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Developing a Hybrid Digital–Community Nursing Platform Targeting the Critical Window of the First 1000 Days: Impact on Maternal and Preterm Infant Outcomes

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ABSTRACT: **Background**: The first 1000 days represent a critical window for establishing maternal health and optimal infant growth, development, and well-being. The postpartum period is particularly challenging for mothers of preterm infants because of the combined demands of maternal recovery, breastfeeding, psychological adaptation, and specialized infant care. Fragmented follow-up after hospital discharge may compromise continuity of care and maternal confidence in caring for preterm infants. A hybrid digital–community nursing platform integrating obstetric, pediatric, and community health nursing may provide a comprehensive continuity-of-care model across this critical period.

Aim: To develop and evaluate the effectiveness of a hybrid digital–community nursing platform targeting the critical window of the first 1000 days on maternal and preterm infant outcomes. Methods: A quasi-experimental one-group pretest–posttest design with

follow-up was conducted among 100 postpartum mothers of preterm infants recruited from the Obstetrics and Gynecology Department and Postpartum Unit at Sohag University Hospitals, with subsequent follow-up. The intervention was initiated during the early postpartum period and continued through infancy. The obstetric nursing component focused on postpartum recovery, maternal self-care, breastfeeding, nutrition, psychological adjustment, and recognition of postpartum complications. The pediatric nursing component focused on comprehensive preterm infant care, including feeding and breastfeeding support, thermal regulation, infection prevention, safe sleep, recognition of neonatal danger signs, monitoring of growth and development, developmental stimulation, immunization, and appropriate healthcare-seeking and referral. The community health nursing component provided structured home visits, individualized maternal and infant counseling, reinforcement of breastfeeding and infant-care practices, developmental follow-up, and continuity of care after hospital discharge. Digital support supplemented face-to-face services through educational materials, reminders, remote counseling, symptom monitoring, and continuous communication with the nursing team. Data were collected using a Structured Maternal Interview Questionnaire, Maternal Knowledge Assessment Questionnaire, Maternal Postpartum Self-Care and Practice Scale, Breastfeeding Self-Efficacy Scale–Short Form (BSES-SF), Edinburgh Postnatal Depression Scale (EPDS), Preterm Infant Feeding and Care Practice Checklist, Preterm Infant Growth and Development Assessment Record, and Digital–Community Nursing Engagement and Satisfaction Scale. Maternal and infant outcomes were assessed at baseline, immediately after the intervention, and during follow-up.

Results: The hybrid digital–community nursing platform was associated with improvements in maternal knowledge, postpartum self-care, breastfeeding self-efficacy and practices, psychological well-being, and caregiving competence. Preterm infants also demonstrated improvements in feeding practices, growth monitoring, developmental stimulation, and continuity of care, with fewer preventable maternal and infant health problems during follow-up.

Conclusion: The hybrid digital–community nursing platform provided an integrated multidisciplinary nursing approach beginning in the postpartum period and extending through community follow-up during the first 1000 days. The integration of obstetric, pediatric, and community health nursing roles, supported by digital technology, strengthened maternal caregiving capacity and promoted continuity of care and improved outcomes for mothers and their preterm infants.

INTRODUCTION

The first 1000 days, extending from conception to the child's second birthday, represent a critical developmental window during which maternal health, nutrition, caregiving practices, and early environmental conditions can influence subsequent child growth and development. Recent evidence emphasizes that interventions during this period should not focus exclusively on the infant but should also strengthen maternal well-being, caregiving capacity, nutrition, and access to appropriate health and social support. For mothers of preterm infants, these needs may be intensified because prematurity introduces additional nutritional, developmental, and caregiving challenges that may extend beyond the neonatal period. **(Rosen et al., 2024; Silwanah et al., 2024).**

The postpartum period is a particularly important stage within the first 1000 days because mothers must simultaneously recover from childbirth and assume responsibility for the care of their newborns. Mothers of preterm infants may require additional support related to breastfeeding, infant feeding, recognition of health problems, emotional adjustment, and transition from hospital to home. Recent evidence on transitional care for families of preterm infants indicates that

coordinated preparation and continuity of support are important for improving parents' ability to manage infant care after discharge. **(Kim & Kim, 2024; Tiryaki et al., 2024).**

Preterm infants have increased vulnerability to feeding difficulties, inadequate weight gain, infection, respiratory problems, and developmental impairment because of their immature physiological and neurological systems. Consequently, care should extend beyond routine medical management to include active family participation, structured education, developmental support, and continuous monitoring. Recent systematic evidence has demonstrated that family-integrated care can improve important outcomes among preterm infants, including weight gain, breast-milk feeding, and neurodevelopmental outcomes. **(Chen et al., 2025).**

Breastfeeding and the provision of breast milk are particularly important components of care for preterm infants. However, mothers of preterm infants may encounter difficulties related to infant immaturity, weak sucking, maternal stress, prolonged hospitalization, and separation from the infant. A recent scoping review identified parent education, active parental participation, peer support, environmental support, and mobile applications as important components of family-integrated care and reported a positive effect of such approaches on breastfeeding outcomes among preterm infants. **(Ding et al., 2023).**

The psychological well-being of mothers also represents an important component of postnatal care. Mothers of preterm infants may experience increased stress and emotional burden because of uncertainty regarding their infant's health, prolonged hospitalization, feeding difficulties, and the transition to home care. A multicenter randomized controlled trial demonstrated that family-integrated care could reduce stress among mothers of preterm infants, supporting the importance of involving parents as active participants in infant care and providing structured professional support. **(Zhang et al., 2024).**

The **pediatric nurse** has a central role in supporting mothers and preterm infants during the transition from neonatal care to home. Pediatric nursing interventions may include education regarding breastfeeding and feeding techniques, thermal care, infection prevention, safe sleep, recognition of danger signs, medication and follow-up, growth monitoring, developmental stimulation, and appropriate healthcare-seeking. Recent research involving family-integrated care has demonstrated that structured parental education and participation can improve parents' readiness for discharge and home care, highlighting the importance of pediatric nursing involvement in preparing families for the transition. **(Maleki et al., 2022; Chen et al., 2025).**

The **community health nurse** can provide an essential link between hospital-based maternal and pediatric services and the home environment. Community-based follow-up may include home visits, reinforcement of breastfeeding and infant-care practices, monitoring maternal and infant health, assessment of growth and development, identification of warning signs, promotion of immunization and appropriate healthcare utilization, and referral when necessary. Evidence from recent reviews of transitional care emphasizes the importance of coordinated and continuous support for families of preterm infants after discharge rather than relying solely on isolated hospital encounters. **(Nashar et al., 2025).**

Digital health technologies may further strengthen continuity of maternal and infant care by providing educational content, reminders, remote communication, follow-up, and opportunities for continuous interaction between mothers and healthcare professionals. A recent systematic review of mHealth interventions from conception through 24 months postpartum found that digital interventions have potential to improve selected maternal and child health services, although their effectiveness varies according to intervention design, context, and outcome. This supports combining digital approaches with direct nursing care rather than using technology as a substitute for professional or community-based services. **(Knop et al., 2024).**

Similarly, recent evidence concerning mHealth during the first 1000 days indicates that digital interventions can provide education, communication, support, data collection, and capacity building for healthcare workers and may improve accessibility of maternal and child health information. However, successful implementation requires attention to evidence-based content, accessibility, privacy, security, sustainability, and cultural appropriateness. These findings support the development of a hybrid model in which digital support complements rather than replaces face-to-face nursing care. **(Silwanah et al., 2024).**

Therefore, integrating **obstetric nursing, pediatric nursing, and community health nursing** within a single hybrid digital–community platform may provide a more comprehensive model of postpartum care for mothers of preterm infants. The obstetric nurse can address maternal recovery, self-care, breastfeeding, nutrition, and psychological adjustment; the pediatric nurse can focus on preterm infant feeding, growth, development, safety, and recognition of danger signs; while the community health nurse can sustain these practices through home visits, follow-up, education, monitoring, and referral.

