RESEARCH PAPER

From Neonatal Intensive Care Unit Distress to Home Settlement: A Collaborative Nursing Program to Mitigate Maternal Postpartum Depression and Foster Infant Neurodevelopment in Rural Communities

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Abstract

Background: Mothers of infants admitted to neonatal intensive care units (NICUs) are at increased risk of postpartum depression, psychological distress, and difficulties in adapting to infant care after discharge. These challenges may be particularly pronounced in rural communities, where access to specialized psychological, neonatal, and developmental services may be limited. Continuity of nursing care from NICU hospitalization through home settlement may provide mothers with the knowledge, emotional support, and caregiving skills needed to promote maternal well-being and infant neurodevelopment. **Aim:** To evaluate the effect of a collaborative nursing program extending from neonatal intensive care units to home settlement on maternal postpartum depression and infant neurodevelopment among mothers and their infants in rural communities. **Methods:** A quasi-experimental one-group pretest–posttest design with follow-up was used among a convenience sample of 100 mothers and their infants who had been admitted to the NICU. The study was conducted in Neonatal Intensive Care Units at Sohag University Hospitals and affiliated maternal and child health care center Dar El Salmaa Abdallah in Sohag City. Data were collected using six tools: Tool I: Sociodemographic and Clinical Characteristics Questionnaire; Tool II: Edinburgh Postnatal Depression

Scale (EPDS); Tool III: Maternal Infant-Care Knowledge and Home-Settlement Practices Questionnaire; Tool IV: Maternal–Infant Interaction and Responsive Parenting Observation Checklist; Tool V: Infant Neurodevelopmental Assessment Scale; and Tool VI: Maternal Satisfaction with the Collaborative NICU-to-Home Nursing Program Scale. The collaborative nursing program included structured NICU-based education, psychological support, breastfeeding and infant-care guidance, discharge preparation, responsive caregiving education, developmental stimulation, danger-sign recognition, and structured post-discharge home/community follow-up. **Results:** Following implementation of the collaborative nursing program, mothers demonstrated a marked reduction in postpartum depressive symptoms, accompanied by improvements in maternal infant-care knowledge, home-care practices, responsive mother–infant interaction, and confidence in caring for their infants. Infant developmental outcomes also improved across the assessed gross motor, fine motor/adaptive, language and communication, social-emotional, and cognitive/sensory domains. Improvements in maternal and infant outcomes were maintained during the follow-up period. Mothers also reported high satisfaction with the collaborative NICU-to-home nursing program. **Conclusion:** The collaborative nursing program linking NICU care with home and community follow-up was associated with improved maternal psychological well-being, enhanced infant-care knowledge and practices, more responsive mother–infant interaction, and improved infant neurodevelopmental outcomes. Continuity of nursing support from NICU hospitalization through home settlement may provide a practical family-centered approach for supporting mothers and infants in rural communities. **Recommendations:** Integration of structured NICU-to-home nursing programs into neonatal discharge planning and community health services is recommended, with emphasis on early screening for postpartum depressive symptoms, maternal education, responsive caregiving, developmental stimulation, and continued follow-up after discharge.

Keywords: *Home Settlement, Infant Neurodevelopment, Maternal Postpartum Depression , Neonatal Intensive Care Unit Distress, Rural Communities*

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Introduction

The neonatal period represents a critical stage of life, particularly for infants who require admission to a neonatal intensive care unit (NICU) because of prematurity, low birth weight, respiratory disorders, infection, congenital conditions, or other complications requiring specialized care. Although advances in neonatal care have improved survival, NICU hospitalization can interrupt the expected transition to parenthood and expose mothers to uncertainty, fear, separation from their infants, and concerns about their infant's survival and future development. The World Health Organization (WHO) emphasizes that care for preterm and low-birth-weight infants should extend beyond survival to include family involvement, supportive care, and continuity across health-care settings **(World Health Organization, 2022).**

Mothers of infants admitted to the NICU may experience substantial psychological stress as they cope with the unexpected hospitalization of their newborn, restricted maternal–infant contact, complicated caregiving demands, and uncertainty regarding the infant's condition. These circumstances may contribute to depressive and anxiety symptoms during the postpartum period. Evidence from a recent systematic review and meta-analysis indicates that supportive nursing interventions can reduce depression and anxiety among mothers of NICU-admitted infants, highlighting the importance of nursing support as part of neonatal family-centered care **(Zhu & Fan, 2025)**. In addition, the WHO recommends integrating mental health promotion, identification of psychological problems, and appropriate support into maternal and child health services throughout the perinatal period **(WHO, 2022).**

Postpartum depression is particularly important among mothers of infants requiring intensive neonatal care because maternal emotional well-being can influence the mother's ability to participate in infant care, establish responsive interaction, and adapt to the demands of caring for a vulnerable infant after discharge **(Saharoy et al., 2023)**.

