary nurse	Kangaroo training
P3	37	Diploma	14	13	Prime nurser	Neonatal resuscitation
P4	29	Bachelor	5	5	Nurse Associate	Neonatal resuscitation
P5	29	Bachelor	4	4	Nurse Associate	Kangaroo training
P6	29	Bachelor	4	4	Nurse Associate	Neonatal resuscitation
P7	35	Diploma	12	9	Primary nurse	Neonatal resuscitation
P8	43	Diploma	22	5	Primary nurse	Kangaroo training
P9	47	Diploma	20	5	Head nursing	Neonatal resuscitation

Theme 1: Premature Infant Problems

Oxygenation is critical because of the immature respiratory function of preterm infants, who are susceptible to asphyxia (P4, P6, and P7). Ensuring adequate oxygen levels is a top priority (P5, P6) given the dependence on respiratory maturity. Thermoregulation is equally vital, as these infants are prone to temperature instability, necessitating careful mechanisms to maintain normothermia (P5, P6, P7). The nutritional challenges inherent in preterm infants stem from suboptimal sucking and swallowing reflexes, which impact their nutritional intake (P4, P6, P7, P8). Moreover, their immune systems are still developing, making them more vulnerable to infections, sepsis, and thrombocytopenia, which are common symptoms (P1-P9). Families, especially mothers, bear heavy emotional and physical burdens as a result of the extended hospital stays related to caring for premature infants (P5, P9). **Table II**

Theme 2: Premature Infant Home Preparation

Several crucial indicators that participants identified as necessary for premature infants to be prepared for discharge. Essential elements include a healthy diet, a strong suction reflex, and

maternal preparedness to provide care. Indicators such as the infant's effective feeding skills, as evidenced by strong feeding reflexes, and the mother's proven proficiency in breastfeeding techniques are particularly crucial. Additionally, nursing staff stress the importance of teaching mothers how to keep their homes clean to reduce the risk of infection and avoid readmission to medical facilities. To maintain a clean environment that is beneficial to the baby's health, preparations should also include reducing exposure to outside guests. Consequently, readiness for home discharge is not solely based on the infant's weight but includes holistic assessments of maternal ability and environmental conditions (Participants P1, P2, P8, and P9). **Table II**

Theme 3: Challenges of Premature Infant Care at Home

In the care of premature infants, families encounter significant challenges, including developing patience and care skills, leading to inadequate attention to the infant's basic needs (P7). Interview data revealed that a lack of consistency in caregiving often results in insufficient fulfillment of nutrition and hygiene requirements, which are essential for an infant's development. Specifically, exclusive breastfeeding without supplemental nutrition poses a risk to premature infants, potentially leading to conditions such as jaundice and malnutrition (P4, P9). Numerous caregivers reported not knowing enough about these infants' nutritional requirements, which can lead to adverse physical health outcomes such as infections and weight loss (P3, P4, P8). **Table II**

Theme 4: Educational Needs for Premature Infant Care

Mothers must receive education on hygiene, nutrition, temperature, immunization, and screening. An appropriate room temperature is also essential. Methods that need to be implemented include the kangaroo method and drying methods. Infant nutritional needs are met through breastfeeding and formula feeding (P1-P4). **Table II**

Theme 5: Educational Methods and Media for Premature Infant Care

Discussions encourage participation and feedback (P5), whereas demonstrations are valuable tools for imparting concepts and practical skills (P2). In terms of educational media, leaflets and flip sheets are the predominant resources, augmented by technology to enhance accessibility. Specifically, many nurses and patients used Internet search engines, such as Google, to obtain additional information (P5, P6). The "kangaroo method" is an example of a specialized flip sheet that provides visual and structured guidance (P6). Collectively, these methods and media strive to improve patient education and nursing practices (P8). **Table II**

Theme 6: The need for digital media for education

Nurses acknowledged that using technology as a teaching tool can help present more engaging and dynamic content. Applying it in the room is preferable (P3). Excellent. It can be used, particularly because everything is electronic these days (P4). The agony of using it as knowledge (P6). According to nurses, devices are believed to provide a clearer visual picture of the care of premature infants. Everyone uses gadgets these days, and I think it's good if used here (P1). It can give patients a summary directly (P3). **Table II**

Theme 7: Mobile Health Educational Materials for Premature Infant Care

Nurses recommended the development of a mobile health app with information on common issues affecting premature babies. Consequently, families may find it easier to comprehend and implement the instructions provided at home. Regarding the problems that sick babies frequently face. Indeed, such as premature infants (P5). Furthermore, the nurse recommended developing a mobile health app that includes instructions for monitoring the baby at home and providing home care. **Table II**