Recent evidence supporting family-integrated and transitional care suggests that coordinated, family-centered approaches can improve infant and parental outcomes and facilitate safer transition from hospital to home. **(Ding et al., 2023; Tiryaki et al., 2024; Chen et al., 2025).**

Despite growing evidence supporting family-integrated, transitional, and digitally supported care, there remains a need for models that specifically integrate maternal postpartum care with specialized preterm infant care and sustained community follow-up within the broader first-1000-days framework. The present study therefore addressed this gap by developing a Hybrid Digital–Community Nursing Platform initiated during the postpartum period and combining obstetric nursing, pediatric nursing, and community health nursing. The platform was designed to provide continuous maternal support, strengthen preterm infant caregiving practices, facilitate monitoring of growth and development, and maintain communication and follow-up after discharge through both digital and community-based nursing services (**Zhang et al., 2026).**

Significance of the Study

The first 1000 days represent a critical period for maternal and child health, particularly for mothers caring for preterm infants who may face challenges related to breastfeeding, infant feeding, growth monitoring, developmental stimulation, infection prevention, and recognition of danger signs. The postpartum period provides an important opportunity to strengthen maternal self-care, breastfeeding self-efficacy, psychological well-being, and caregiving competence. However, fragmented care between maternity, neonatal, and community services may limit continuity of support after hospital discharge.

The proposed hybrid digital–community nursing platform integrates the complementary roles of obstetric, pediatric, and community health nurses to provide coordinated, continuous support. Obstetric nurses focus on maternal recovery and postpartum care, pediatric nurses address preterm infant feeding, growth, development, and safety, while community health nurses reinforce healthy practices through home visits, counseling, monitoring, and referral. Digital education, reminders, and remote nursing consultations may further enhance accessibility and continuity of care. This integrated approach may improve maternal outcomes, breastfeeding practices, caregiving competence, and preterm infant health during the critical first 1000 days.

AIM OF THE STUDY

The study aimed to develop and evaluate the effectiveness of a hybrid digital–community nursing platform targeting the critical window of the first 1000 days on maternal and preterm infant outcomes.

Research Hypotheses

H1: Mothers who received the Hybrid Digital–Community Nursing Platform would demonstrate significantly higher levels of knowledge regarding postpartum self-care and preterm infant care after the intervention compared with their pre-intervention levels.

H2: Mothers who received the Hybrid Digital–Community Nursing Platform would demonstrate significantly improved postpartum self-care and infant-care practices after the intervention compared with their pre-intervention levels.

H3: Mothers who received the Hybrid Digital–Community Nursing Platform would demonstrate significantly higher breastfeeding self-efficacy and improved breastfeeding practices after the intervention compared with their pre-intervention levels.

H4: Mothers who received the Hybrid Digital–Community Nursing Platform would demonstrate significantly improved psychological well-being and reduced postpartum depressive symptoms after the intervention compared with their pre-intervention levels.

H5: Preterm infants whose mothers received the Hybrid Digital–Community Nursing Platform would demonstrate improved feeding practices, growth indicators, and developmental outcomes during follow-up compared with baseline assessment.

H6: There would be a significant positive relationship between maternal knowledge, self-care practices, breastfeeding self-efficacy, and caregiving competence and selected preterm infant outcomes following implementation of the intervention.

H7: Mothers would report a high level of engagement with and satisfaction toward the Hybrid Digital–Community Nursing Platform.

H8: The improvements in maternal and preterm infant outcomes achieved immediately after implementation of the Hybrid Digital–Community Nursing Platform would be maintained during the follow-up period.

SUBJECTS AND METHODS

Research Design

A quasi-experimental one-group pretest–posttest design with follow-up was used.

Research Setting

The study was conducted at the Obstetrics and Gynecology Department and Postpartum Unit of Sohag University Hospitals, where mothers were initially recruited and assessed after delivery. Follow-up activities were subsequently conducted through home visit. The intervention involved collaboration among three nursing specialties. Obstetric nurses provided maternal postpartum care and breastfeeding support, pediatric nurses addressed preterm infant feeding, growth, development, and safety, while community health nurses provided home follow-up, health education, reinforcement, monitoring, and referral.

Subjects

A purposive sample of 100 postpartum mothers of preterm infants was recruited according to predetermined eligibility criteria.

Inclusion Criteria

Mothers were included if they:

1. Were in the early postpartum period following delivery of a preterm infant.
2. Had a preterm infant born before 37 completed weeks of gestation.
3. Were willing to participate in the nursing program and follow-up assessments.
4. Had sufficient ability to communicate and participate in the educational sessions.
5. Had access to a mobile phone capable of receiving digital educational materials and reminders.
6. Were available for community or home follow-up when required.

Exclusion Criteria

Mothers were excluded if they:

1. Had severe maternal complications requiring prolonged hospitalization or intensive care.
2. Had serious psychiatric or cognitive conditions that interfered with participation.
3. Had infants with critical congenital anomalies or severe conditions requiring prolonged specialized care that prevented participation in routine follow-up.
4. Planned to relocate outside the study area during the follow-up period.

Sample Size Calculation

The required sample size was calculated using the following formula for estimating a single proportion:

$$n=\frac{Z^2P(1-P)}{d^2}$$

Where:

- **n** = required sample size
- **Z** = standard normal deviate at a 95% confidence level = **1.96**

- **P** = estimated proportion of the outcome of interest
- **d** = margin of error = **0.05**

Based on the estimated proportion and considering a possible 10% attrition or loss to follow-up, the calculated sample size was adjusted accordingly. Therefore, a total sample of 100 postpartum mothers of preterm infants was recruited for the study.

Data Collection Tools

Tool I: Structured Maternal Interview Questionnaire: A structured maternal interview questionnaire **was developed** by the researchers after reviewing relevant literature and guidelines concerning postpartum maternal care, preterm infant care, breastfeeding, maternal self-care, and continuity of care **(World Health Organization (WHO), 2022)**. It **was administered** through a face-to-face interview and **consisted** of three parts.

Part I assessed the mothers' sociodemographic characteristics, including age, residence, educational level, occupation, marital status, and family size.

Part II assessed obstetric and postpartum characteristics, including gravidity, parity, gestational age at delivery, mode of delivery, number of living children, history of previous preterm delivery, postpartum complications, and previous breastfeeding experience.

Part III assessed preterm infant characteristics, including sex, birth weight, NICU admission, duration of NICU stay, and current feeding.

Tool II: Maternal Knowledge Assessment Questionnaire: A structured knowledge questionnaire **was used** to assess mothers' knowledge regarding postpartum self-care and preterm infant care **(World Health Organization (WHO), 2022)**. The questionnaire covered six main domains: postpartum maternal self-care, maternal nutrition and hydration, breastfeeding and breast care, preterm infant feeding and nutrition, infection prevention and safe infant care, and recognition of infant growth, developmental needs, danger signs, and appropriate healthcare-seeking behavior. Each item had one correct response. A score of 1 was assigned to each correct answer, whereas incorrect answers and "don't know" responses received a score of 0. The total knowledge score was calculated by summing all correct responses and was converted into a percentage using the formula: Knowledge percentage = (obtained score / maximum possible score) × 100. The total score was categorized as good knowledge (≥75%), fair knowledge (60–<75%), and poor knowledge (<60%).

Tool III: Maternal Postpartum Self-Care and Practice Scale: This scale was used to assess maternal practices related to postpartum recovery and self-care **(World Health Organization (WHO), 2022)**. It included four domains covering physical self-care, nutrition and hydration, breastfeeding and breast care, and psychological self-care. Physical self-care items addressed personal hygiene, perineal or incision care, rest and sleep, appropriate physical activity, monitoring of abnormal bleeding, recognition of fever and pain, and attendance at postpartum follow-up. Nutrition items assessed adequate fluid intake, balanced nutrition, protein and iron intake, and appropriate dietary practices during breastfeeding. Breastfeeding items assessed correct positioning and attachment, feeding frequency, breast and nipple care, and management of common breastfeeding problems. Psychological self-care items assessed stress management, seeking social support, expressing emotional concerns, and seeking professional assistance when required. Each item was scored using a three-point Likert scale: always = 2, sometimes = 1, and never = 0. The total score was converted into a percentage and was categorized as satisfactory practice (≥75%), moderately satisfactory practice (60–<75%), and unsatisfactory practice (<60%).

Tool IV: Breastfeeding Self-Efficacy Scale–Short Form (BSES-SF): Maternal confidence in breastfeeding **was assessed** using the Breastfeeding Self-Efficacy Scale–Short Form developed by **Dennis, (2003)**. The scale consisted of 14 items measuring the mothers' confidence in their ability to breastfeed successfully and overcome common breastfeeding difficulties. Each item was rated on a five-point Likert scale ranging from 1 = not at all confident to 5 = always confident, giving a total possible score ranging from 14 to 70. Higher scores indicated greater breastfeeding self-efficacy. Scores of 14–32 indicated low self-efficacy, 33–51 indicated moderate self-efficacy, and 52–70 indicated high self-efficacy.