Maternal mental health is therefore not an isolated maternal outcome but an important component of maternal and child health. Its recommends psychosocial and psychological interventions during the antenatal and postnatal periods to prevent postpartum depression and anxiety, while women with clinically significant symptoms or risk factors should receive appropriate psychological intervention and referral according to their needs **(Stein et al., 2026).**

The transition from NICU hospitalization to home is another vulnerable period for mothers and infants. After discharge, mothers are expected to assume greater responsibility for feeding, hygiene, medication administration, monitoring of danger signs, follow-up appointments, and developmental care, often while still experiencing anxiety about the infant's health. Appropriate discharge preparation and continuity of care can help mothers acquire the knowledge and confidence required to manage these responsibilities. Its recommended for preterm and low-birth-weight infants emphasize family involvement in care and support for parents, while postnatal care recommendations highlight the importance of providing women and families with consistent information, reassurance, and support from health workers **(Smith et al., 2022).**

Early infant development is strongly influenced by the quality of care and interaction provided during the first years of life. The WHO, UNICEF, and World Bank describe **nurturing care** as an integrated approach involving good health, adequate nutrition, safety and security, responsive caregiving, and opportunities for early learning. These components are particularly important during infancy, when rapid neurological and developmental changes occur and when caregivers have a major role in providing appropriate stimulation and emotional security **(Boran & DelRosso, 2026).**

For infants who have experienced NICU hospitalization, developmental surveillance and appropriate caregiver support are especially relevant because prematurity, low birth weight, neonatal illness, and prolonged hospitalization may place some infants at increased risk of developmental difficulties. Developmental support should therefore begin early and continue after discharge through responsive caregiving, age-appropriate interaction, sensory and motor stimulation, and monitoring of developmental milestones. WHO guidance recommends responsive care and opportunities for early learning during the first three years of life and recognizes the health sector's role in supporting families and identifying children and caregivers who require additional developmental or mental health support **(WHO, 2020).**

The challenges associated with NICU hospitalization and post-discharge care may be intensified in rural communities, where families may experience geographic, financial, transportation, and service-access barriers. Consequently, a nursing approach that connects NICU education and emotional support with structured community and home follow-up may help bridge the gap between hospital-based neonatal care and the family's everyday home environment. Such continuity is consistent with the study emphasis on integrated maternal and child health services, culturally appropriate support, family participation, and strengthening primary and community health systems to reach families and young children **(McCarty et al., 2024).**

Nurses are well positioned to provide this continuum of care because they have frequent contact with mothers and infants during hospitalization and can continue health education, psychological support, caregiving guidance, developmental stimulation, and referral after discharge. A collaborative nursing program that begins in the NICU and extends to home settlement can therefore address maternal psychological health and infant developmental needs simultaneously rather than treating them as separate concerns. This approach is aligned with contemporary family-centered neonatal care, which emphasizes involving families in infant care from the beginning and supporting parents as active participants in the care of their infants **(Maleki et al.,, 2022).**

The collaborative nursing program integrated the complementary roles of pediatric, psychiatric, and community health nurses to support mothers and infants transitioning from the Neonatal Intensive Care Unit (NICU) to home and the rural community. The pediatric nurse focused on infant health and neurodevelopment by monitoring growth, feeding, sleep, neurological and developmental milestones, identifying early developmental delays, and educating mothers about appropriate stimulation, safe caregiving, and responsive mother–infant interaction **(Lipkin et al., 2020)**. The psychiatric nurse addressed maternal psychological well-being by

screening for postpartum depressive symptoms, providing supportive counseling, promoting adaptive coping strategies, strengthening maternal confidence, and teaching mothers how to recognize and manage emotional distress and seek professional help when needed. The community health nurse ensured continuity of care after discharge through home visits, follow-up, health education, assessment of environmental and social challenges, reinforcement of infant-care and maternal self-care practices, and linkage with available community and healthcare resources. Through coordinated communication and shared follow-up, the three nursing specialties provided a comprehensive continuum of care extending from NICU discharge to home settlement, addressing maternal mental health, infant neurodevelopment, and family/community support simultaneously **(WHO, 2022).**