Table II: Thematic Matrix for Premature Infant Care

Theme	Keywords/Concepts	Participant Statements Reference
Premature Infant Problems	Oxygenation, Thermal Stability, Nutritional Challenges, Infection Vulnerability, Emotional Burden	P1-P9, P4-P8
Home Preparation	Healthy Diet, Suction Reflex, Maternal Capability, Infection Prevention, Clean Environment	P1, P2, P5, P8, P9
Challenges at Home	Care Skills, Patience, Nutritional Knowledge, Inadequate Attention, Health Risks	P3, P4, P7, P8, P9
Educational Needs	Hygiene, Nutrition, Temperature Control, Immunization, Screening Methods	P1-P4
Educational Methods and Media	Participative Discussions, Demonstrations, Leaflets, Technology Utilization, Kangaroo Method	P2, P5, P6, P8
Digital Media in Education	Engagement, Dynamic Content, Electronic Tools, Visualization	P1, P3, P4, P6
Mobile Health Materials	Mobile App Development, Home Monitoring, Instructional Support	P5

Twelve mothers of premature infants were interviewed in depth. The participants' characteristics are presented in **Table III**.

Table III: Characteristics of 12 parents of premature infants

Characteristics	Frequency	Percentage (%)
Age (year)		
Teenagers (12-18 years)	1	8,3%
Young Adults (19-30 years)	7	58,3%
Adults (31-59 years)	4	33,4%
Gender		
Male	6	50%
Female	6	50%
Educational level		
Elementary school	8	66,6%
Bachelor degree	4	33,4%

From the results of the data analysis, four main themes were identified.