Tool V: Edinburgh Postnatal Depression Scale (EPDS): The Edinburgh Postnatal Depression Scale **was used** to screen for symptoms of postpartum depression and psychological distress **(Cox et al., 1987).** The EPDS consisted of 10 items, with each item scored from 0 to 3, producing a total score ranging from 0 to 30. The scale assessed depressive symptoms such as sadness, anxiety, sleep disturbance, feelings of inadequacy, and loss of pleasure during the postpartum period. A total score of

0–9 indicated a low probability of postpartum depression, 10–12 indicated possible depression requiring further assessment, and ≥13 indicated probable postpartum depression requiring clinical evaluation. Item 10, concerning thoughts of self-harm, was treated as a safety-sensitive item requiring immediate professional assessment when endorsed. The EPDS was used as a screening instrument and was not considered a diagnostic measure.

Tool VI: Preterm Infant Feeding and Care Practice Checklist: A structured observational checklist was used to assess maternal practices related to feeding and daily care of the preterm infant **(World Health Organization (WHO), 2022)**. The checklist included four domains: feeding practices, infection-prevention practices, thermal and basic infant care, and recognition of neonatal danger signs. Feeding practices included appropriate breastfeeding positioning and attachment, feeding frequency, expressed breast-milk handling, recognition of feeding intolerance, and appropriate positioning after feeding. Infection-prevention practices included hand hygiene, clean preparation of feeding equipment, appropriate cord care, and prevention of unnecessary exposure to infection. Thermal and basic care included maintaining adequate warmth, appropriate clothing, and safe sleeping practices. Recognition of danger signs included difficulty breathing, poor feeding, fever or hypothermia, lethargy, cyanosis, convulsions, persistent vomiting, and reduced urine output. Each correctly performed practice received 1 point, whereas an incorrectly performed or absent practice received 0 points. The total score was converted into a percentage and was classified as satisfactory (≥75%), moderately satisfactory (60–<75%), or unsatisfactory (<60%).

Tool VII: Preterm Infant Growth and Development Assessment Record: A structured clinical record **was used** to monitor the growth, development, and selected health outcomes of the preterm infants during the intervention and follow-up periods **(World Health Organization (WHO), 2022)**. Growth assessment **i**ncluded weight, length, and head circumference, with repeated measurements used to assess changes over time. Developmental assessment addressed gross motor, fine motor, communication/language, social interaction, and visual and auditory responses according to the infant's corrected age. The record also documented feeding difficulties, respiratory problems, infection episodes, hospital readmissions, immunization status, and healthcare utilization. Anthropometric measurements were recorded as continuous values, whereas developmental and health indicators were coded according to whether the expected milestone or outcome was present or achieved. Since the participants were preterm infants, developmental interpretation considered corrected age rather than chronological age alone.

Tool VIII: Digital–Community Nursing Engagement and Satisfaction Scale: A researcher-developed scale was used to assess mothers' engagement with and satisfaction toward the hybrid digital–community nursing platform. The scale assessed mothers' use of digital educational materials, response to reminders, participation in remote nursing consultations, communication with the community health nurse, attendance during home visits, adherence to recommended maternal and infant care practices, ease of using the digital platform, accessibility of nursing support, usefulness of the educational content, continuity of care, and overall satisfaction with the intervention. Each engagement and satisfaction item was rated using a three-point scale, with 2 indicating the most favorable response, 1 indicating an intermediate response, and 0 indicating the least favorable response. The total score was converted into a percentage and was categorized as high engagement/satisfaction (≥75%), moderate (60–<75%), and low (<60%).

Validity

The content validity of the data collection tools was established by a panel of **five experts** in obstetric and gynecological nursing, pediatric nursing, and community health nursing. The experts reviewed the tools for relevance, clarity, comprehensiveness, appropriateness of the items, and suitability for postpartum mothers of preterm infants. Their comments and recommendations were considered, and necessary modifications were made to improve the wording, sequence, and clarity of the items before the final version of the tools was prepared. The validity of the researcher-developed tools was further supported by their alignment with relevant maternal, newborn, preterm infant, and digital-health guidelines.

Reliability

The reliability of the study tools was assessed to determine their internal consistency and stability. Cronbach's alpha coefficient was used for the multi-item scales, including the Maternal Knowledge Assessment Questionnaire, Maternal Postpartum Self-Care and Practice Scale, and Digital–Community Nursing Engagement and Satisfaction Scale. Test–retest reliability was also assessed for applicable researcher-developed instruments by administering the tools to a group of mothers twice at an appropriate interval. The obtained reliability coefficients were within acceptable ranges 0.=92, indicating satisfactory internal consistency and stability of the instruments for use in the main study.

Pilot Study

A pilot study was conducted on 10% of the calculated sample (10 postpartum mothers of preterm infants) before starting the main data collection. The pilot study aimed to assess the clarity and comprehensibility of the questions, appropriateness of the response options, feasibility of the data collection procedures, applicability of the intervention, and time required to complete the assessment tools. It also helped identify any practical difficulties related to the digital platform, communication procedures, and community follow-up. The mothers participating in the pilot study were excluded from the final study sample to avoid duplication of data.

Ethical Considerations

The study was conducted after obtaining approval from the relevant Research Ethics Committee of the Faculty of Nursing (167/2024), Sohag University, and the necessary administrative permissions from the study settings. The purpose, procedures, potential benefits, and voluntary nature of participation were explained to each eligible mother. Written consent was obtained before enrollment. Mothers were informed that participation was voluntary and that they had the right to withdraw from the study at any time without affecting the care provided to them or their infants. Confidentiality and privacy were maintained throughout all phases of the study. Each participant was assigned a code rather than using her name on the study forms. Maternal and infant information obtained through face-to-face assessments, community visits, and the digital platform was kept confidential and was used only for research purposes. Digital communication and electronic records were handled with appropriate privacy precautions. Mothers who demonstrated concerning postpartum depressive symptoms or whose infants showed significant danger signs were referred to the appropriate healthcare professionals for further assessment and management.

Data Collection Procedure

Data were collected over a period of approximately six months from July to December/ 2024, including recruitment, baseline assessment, implementation of the intervention, post-intervention assessment, and follow-up. Eligible postpartum mothers of preterm infants were identified at the Obstetrics and Gynecology Department and Postpartum Unit of Sohag University Hospitals. Each eligible mother was approached individually, the purpose and procedures of the study were explained, and written informed consent was obtained before enrollment. At baseline, the researchers collected sociodemographic, obstetric, postpartum, and infant-related data. Maternal knowledge, postpartum self-care practices, breastfeeding self-efficacy, psychological well-being, and preterm infant care practices were assessed. Baseline infant anthropometric and developmental indicators were also recorded.

Following baseline assessment, mothers participated in the Hybrid Digital–Community Nursing Platform. The intervention was delivered through coordinated face-to-face nursing sessions, practical demonstrations, digital education and reminders, and community/home follow-up. The intervention was individualized according to maternal and infant needs. The obstetric nurse focused primarily on maternal postpartum recovery, self-care, nutrition, breastfeeding, breast care, psychological adjustment, and recognition of postpartum warning signs. The pediatric nurse focused on preterm infant feeding, infection prevention, thermal regulation, safe sleep, danger-sign recognition, growth, developmental stimulation, immunization, and healthcare seeking. The community health nurse provided continuity of care after discharge through home/community follow-up, reinforcement of education, monitoring of maternal and infant practices, breastfeeding support, assessment of adherence, and referral when indicated.

The digital component was used throughout the intervention to reinforce face-to-face education. Mothers received educational materials, reminders, follow-up messages, breastfeeding and infant-care guidance, and remote communication with the nursing team.

Following completion of the intervention, the same relevant assessment tools were administered to evaluate changes in maternal and infant outcomes. A subsequent follow-up assessment was conducted to determine the sustainability of the intervention effects.

Phases of the Intervention

The intervention was implemented in **four sequential phases**:

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Phase I: Preparation and Baseline Assessment

This phase included recruitment of eligible mothers, obtaining informed consent, establishing baseline measurements, and identifying individual maternal and infant needs. The researchers also introduced mothers to the digital platform and explained how to access educational materials and communicate with the nursing team.