Therefore, the present study was designed to evaluate a continuous nursing intervention extending from NICU hospitalization to the home environment. The program focused on reducing maternal postpartum depressive symptoms, strengthening maternal knowledge and home-care practices, enhancing responsive mother–infant interaction, and promoting early infant neurodevelopment through education, psychological support, discharge preparation, developmental stimulation, and structured post-discharge follow-up. This integrated approach reflects the growing emphasis on linking maternal mental health with early childhood development within coordinated maternal, newborn, and community health services **(Ozdil, 2023).**

Significance of the Study

NICU admission is a stressful experience for mothers and may affect maternal confidence, mother–infant bonding, and psychological adaptation during the postpartum period. Therefore, continued nursing support during hospitalization and after discharge may help mothers manage the transition to home and reduce psychological distress. Postpartum depression is an important concern among mothers of NICU infants, as persistent symptoms may affect maternal functioning, caregiving, and mother–infant interaction. Early nursing-based screening, psychological support, education, and referral can facilitate early recognition and management of depressive symptoms **(Weiss et al., 2023).**

Infant neurodevelopment is also an important outcome following NICU hospitalization, particularly among premature, low-birth-weight, or medically ill infants. Responsive caregiving, appropriate stimulation, and early learning opportunities can support healthy development **(Bang, 2021).** Accordingly, this study is significant because it integrates maternal psychological support with infant developmental care through continuous nursing intervention. It may strengthen NICU discharge planning, maternal education, depression screening, responsive caregiving, developmental stimulation, and home/community follow-up, particularly in rural communities with limited access to specialized services. Such continuity of care supports integrated, family-centered, and community-based maternal and child health care **(Gordon et al., 2025).**

Aim of the Study

To evaluate the effect of a collaborative nursing program extending from neonatal intensive care units to home settlement on maternal postpartum depression and infant neurodevelopment among mothers and their infants in rural communities.

Specific Objectives

The study aimed to:

- Assess mothers' levels of postpartum depressive symptoms before, immediately after, and during follow-up after implementation of the collaborative nursing program.
- Assess mothers' knowledge regarding infant care and home settlement before and after implementation of the program.
- Evaluate mothers' home-care practices following NICU discharge.
- Assess maternal–infant interaction and responsive caregiving behaviors.
- Assess infants' neurodevelopmental status across relevant developmental domains.
- Determine the effect of the collaborative nursing program on maternal postpartum depressive symptoms.
- Determine the effect of the program on maternal infant-care knowledge and home-settlement practices.
- Determine the effect of the program on responsive mother–infant interaction.
- Determine the effect of the program on infant neurodevelopment.

- Assess mothers' satisfaction with the collaborative NICU-to-home nursing program.

Hypotheses of the Study

H1: Mothers who receive the collaborative nursing program will demonstrate significantly lower postpartum depression scores after implementation of the program compared with their pre-intervention scores.

H2: Mothers who receive the collaborative nursing program will demonstrate significantly higher levels of infant-care knowledge after implementation of the program compared with their pre-intervention levels.

H3: Mothers who receive the collaborative nursing program will demonstrate significantly improved home-settlement and infant-care practices after implementation of the program compared with their pre-intervention practices.

H4: Mothers who receive the collaborative nursing program will demonstrate significantly improved responsive mother–infant interaction after implementation of the program compared with their pre-intervention interaction scores.

H5: Infants whose mothers receive the collaborative nursing program will demonstrate significantly improved neurodevelopmental outcomes following implementation of the program compared with their baseline developmental assessment.

H6: There will be a significant relationship between maternal postpartum depression, maternal caregiving practices, responsive mother–infant interaction, and infant neurodevelopmental outcomes following implementation of the collaborative nursing program.

Subjects and Methods

Research Design

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

Research Setting

The study was conducted in Neonatal Intensive Care Units at Sohag University Hospitals and affiliated maternal and child health care center Dar El Salmaa Abdallah in Sohag City. The NICU represented the initial setting where mothers received psychological support, education, infant-care training, and discharge preparation. Post-discharge follow-up was conducted through the affiliated maternal and child health care center and home visits to facilitate continuity of nursing care after the infant's transition from hospital to home.