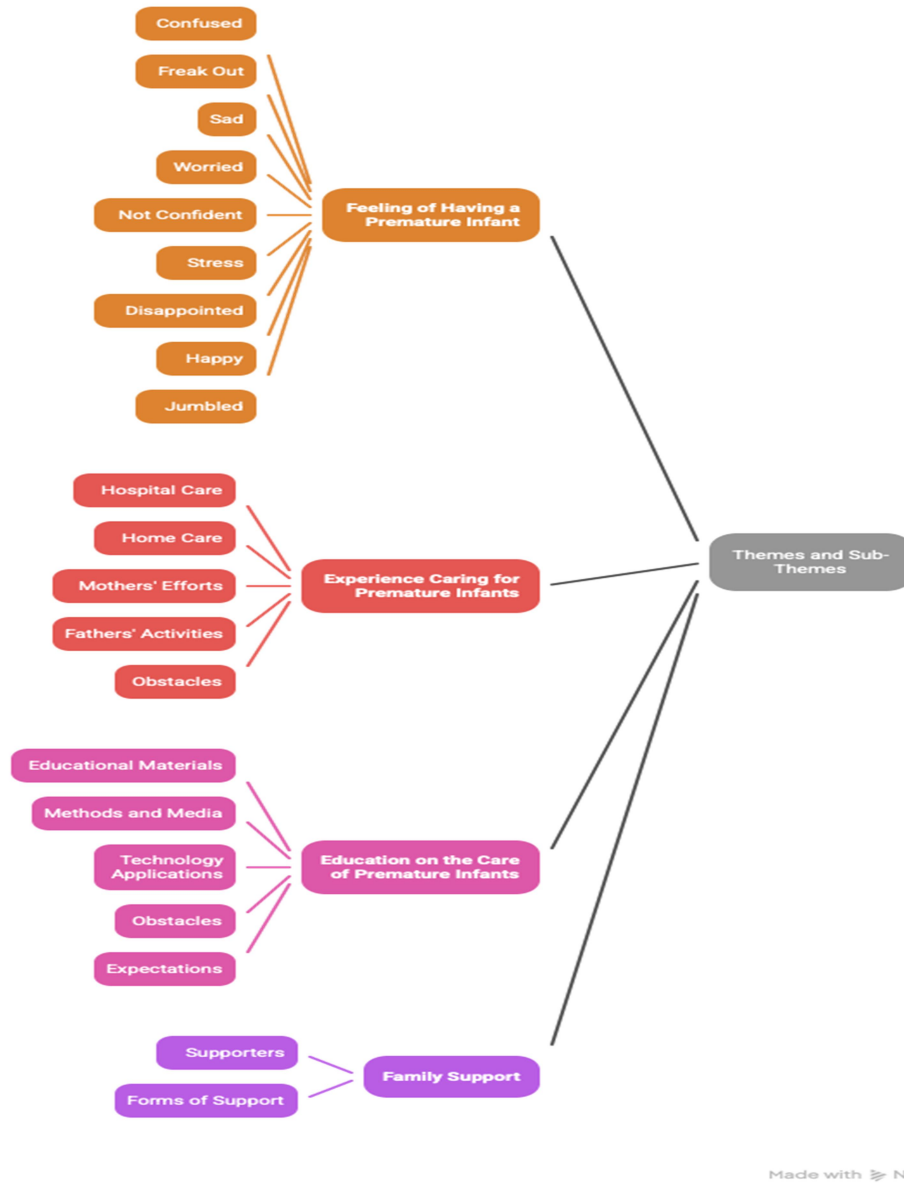


Figure 1: Themes emerged from data analysis

DISCUSSION

The second research stage was the development stage of the mHealth application model, during which the researcher involved expert reviewers to conduct a content validity test of the application. Validity test stage 1 involved pediatricians (perinatology consultants), perinatology nurses, maternity nurses, linguists, and information system experts. The validators provided suggestions for improving mobile health education, including 1) immunization schedule, 2) conditions of premature infants who must be taken to the hospital, 3) self-monitoring of mothers, and 4) foreign languages replaced with languages that are easy for mothers to understand. The validators' suggestions were used to improve the health education application for mothers of premature infants. Stage 2: A content validity test was also conducted on 20 mothers who had premature infants. The results of the content validity test included understanding of the content, benefits and uses, and appearance and ease of use, with a score range of 1-4. The content validity test was analyzed using Aiken's V formula, yielding a very high value ($V = 0.81$).

Mothers of premature babies experience high levels of stress and a lack of knowledge about infant care. As a result, they require assistance from a variety of interventions and educational resources¹⁵. The literature suggests that health education can reduce the infant's physical and emotional effects and increase mothers' understanding of how to care for premature infants. However, there is a wide range of care for premature infants, and mothers can only receive the most essential care⁹.

According to the current study, nurses' perceptions of the educational needs of mothers of premature infants were described by seven themes. (1) Issues with Premature Infants; (2) Preparing the Home for Premature Infants; (3) Difficulties in Providing Care at Home; (4) Educational Needs for Premature Infants; (5) Educational Media and Methods for Premature Infants Care; (6) The necessity of digital media for education; and (7) Mobile Health Educational Materials for Premature Infants Care. Meanwhile, the research results from in-depth interviews with mothers revealed four main themes: (1) the feeling of having a premature infant is complex and dynamic; (2) challenging care experiences from the NICU to home care; (3) the need for practical, personal, and ongoing education; and (4) family support as an emotional and practical protective factor. Based on the qualitative research results, a mobile application was developed, consisting of three main features: 1) main information about premature infants, 2) educational materials for premature infants, and 3) videos on caring for premature infants.

According to other studies, mothers of premature infants should be provided with information about the following topics: what constitutes a premature infant, how to care for a premature infant, common diseases that affect premature infants, stress management, general health issues, follow-up, infection control, nutrition, normal physical and mental development, breastfeeding, and vaccination¹⁶. Mothers should be informed about the relationship between them and premature babies, as well as neonatal health care¹⁷. Through interviews with medical professionals and mothers of premature infants, the research participants' varied information needs were ascertained. In another study,¹⁸ reviewed clinical guidelines to provide educational content.

Numerous studies' findings demonstrate that education delivered via computers, the internet, and mobile devices is far more effective than traditional classroom instruction¹⁹. However, mobile devices are becoming increasingly common, and as a result, mobile applications are being used more frequently than other educational resources²⁰. Additional research indicates that mobile applications are helpful resources for assisting mothers and nurses caring for premature babies²¹.

The most important part of the software development process is testing the usability of the system or application²². End users who use the application and interact with the system typically evaluate mobile-based applications²³. In this study, the main users of the application, namely mothers of premature infants, were explained how to use the application and their use was measured using instruments, and the results were analyzed. This research stage is in accordance with other studies, namely, mothers of premature infants were invited to participate in testing the usability of the application¹¹. Based on the findings, the application's usability was assessed as very high, with a validity value of $V = 0.81$. According to a related study, e-learning courses designed for mothers were deemed practical and easy to use^{24,25}.

Limitations and recommendations

While this study provides valuable insights into the development of a mobile health app to educate mothers of premature babies, it has a notable limitation: it did not address potential technology accessibility issues for some mothers, which could impact app use. Plans to address accessibility limitations could be added to future research.

CONCLUSION

The findings of this study provide critical insights into the educational needs of mothers and caregivers of premature infants, as well as the challenges inherent in their care. A total of 9 experienced nurses and 12 mothers of premature infants were interviewed, revealing significant themes related to the multifaceted challenges of caring for premature infants. Seven major themes were identified from the nurses' perspectives: Premature Infant Problems, Home Preparation, Care Challenges, Educational Needs, Methods and Media, Digital Media, and Mobile Health Resources. Similarly, the mothers' responses highlighted feelings of confusion and stress, educational needs, and the importance of family support. The need for a mobile health application was underscored as a vital educational tool to facilitate ongoing parental education, enhance understanding, and reduce stress, aligning with the literature suggesting that mobile-based education is more effective than traditional methods. With a high content validity score ($V = 0.81$), this application is positioned to empower mothers with essential knowledge, thereby improving care outcomes for premature infants.

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Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing

AUTHOR CONTRIBUTION

Riyanti E:	Research design, write a draft, revise the manuscript, and final approval.
Lasimbang HB:	Research design, write a draft, revise the manuscript, and final approval.
Sa'at SF:	Research design, write a draft, revise the manuscript, and final approval.
Teck KS:	Research design, write a draft, revise the manuscript, and final approval.

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