Phase II: Early Postpartum Hospital-Based Intervention

This phase started during the early postpartum period before discharge and consisted of structured sessions delivered by obstetric and pediatric nurses. The obstetric nursing component addressed maternal recovery, hygiene, nutrition, hydration, rest, breastfeeding, breast care, emotional adjustment, postpartum warning signs, and appropriate healthcare seeking. The pediatric nursing component addressed preterm infant feeding, breastfeeding techniques, thermal protection, infection prevention, hygiene, safe sleep, danger signs, and basic developmental care.

Phase III: Digital Reinforcement and Community-Based Follow-up

After discharge, the community health nurse continued follow-up through scheduled home visits . Digital support was provided between visits through educational messages, reminders, follow-up prompts, and remote communication. This phase emphasized reinforcement rather than replacing face-to-face care. Mothers were encouraged to apply learned practices, report difficulties, and seek professional assistance when maternal or infant warning signs occurred.

Intervention Sessions

The intervention consisted of **eight structured sessions** delivered over approximately **four weeks**, followed by community and digital follow-up.

Session	Main Content	Responsible Nurse	Duration
Session 1: Maternal Postpartum Recovery	Postpartum physiological changes, hygiene, rest, nutrition, hydration, pain management, warning signs, and healthcare seeking	Obstetric Nurse	45–60 min
Session 2: Breastfeeding and Maternal Nutrition	Breastfeeding techniques, positioning and attachment, breast care, adequate nutrition and hydration, common breastfeeding problems	Obstetric Nurse	45–60 min
Session 3: Preterm Infant Feeding and Basic Care	Breastfeeding/expressed breast milk, feeding frequency, feeding difficulties, thermal regulation, hygiene, and safe sleep	Pediatric Nurse	60 min
Session 4: Infection Prevention and Danger Signs	Hand hygiene, infection prevention, respiratory and feeding danger signs, temperature abnormalities, and emergency referral	Pediatric Nurse	45–60 min
Session 5: Growth and Development of the Preterm Infant	Growth monitoring, corrected age, developmental milestones, stimulation, interaction, immunization, and follow-up	Pediatric Nurse	45–60 min
Session 6: Maternal Psychological Well-being and Caregiving Competence	Emotional adjustment, stress management, maternal confidence, coping, mother–infant interaction, and available support	Obstetric/Community Health Nurse	45–60 min
Session 7: Community-Based Continuity of Care	Home-care practices, breastfeeding reinforcement, maternal self-care, infant-care review, adherence, and referral	Community Health Nurse	45–60 min

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Session	Main Content	Responsible Nurse	Duration
Session 8: Digital Follow-up and Self-management	Use of digital educational materials, reminders, remote communication, monitoring, problem reporting, and maintaining healthy practices	Community Health Nurse	30–45 min

Session Implementation

Each educational session followed a standardized structure consisting of introduction, assessment, education, demonstration, return demonstration, discussion, and evaluation. At the beginning of each session, the nurse assessed the mother's previous knowledge and current concerns. The educational content was then delivered using simple language and appropriate teaching methods, including short lectures, discussion, demonstrations, practical training, printed materials, and digital educational resources. Practical skills, particularly breastfeeding, expressed breast milk handling, infant positioning, hygiene, thermal care, and recognition of infant danger signs, were demonstrated by the nurse. Mothers were encouraged to perform return demonstrations to ensure correct understanding and application. At the end of each session, the nurse summarized the key messages, answered questions, corrected misconceptions, and provided specific home-care tasks. Digital reminders were subsequently used to reinforce the session content.

Duration and Frequency of the Intervention

The structured intervention was delivered over approximately **four weeks**, with **two sessions per week**. Each session lasted approximately **45–60 minutes**, depending on the topic and individual maternal needs. Community-based follow-up and digital reinforcement continued after completion of the structured sessions.

The follow-up period extended beyond the active educational phase to assess whether improvements in maternal practices and infant outcomes were maintained. Community nurses maintained contact with participating mothers through scheduled follow-up visits and Family Health Unit contacts, while the digital platform provided continuous reinforcement, reminders, and communication between scheduled contacts.

Phase IV: Evaluation and Follow-up

The final phase included post-intervention assessment and follow-up evaluation. Maternal knowledge, self-care, breastfeeding self-efficacy, psychological well-being, infant-care practices, and infant growth and developmental indicators were reassessed. Mothers' engagement with and satisfaction with the hybrid platform were also evaluated.

Statistical Analysis

Data were coded, tabulated, and statistically analyzed using the Statistical Package for the Social Sciences (SPSS), version 26. Data were first checked for completeness, consistency, and accuracy before analysis. Descriptive statistics were used to summarize the study variables. Frequencies and percentages were calculated for categorical variables, while means, standard deviations, medians, and ranges were used for quantitative variables as appropriate. The Chi-square test (χ^2) was used to examine associations between categorical variables. For comparison of categorical outcomes measured at different study phases, such as pre-intervention, post-intervention, and follow-up. For quantitative variables measured before and after the intervention, the paired t-test was used when the data were normally distributed. For comparisons across the three assessment periods (pre-intervention, post-intervention, and follow-up), repeated-measures ANOVA was used for normally distributed continuous data, whereas the Friedman test was used for non-parametric repeated measurements. Pearson's correlation coefficient (r) was used to examine relationships between normally distributed continuous variables, while Spearman's rank correlation coefficient (rs) was used for non-normally distributed or ordinal variables. Correlation analysis was used to examine the relationships between maternal knowledge, postpartum self-care, breastfeeding self-efficacy, caregiving practices, and selected preterm infant outcomes. The internal consistency of the multi-item study scales was assessed using Cronbach's alpha coefficient. The distribution and assumptions of quantitative variables were assessed before applying parametric statistical tests. The level of statistical significance was set at $p < 0.05$, while $p < 0.001$ was considered highly statistically significant. Results with $p \geq 0.05$ were considered statistically non-significant.

RESULTS

Table (1): Distribution of the Studied Mothers According to Their Sociodemographic Characteristics (n=100)

Characteristics	No.	%
Age (years)		
<25	18	18.0
25–<35	46	46.0
35–<45	29	29.0
≥45	7	7.0
Mean ± SD	32.4 ± 6.8	
Residence		
Rural	62	62.0
Urban	38	38.0
Educational level		
Illiterate	12	12.0
Basic education	25	25.0
Secondary education	39	39.0
University education	24	24.0
Occupation		
Housewife	82	82.0
Working	18	18.0
Marital status		
Married	97	97.0
Other	3	3.0
Family size		
<4 members	31	31.0
≥4 members	69	69.0

Table (1) shows that nearly half of the studied mothers (46.0%) were aged 25–<35 years, with a mean age of 32.4 ± 6.8 years. More than three-fifths (62.0%) lived in rural areas. Regarding educational level, 39.0% had secondary education, followed by 25.0% with basic education and 24.0% with university education. The majority of mothers (82.0%) were housewives, and almost all (97.0%) were married. More than two-thirds (69.0%) had a family size of four or more members.

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Table (2): Distribution of the Studied Mothers According to Their Obstetric and Postpartum Characteristics (n=100)

Characteristics	No.	%
Gravidity		
Primigravida	27	27.0
Multigravida	73	73.0
Parity		
Primipara	31	31.0
Multipara	69	69.0
Previous preterm delivery		
Yes	21	21.0
No	79	79.0
Mode of delivery		
Vaginal delivery	42	42.0
Cesarean section	58	58.0
Gestational age		
<32 weeks	18	18.0
32–<34 weeks	35	35.0
34–<37 weeks	47	47.0
Postpartum complications		
Yes	26	26.0
No	74	74.0
Previous breastfeeding experience		
Yes	69	69.0
No	31	31.0

Table (2) reveals that the majority of mothers (73.0%) were multigravida and 69.0% were multipara. More than half (58.0%) delivered by cesarean section. Regarding gestational age, 47.0% of preterm infants were born at 34–<37 weeks, while 35.0% were born at 32–<34 weeks and 18.0% before 32 weeks. Most mothers (74.0%) had no reported postpartum complications, and 69.0% had previous breastfeeding experience.