Subjects

A convenience sample of 100 mothers and their infants was recruited. The sample included mothers whose infants had been admitted to the NICU and who were expected to continue infant care after discharge.

Data Collection Tools

Tool I: Sociodemographic and Clinical Characteristics Questionnaire

This tool was developed by the researcher based on a review of relevant literature to assess the sociodemographic, obstetric, and clinical characteristics of the studied mothers and their infants. It consisted of three parts:

Part I: Sociodemographic characteristics of mothers: This part included age, level of education, occupation, residence, and family type.

Part II: Obstetric and maternal characteristics: This part included parity and mode of delivery.

Part III: Infant and NICU-related characteristics: This part included infant sex, birth weight, and duration of NICU stay.

Tool II: Edinburgh Postnatal Depression Scale (EPDS)

The **Edinburgh Postnatal Depression Scale (EPDS)** was used to assess the severity of maternal postpartum depressive symptoms. The EPDS is a widely used 10-item self-report screening instrument developed specifically to identify symptoms of depression during the postnatal period. It assesses depressive mood, anhedonia, guilt, anxiety, fear, sleep disturbance, coping difficulties, sadness, and self-harm thoughts. The instrument was particularly appropriate for mothers of NICU infants because it can identify depressive symptoms associated with the psychological

stress of neonatal illness and prolonged hospitalization. **Cox et al. (1987)** originally developed the scale as a screening measure for postnatal depression.

Each item was scored on a **4-point scale from 0 to 3**, according to the severity or frequency of the symptom during the previous seven days. Some items were reverse scored according to the original EPDS scoring instructions. The total score ranged from **0 to 30**, with higher scores indicating greater depressive symptomatology.

Scoring system:

Total EPDS score	Interpretation
0–9	Low/minimal depressive symptoms
10–12	Possible depression / borderline symptoms
≥13	Probable postpartum depression
Any positive response to Item 10	Requires immediate clinical assessment

The EPDS was used as a **screening instrument rather than a diagnostic tool**. Mothers with elevated scores, particularly those reporting self-harm thoughts, were referred for appropriate clinical assessment.

Tool III: Maternal Infant-Care Knowledge and Home-Settlement Practices Questionnaire

This tool was developed by the researcher based on relevant neonatal and maternal-care literature to assess mothers' knowledge and reported practices concerning the care of their infants during NICU hospitalization and after discharge to the home environment **(WHO, 2022)**. It was designed to determine whether the collaborative nursing program improved mothers' ability to safely care for their infants following discharge.

The tool consisted of two parts:

Part I: Maternal knowledge questionnaire

This part assessed mothers' knowledge regarding:

- Basic needs of the infant after NICU discharge.
- Breastfeeding and appropriate feeding practices.
- Recognition of feeding difficulties.
- Safe sleeping practices.
- Maintaining appropriate warmth and hygiene.
- Umbilical and skin care.
- Medication administration and adherence.
- Recognition of danger signs.
- Prevention of infection.
- Follow-up appointments and immunization.
- Appropriate stimulation and interaction.
- Importance of maternal emotional well-being.
- When and where to seek medical assistance.

Scoring of knowledge:
A correct answer was scored **1**, whereas an incorrect or "don't know" answer was scored **0**. The total knowledge score was calculated by summing all items.

Knowledge levels were classified as:

- **Poor:** <50% of the total score.
- **Fair:** 50–<75%.
- **Good:** ≥75%.

Part II: Maternal home-care practices

This part assessed mothers' reported practices regarding feeding, hygiene, medication administration, infection prevention, safe sleep, monitoring infant condition, recognizing danger signs, developmental stimulation, responsive interaction, and attendance at scheduled follow-up visits.

Each practice item was scored using a **3-point scale**:

- **2 = Always/adequately practiced**
- **1 = Sometimes/partially practiced**
- **0 = Never/not practiced**

The total practice score was calculated by summing the individual item scores.

Practice levels were classified as:

- **Unsatisfactory:** <60% of the total score.
- **Satisfactory:** ≥60% of the total score.

Tool IV: Maternal–Infant Interaction and Responsive Parenting Observation Checklist

This tool was developed by the researcher based on literature (World Health Organization, UNICEF, & World Bank Group. (2018), concerning responsive caregiving and early mother–infant interaction. It was used to assess the mother's ability to recognize and appropriately respond to her infant's behavioral and emotional cues during NICU hospitalization and after transition to the home environment.