Table (3): Distribution of the Studied Mothers According to Their Preterm Infants' Characteristics (n=100)

Characteristics	No.	%
Infant sex		
Male	54	54.0
Female	46	46.0
Birth weight		
<1500 g	19	19.0
1500–<2500 g	73	73.0

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Characteristics	No.	%
≥2500 g	8	8.0
NICU admission		
Yes	91	91.0
No	9	9.0
Duration of NICU admission		
<7 days	23	23.0
7–<14 days	41	41.0
≥14 days	36	36.0
Current feeding		
Exclusive breastfeeding	34	34.0
Mixed feeding	49	49.0
Formula feeding	17	17.0
Current weight (kg)	2.31 ± 0.54	

Table (3) demonstrates that 54.0% of the preterm infants were males. Most infants (73.0%) had a birth weight of 1500–<2500 g, while 19.0% weighed less than 1500 g. The majority (91.0%) required NICU admission, with 36.0% remaining in the NICU for 14 days or more. Regarding current feeding, almost half of the infants (49.0%) received mixed feeding, whereas 34.0% were exclusively breastfed. The mean current weight was 2.31 ± 0.54 kg.

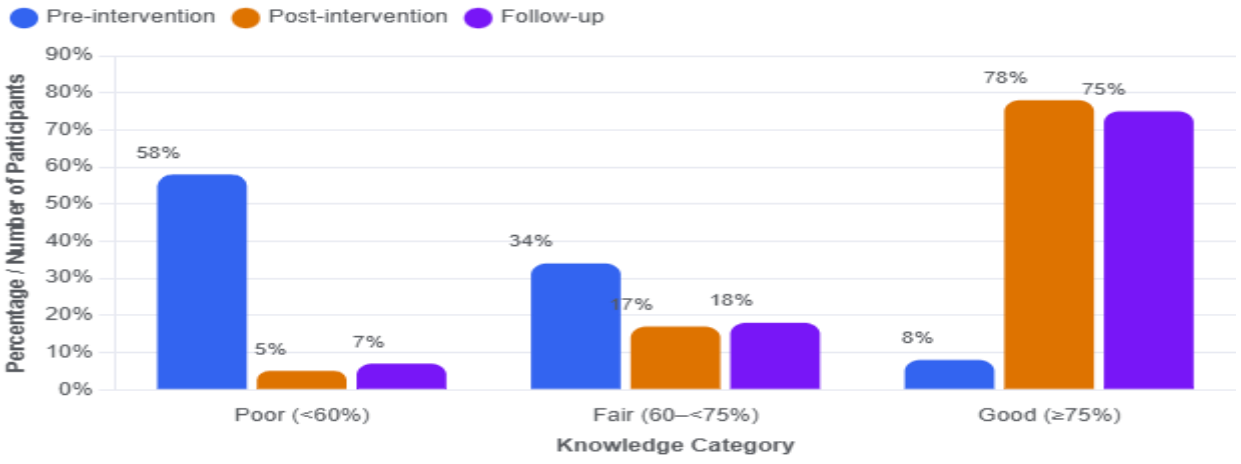

Figure (1): Distribution of the Studied Mothers According to Their Overall Knowledge Level Before, After the Intervention, and at Follow-up (n=100)

Figure (1): shows a substantial improvement in mothers' overall knowledge following the intervention, with good knowledge increasing from 8.0% pre-intervention to 78.0% post-intervention and remaining high at 75.0% at follow-up. Conversely, poor knowledge decreased markedly from 58.0% to 5.0% post-intervention, with only a slight increase to 7.0% at follow-up.

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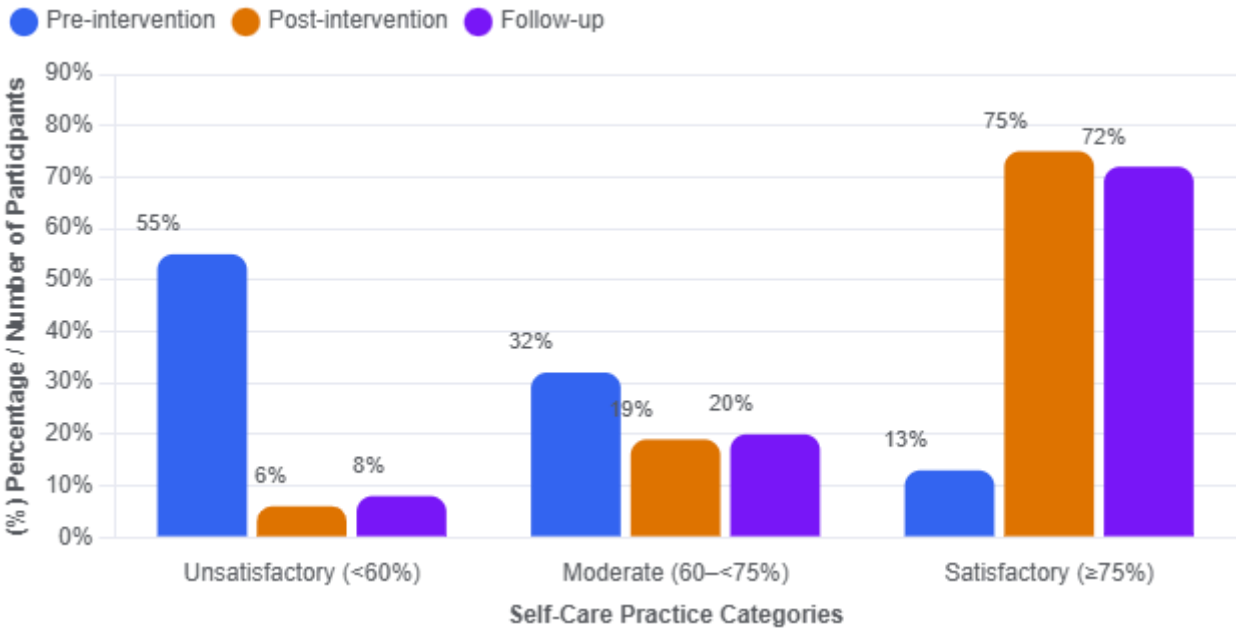

Figure (2): Distribution of the Studied Mothers According to Their Postpartum Self-Care Practice Level Before, After the Intervention, and at Follow-up (n=100)

Figure (2) demonstrates a marked improvement in the studied mothers' postpartum self-care practice following implementation of the intervention. Before the intervention, more than half of the mothers **(55.0%)** had unsatisfactory self-care practices, while only **13.0%** had satisfactory practices. After the intervention, the proportion with satisfactory practices increased substantially to **75.0%**, whereas unsatisfactory practices decreased to **6.0%**. At follow-up, the improvement was largely maintained, with **72.0%** of mothers demonstrating satisfactory self-care practices, while only **8.0%** remained unsatisfactory.

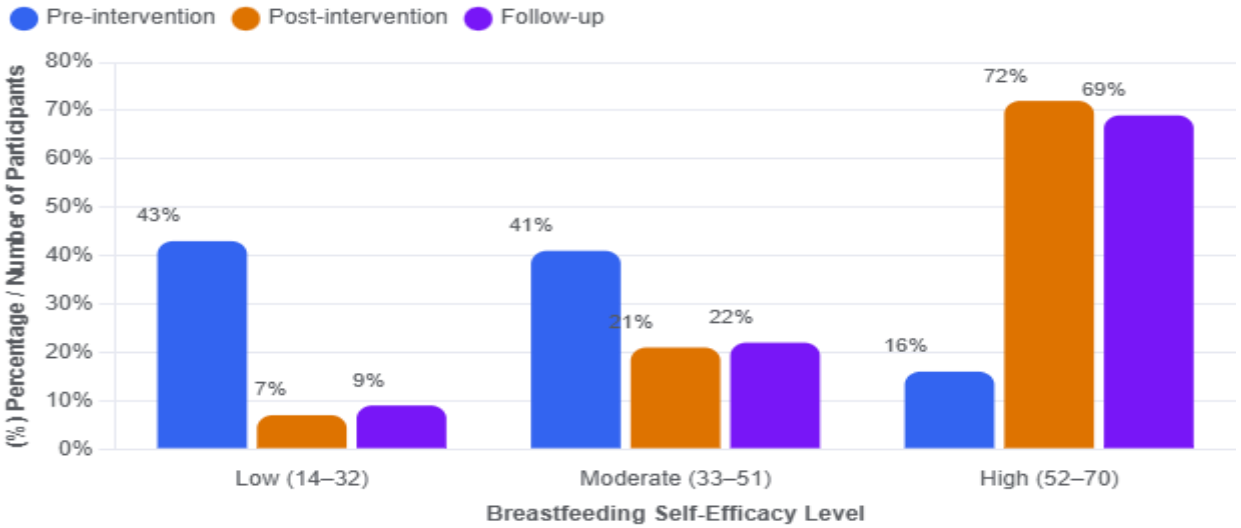

Figure (3): Distribution of the Studied Mothers According to Breastfeeding Self-Efficacy Level Before, After the Intervention, and at Follow-up (n=100)

Figure (3) demonstrates a marked improvement in breastfeeding self-efficacy among the studied mothers following the intervention. Before the intervention, **43.0%** of mothers had low self-efficacy, **41.0%** had moderate self-efficacy, and only **16.0%** had high self-efficacy. Following the intervention, high self-efficacy increased substantially to **72.0%**, while low self-

efficacy decreased to **7.0%**. At follow-up, the improvement was largely maintained, with **69.0%** of mothers having high self-efficacy compared with only **9.0%** having low self-efficacy.