The checklist included domains related to:

- Eye contact and visual attention.
- Appropriate verbal interaction.
- Gentle touch and comforting.
- Recognition of infant cues.
- Appropriate response to crying.
- Holding and positioning the infant appropriately.
- Feeding interaction.
- Skin-to-skin/contact behaviors when appropriate.
- Positive emotional expression toward the infant.
- Appropriate developmental stimulation.
- Allowing adequate rest and avoiding overstimulation.
- Responding appropriately to signs of distress.
- Encouraging infant social responsiveness.

Each item was scored as:

- **2 = Adequately performed**
- **1 = Partially performed**
- **0 = Not performed**

The total score represented the mother's overall responsive caregiving performance.

Scoring:

- **Poor responsive interaction:** <50% of the total score.
- **Moderate responsive interaction:** 50–<75%.
- **Good responsive interaction:** ≥75%.

Tool V: Infant Neurodevelopmental Assessment Scale

This tool was used to assess the developmental status of infants following NICU discharge **(World Health Organization, 2012).** The assessment was based on recognized principles of early childhood developmental surveillance and focused on developmental domains relevant to infants who experienced neonatal hospitalization.

The tool included five major developmental domains:

A. Gross motor development:
Head control, rolling, sitting, reaching, movement symmetry, and age-appropriate postural control.

B. Fine motor and adaptive development:
Grasping objects, transferring objects, hand-to-mouth activity, visual tracking, and age-appropriate manipulation.

C. Language and communication:
Response to sound, vocalization, babbling, recognition of familiar voices, and age-appropriate communication behaviors.

D. Social and emotional development:
Social smile, eye contact, response to caregivers, social engagement, recognition of familiar persons, and emotional responsiveness.

E. Cognitive and sensory development:
Attention to objects, visual tracking, response to environmental stimuli, exploration, and age-appropriate problem-solving behaviors.

Each applicable developmental item was scored:

- **2 = Achieved/appropriate for age**
- **1 = Emerging/partially achieved**
- **0 = Not achieved**

Items were interpreted according to the infant's corrected age when appropriate for preterm infants.

Scoring:
The total score was obtained by summing the scores across applicable developmental items. The percentage of the maximum possible score was then calculated:

The developmental level was categorized as:

- **Normal/appropriate:** ≥75%.
- **Suspected developmental delay:** 50–<75%.
- **At-risk/significant developmental concern:** <50%.

Tool VI: Maternal Satisfaction with the Collaborative NICU-to-Home Nursing Program

This tool was developed by the researcher based on literature **(World Health Organization, 2022)** related to family-centered neonatal care, discharge preparation, continuity of care, and nursing support. It was used to assess mothers' perceptions of the usefulness and acceptability of the collaborative nursing program.

The scale included items addressing:

- Clarity of nursing explanations.
- Adequacy of NICU discharge preparation.
- Helpfulness of home-care education.
- Support in managing infant feeding.
- Guidance regarding infant danger signs.
- Assistance with maternal emotional concerns.
- Helpfulness of home/community follow-up.
- Accessibility of nursing support.
- Improvement in maternal confidence.
- Helpfulness of developmental stimulation guidance.
- Improvement in communication with the infant.
- Overall satisfaction with the program.

Each item was rated on a **5-point Likert scale**:

- **4 = Strongly satisfied**
- **3 = Satisfied**
- **2 = Neutral**
- **1 = Dissatisfied**
- **0 = Strongly dissatisfied**

The total score was calculated by summing all items and converting the result into a percentage of the maximum possible score.

Scoring:

- **Low satisfaction:** <60%.
- **Moderate satisfaction:** 60–<75%.
- **High satisfaction:** ≥75%.

Validity of the Study Tools

The content validity of the researcher-developed tools was assessed by a panel of five experts specialized in Maternal and Newborn Health Nursing, Pediatric Nursing, Community Health Nursing, and Mental Health Nursing. The experts reviewed the tools for relevance, clarity, comprehensiveness, appropriateness of wording, and suitability for mothers of infants discharged from NICUs. Their recommendations were considered, and necessary modifications were made to improve the clarity and applicability of the tools before the final data collection. The Edinburgh Postnatal Depression Scale (EPDS) was used in its established standardized form without altering its core items or scoring system.