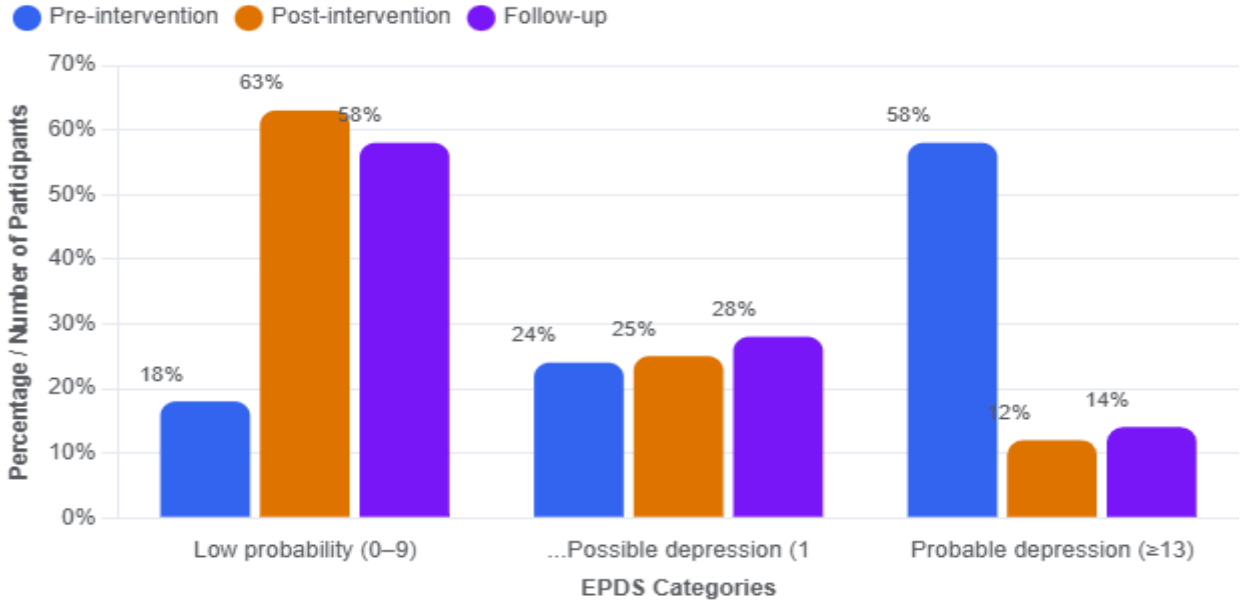

Figure (4): Distribution of the Studied Mothers According to EPDS Levels Before, After the Intervention, and at Follow-up (n=100)

Figure (4) demonstrates a clear improvement in maternal psychological well-being. At baseline, 58.0% of mothers had EPDS scores indicating probable depression, while only 18.0% were classified as having a low probability of depression. Following the intervention, the proportion with low probability increased to 63.0%, whereas probable depression decreased to 12.0%. At follow-up, the favorable effect was largely maintained, with 58.0% classified as low probability and 14.0% as probable depression.

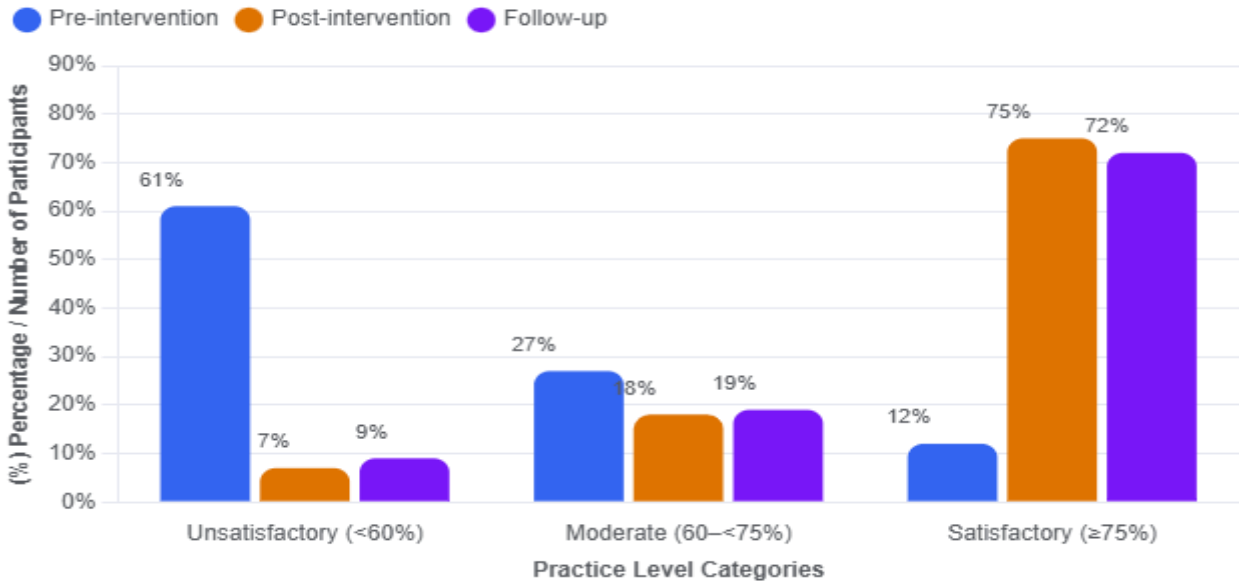

Figure (5): Distribution of the Studied Mothers According to Their Preterm Infant Feeding and Care Practice Level Before, After the Intervention, and at Follow-up (n=100)

Figure (5) indicates a substantial improvement in mothers' preterm infant feeding and care practices following the intervention. Before the intervention, the majority of mothers (**61.0%**) had unsatisfactory practices, while only **12.0%**

demonstrated satisfactory practices. After the intervention, satisfactory practices increased markedly to **75.0%**, accompanied by a reduction in unsatisfactory practices to **7.0%**. At follow-up, the improvement was largely maintained, with **72.0%** of mothers demonstrating satisfactory practices and only **9.0%** remaining at the unsatisfactory level.

Table (4): Comparison of Preterm Infants' Growth Indicators Before the Intervention, After the Intervention, and at Follow-up (n=100)

Growth indicator	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	Follow-up Mean ± SD	F	p-value
Weight (kg)	2.31 ± 0.54	3.18 ± 0.63	4.02 ± 0.71	126.84	<0.001*
Length (cm)	46.7 ± 3.2	51.8 ± 3.5	56.9 ± 3.8	118.37	<0.001*
Head circumference (cm)	32.4 ± 2.1	35.6 ± 2.2	38.2 ± 2.4	96.52	<0.001*

Note: *$p < 0.001$ = highly highly significant.*

Table (4) demonstrates progressive improvement in the growth indicators of the preterm infants. Mean weight increased from 2.31 ± 0.54 kg before the intervention to 3.18 ± 0.63 kg after the intervention and 4.02 ± 0.71 kg at follow-up. Similarly, mean length increased from 46.7 ± 3.2 cm to 51.8 ± 3.5 cm and 56.9 ± 3.8 cm, respectively. Mean head circumference also increased progressively. All changes were highly statistically significant (**$p < 0.001$**).

Table (5): Distribution of Preterm Infants According to Selected Developmental and Health Outcomes Before, After the Intervention, and at Follow-up (n=100)

Developmental/health indicator	Pre-intervention No. (%)	Post-intervention No. (%)	Follow-up No. (%)	χ^2	p-value
Appropriate gross motor progress	39 (39.0)	66 (66.0)	76 (76.0)	42.18	<0.001*
Appropriate fine motor progress	35 (35.0)	62 (62.0)	73 (73.0)	46.27	<0.001*
Appropriate communication/language	32 (32.0)	59 (59.0)	70 (70.0)	45.61	<0.001*
Appropriate social interaction	43 (43.0)	71 (71.0)	80 (80.0)	39.84	<0.001*
Completed recommended immunization	61 (61.0)	82 (82.0)	91 (91.0)	35.72	<0.001*
No major feeding problem	42 (42.0)	68 (68.0)	79 (79.0)	41.36	<0.001*
No infection/readmission	63 (63.0)	78 (78.0)	86 (86.0)	24.18	<0.001*

Note: *$p < 0.001$ = highly highly significant.*

Table (5) shows progressive improvement in selected developmental and health outcomes. Appropriate gross motor progress increased from 39.0% at baseline to 66.0% post-intervention and 76.0% at follow-up. Similar improvements were observed in fine motor, communication, and social interaction domains. Immunization completion increased from 61.0% to 91.0%. The proportion of infants without major feeding problems also increased from 42.0% to 79.0%. All reported comparisons were highly statistically significant (**$p < 0.001$**).

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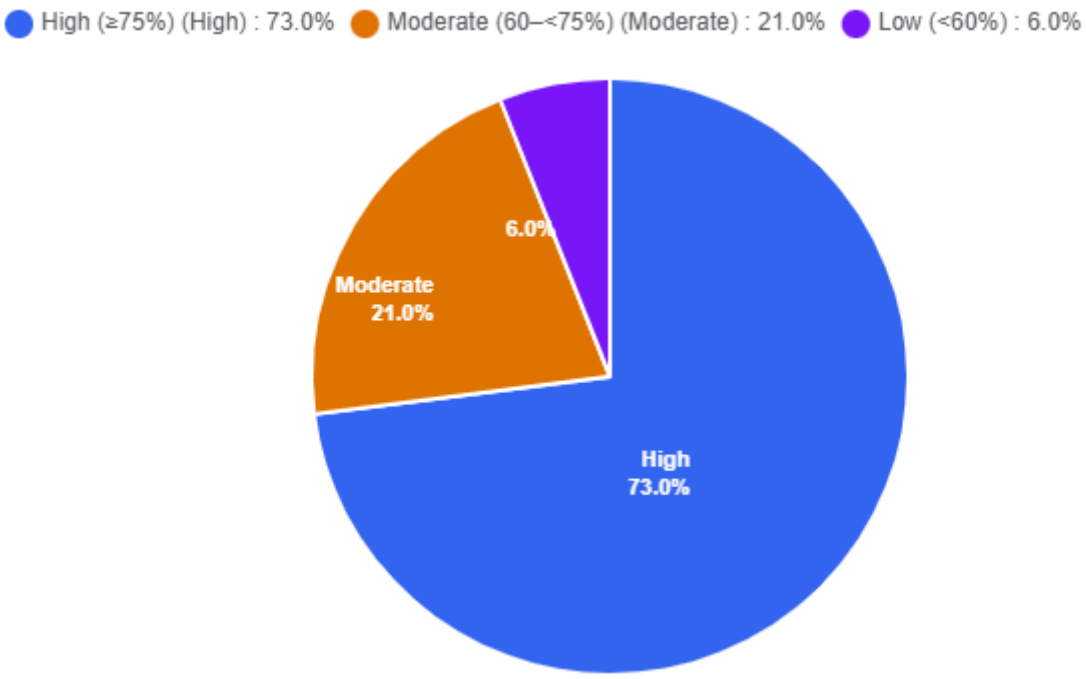

Figure (6): Distribution of the Studied Mothers According to Their Engagement and Satisfaction with the Hybrid Digital–Community Nursing Platform (n=100)

Figure (6) indicates a high level of maternal acceptance of the hybrid digital–community nursing platform. Nearly three-quarters of the studied mothers (73.0%) demonstrated a high level of engagement and satisfaction, while 21.0% demonstrated a moderate level and only 6.0% reported a low level.

Table (6): Correlation Beween Maternal Outcomes and Selected Preterm Infant Outcomes at Follow-up (n=100)

Maternal variable	Infant growth (r)	Infant care practices (r)	Developmental outcomes (r)
Maternal knowledge	0.421***	0.583***	0.397***
Postpartum self-care	0.356***	0.512***	0.344***
Breastfeeding self-efficacy	0.487***	0.621***	0.438***
Caregiving competence	0.463***	0.674***	0.529***

Note: *$p < 0.001$ = highly highly significant.*

Table (6) demonstrates statistically significant positive correlations between maternal outcomes and selected preterm infant outcomes at follow-up. Maternal knowledge showed positive correlations with infant growth ($r=0.421$, $p<0.001$), infant-care practices ($r=0.583$, $p<0.001$), and developmental outcomes ($r=0.397$, $p<0.001$). Breastfeeding self-efficacy was also positively correlated with infant growth ($r=0.487$, $p<0.001$) and infant-care practices ($r=0.621$, $p<0.001$). The strongest correlation was observed between caregiving competence and infant-care practices ($r=0.674$, $p<0.001$).

DISCUSSION:

The first 1000 days of life constitute a critical window for establishing the foundations of maternal and child health, growth, brain development, and lifelong well-being. This period is particularly important for preterm infants, who require enhanced nutritional, developmental, preventive, and family-centered care because of their increased vulnerability to feeding difficulties, infections, impaired growth, and developmental problems. At the same time, mothers of preterm infants may experience substantial challenges in postpartum recovery, breastfeeding, psychological adjustment, and acquiring the skills required to provide specialized infant care. Therefore, continuity of support from hospital to home and community is essential. The

World Health Organization emphasizes family involvement and integrated facility- and community-based care for preterm and low-birth-weight infants, while the Nurturing Care Framework highlights the importance of health, nutrition, responsive caregiving, security and safety, and early learning during the earliest years of life **(Suri et al., 2025).**

The present study demonstrated that the Hybrid Digital–Community Nursing Platform was associated with substantial improvements across maternal knowledge, postpartum self-care, breastfeeding self-efficacy, psychological well-being, preterm infant-care practices, infant growth and developmental indicators, and maternal engagement with the intervention. The observed pattern of improvement is consistent with the underlying concept of integrated, family-centered care, in which mothers are not merely recipients of information but active partners in the care of their preterm infants. The combination of hospital-based nursing education, practical demonstrations, digital reinforcement, and community follow-up may have provided repeated opportunities for mothers to acquire knowledge, practice new skills, receive feedback, and maintain these behaviors after discharge. This approach is consistent with **Curan et al., (2024)** emphasizing family involvement, continuity of care, feeding support, kangaroo mother care, and facility- and community-based care for preterm and low-birth-weight infants. The findings also support the Nurturing Care Framework, by **Shi et al., (2024)**which emphasizes health, adequate nutrition, responsive caregiving, security and safety, and opportunities for early learning during the critical early-life period.

The present study revealed a marked improvement in maternal knowledge following implementation of the hybrid nursing platform. Before the intervention, more than half of the mothers had poor knowledge, whereas after the intervention the majority achieved a good knowledge level, with the difference being highly statistically significant. This finding may be attributed to the structured educational content provided by the obstetric and pediatric nurses, which addressed postpartum self-care, maternal nutrition, breastfeeding, preterm infant feeding, infection prevention, danger signs, growth, development, and appropriate healthcare seeking. The repeated presentation of information through face-to-face sessions and digital educational materials may also have facilitated reinforcement and retention of knowledge. These findings are consistent with **Khalil et al., (2024)**emphasize educating and supporting parents as an integral component of preterm and low-birth-weight infant care. They are also consistent with evidence from systematic reviews showing that parenting education and family-centered interventions can improve parental knowledge and caregiving skills among families of preterm infants **(Lubbe et al., 2026).**

A substantial improvement was also observed in maternal postpartum self-care practices, as the proportion of mothers with satisfactory self-care increased considerably after implementation of the intervention, while unsatisfactory practices declined. This improvement may be explained by the practical orientation of the intervention, which went beyond theoretical education to include demonstrations, return demonstrations, individualized counseling, and continuous reinforcement. The obstetric nursing component addressed maternal recovery, nutrition, hydration, breast care, personal hygiene, and psychological self-care, while community nurses reinforced these behaviors during follow-up. This finding agrees with the WHO recommendation for a positive postnatal experience, which emphasizes individualized education, emotional support, breastfeeding assistance, and continuity of postnatal care. It is also compatible with evidence that integrated interventions involving parents of preterm infants can improve parental competence and psychosocial outcomes. However, the improvement in self-care observed in the present study may be greater than that reported in some previous studies because the current intervention combined hospital education with digital and community-based follow-up rather than relying on a single point of care **(Oh & Heo, 2024).**

The findings demonstrated a pronounced increase in breastfeeding self-efficacy, with the proportion of mothers having high self-efficacy increasing. This improvement may reflect the combined effect of breastfeeding education, individualized counseling, practical guidance, repeated encouragement, and digital communication that allowed mothers to receive support when breastfeeding difficulties emerged. The result is strongly consistent with the systematic review and meta-analysis by **de Sousa et al. (2025),** which found that interventions designed to improve breastfeeding self-efficacy significantly increased maternal self-efficacy and breastfeeding outcomes, particularly when interventions were delivered during the postpartum period and through combined settings. Similarly, **Wong et al. (2021)** reported that educational and supportive interventions significantly improved breastfeeding self-efficacy. More recent evidence has also demonstrated that digital interventions can improve breastfeeding self-efficacy and knowledge, although the magnitude of effect varies according to intervention design and maternal context **(Thepha et al., 2024)**. Thus, the present finding supports the value of combining direct nursing support with digital reinforcement rather than using digital education alone.

The present findings showed a substantial reduction in the proportion of mothers classified as having probable postpartum depression according to the EPDS, accompanied by an increase in the proportion with low probability of depression. The beneficial effect was largely maintained at follow-up, suggesting that the intervention may have provided not only an immediate educational benefit but also continuing psychological and caregiving support. This finding is understandable because mothers of preterm infants may experience uncertainty, fear regarding infant survival and development, breastfeeding difficulties, and increased caregiving demands. The intervention provided opportunities for mothers to discuss concerns, receive reassurance, develop caregiving competence, and maintain contact with nurses after discharge. The finding is consistent with **Zhang et al., (2021)** a systematic review of early interventions for preterm infants and their mothers, which reported significant positive effects on maternal depressive symptoms and self-efficacy. It is also supported by a randomized controlled trial of a home-based intervention for parents of preterm infants, which demonstrated improvements in parental depression and anxiety following continued home-based support (**Zheng et al., 2025).**

The current study showed a significant improvement in mothers' preterm infant feeding and care practices, with satisfactory practices increasing after its implementation. This improvement may be explained by the pediatric nursing component, which incorporated practical instruction concerning feeding techniques, breastfeeding, thermal care, infection prevention, danger signs, and appropriate healthcare seeking. The community health nurse subsequently reinforced these practices through home visits and follow-up, while the digital platform provided reminders and rapid access to nursing guidance. The finding is strongly consistent with WHO recommendations, which identify family involvement, early feeding, mother's own milk, kangaroo mother care, and continuity between facility and community as important elements of preterm infant care **(WHO, 2022).** It also agrees with family-centered care evidence showing improvements in parental knowledge and skills and selected infant outcomes. Conversely, some previous reviews have reported variable effects of family-centered interventions on specific infant outcomes, indicating that effectiveness may depend on intervention intensity, parental participation, and continuity of support **(Raghupathy et al., 2021).**

The present study demonstrated progressive increases in infant weight, length, and head circumference across the assessment periods, with statistically significant differences between measurements. These findings may be related to the combined improvement in maternal knowledge, breastfeeding self-efficacy, feeding practices, infection prevention, and adherence to follow-up. Improved maternal ability to recognize feeding difficulties and illness signs may also have facilitated earlier healthcare seeking and reduced interruptions in feeding and growth. The findings are consistent with **Güneş et al., (2023)** emphasizing adequate nutrition, mother's own milk, early feeding, kangaroo mother care, and family participation as important components of care for preterm infants. They are also supported by **Qiu et al., (2026)**, systematic-review evidence indicating that developmental and family-centered interventions may improve short-term growth outcomes among preterm infants. However, some reviews have found inconsistent effects on growth, suggesting that infant gestational age, birth weight, medical complications, nutritional status, and duration of intervention can modify the observed effect.

The findings also demonstrated progressive improvement in age-appropriate developmental indicators, including gross motor, fine motor, communication, and social interaction. This improvement may be attributed to the intervention's emphasis on responsive caregiving, appropriate stimulation, parent–infant interaction, and early recognition of developmental concerns. The community-based component may have been particularly important because it enabled nurses to observe the infant within the home environment and reinforce developmental activities within routine maternal caregiving. These results are consistent with **Jeong et al., (2021),** a recent systematic review and meta-analysis demonstrating that parenting interventions for children born prematurely can positively influence cognitive, language, motor, and behavioral outcomes. Similarly, a systematic review of early interventions involving parental participation reported beneficial effects on neurodevelopment among premature children. Nevertheless, the literature is not completely consistent; some studies have found limited effects on long-term neurodevelopment despite improvements in parental outcomes, suggesting that developmental outcomes may require longer follow-up than the period used in the present study **(Molloy et al., 2024).**

The high level of maternal engagement and satisfaction with the hybrid platform provides an important finding because successful digital health interventions depend not only on clinical effectiveness but also on acceptability, accessibility, and sustained user engagement. In the present study, most mothers reported high engagement and satisfaction, which may have resulted from combining digital support with direct human contact through community nursing visits. This combination likely reduced the limitations of digital-only interventions by allowing mothers to obtain personalized clarification and practical assistance when needed. The finding is consistent with **Thepha et al., (2024)**, a systematic-review evidence showing

that digital health interventions can improve breastfeeding outcomes, self-efficacy, and knowledge, particularly when interactive communication such as telephone support, text messaging, or personalized feedback is incorporated. However, evidence also indicates considerable heterogeneity between digital interventions and differences in engagement according to socioeconomic, cultural, technological, and individual factors. Therefore, the high satisfaction observed in the present study may be partly attributable to the community nursing component, which provided a human link between the digital platform and mothers' real-life caregiving needs **(Liu et al., 2026).**

The present study demonstrated significant positive correlations between maternal knowledge, postpartum self-care, breastfeeding self-efficacy, caregiving competence, and selected infant outcomes. The strongest relationship was observed between caregiving competence and infant-care practices, indicating that mothers who possessed greater confidence and competence were more likely to apply appropriate feeding and care behaviors. This relationship supports the conceptual basis of family-centered and nurturing care models, whereby maternal capabilities constitute an important pathway through which interventions influence infant health and development. The finding is consistent with **Oh & Heo, (2024)**, evidence showing that interventions aimed at empowering parents of preterm infants can improve parental self-efficacy and caregiving skills while also contributing to infant outcomes. **Prime et al., (2023),** done a systematic review of parenting interventions reported significant benefits for child cognition, language, motor development, and behavioral outcomes, while another meta-review identified positive effects of parent-focused interventions across several maternal and infant outcomes. Nevertheless, the observed correlations should not be interpreted as proof of causation because maternal and infant outcomes may be influenced by socioeconomic status, infant illness severity, gestational age, birth weight, and access to healthcare.

CONCLUSION

In conclusion, the present study demonstrated the potential effectiveness of a Hybrid Digital–Community Nursing Platform in improving maternal and preterm infant outcomes throughout the critical first 1000 days of life. The Hybrid Digital–Community Nursing Platform was effective in improving maternal knowledge, postpartum self-care, breastfeeding self-efficacy, psychological well-being, and preterm infant-care practices. It was also associated with favorable improvements in preterm infant growth, developmental progress, feeding, and continuity of care. The high maternal engagement and satisfaction indicate that integrating obstetric, pediatric, and community nursing with digital support is a feasible approach for strengthening maternal and preterm infant outcomes during the first 1000 days.

Recommendations

Based on the findings of the present study, the following recommendations are proposed

- Integrating hybrid digital–community nursing support into routine postpartum care for mothers of preterm infants.
- Initiating nursing education and breastfeeding support before hospital discharge and continue it through community follow-up.
- Strengthening collaboration among obstetric, pediatric, and community health nurses.
- Using secure digital platforms for education, reminders, remote counseling, and follow-up.
- Providing regular maternal psychological screening and appropriate referral when needed.
- Monitoring preterm infants regularly for growth, feeding, immunization, and developmental progress.
- Including fathers and family caregivers in educational and supportive interventions.
- Conducting larger randomized studies with longer follow-up to evaluate the long-term effectiveness and cost-effectiveness of the platform.

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