Reliability of the Study Tools

The reliability of the researcher-developed tools was assessed to determine their internal consistency and stability. **Cronbach's alpha coefficient** was calculated for the knowledge, home-settlement practices, maternal–infant interaction, infant neurodevelopmental assessment, and maternal satisfaction scales. A Cronbach's alpha coefficient of **≥0.70** was considered acceptable for research purposes.

Pilot Study

A pilot study was conducted on 10 mothers and their infants, representing approximately 10% of the total study sample, before the beginning of the main study. The pilot study aimed to assess the clarity and comprehensibility of the study tools, determine the time required to complete the questionnaires and assessments, evaluate the feasibility of the data collection procedure, and identify any difficulties that might arise during implementation of the collaborative nursing program. The pilot participants were selected according to the same eligibility criteria as the main study. Based on the findings of the pilot study, minor modifications were made to the wording, sequence, and organization of some items to improve clarity and facilitate administration. The pilot participants were excluded from the final study sample to avoid duplication of data and potential influence on the study findings.

Ethical Considerations

The study was conducted after obtaining approval from the Research Ethics Committee (No/ 177-2025) of the responsible academic institution and permission from the authorities of the selected study settings. The purpose, procedures, potential benefits, and nature of participation were explained clearly to each eligible mother before enrollment. Written **informed consent** was obtained from each mother before data collection. Participation

was completely voluntary, and mothers were informed that they had the right to refuse participation or withdraw from the study at any time without affecting the health-care services provided to them or their infants. Confidentiality and privacy were maintained throughout all stages of the study. Each participant was assigned a **code number** rather than having her name recorded on the research data forms. The collected information was used exclusively for research purposes and was stored securely. Interviews and assessments were conducted in a private and appropriate environment whenever possible.

Data Collection Procedure

The study was conducted through a structured collaborative nursing program that started during the infant's NICU admission and continued after discharge during the transition to home care. Initially, eligible mothers were identified. The researcher explained the purpose and procedures of the study to each eligible mother, and written informed consent was obtained before data collection.

At the baseline assessment, the researcher collected the mothers' sociodemographic and clinical characteristics and the infants' clinical and NICU-related characteristics using **Tool I**. Maternal postpartum depressive symptoms were assessed using the **Edinburgh Postnatal Depression Scale (Tool II)**. Maternal knowledge and home-settlement practices were assessed using **Tool III**, while mother–infant interaction and responsive caregiving were evaluated using **Tool IV**. Infant neurodevelopment was assessed using **Tool V**.

Following the baseline assessment, the mothers participated in the collaborative nursing program. The intervention was delivered through structured individual and small-group nursing sessions during NICU hospitalization, supplemented by individualized demonstrations and return demonstrations. The content was adapted according to the infant's clinical condition and the mother's level of understanding.

Before discharge, mothers received individualized preparation for transition to home, including infant feeding, hygiene, medication administration when prescribed, infection prevention, safe sleep, recognition of danger signs, follow-up appointments, and developmental stimulation. Mothers were also trained in responsive interaction and appropriate ways of interpreting and responding to infant cues.

After discharge, continuity of nursing care was maintained through scheduled telephone contacts and home/community follow-up. During these contacts, the researcher reviewed maternal psychological status, infant-care practices, feeding, adherence to recommendations, developmental stimulation, and mother–infant interaction. Problems identified during follow-up were addressed through individualized nursing guidance, and mothers or infants requiring specialized assessment were referred to the appropriate health-care service.

Immediately after completion of the intervention, the relevant study tools were readministered to assess changes in maternal and infant outcomes. A subsequent follow-up assessment was conducted after the post-discharge period to determine the sustainability of the observed changes. Maternal satisfaction with the collaborative nursing program was assessed using **Tool VI** at the end of the intervention.

Phases and Sessions of the Collaborative Nursing Program

The collaborative nursing program was organized into **five sequential phases comprising eight structured sessions**, beginning in the NICU and extending into the home/community setting.

Phase I: Initial Assessment and Rapport Building

Session 1: Baseline Assessment and Orientation

The first session was conducted during the infant's NICU hospitalization. The researcher established rapport with the mother, explained the purpose and importance of the program, obtained informed consent, and completed the baseline assessment.

The session included assessment of maternal sociodemographic and clinical characteristics, infant and NICU characteristics, maternal depressive symptoms, infant-care knowledge and practices, responsive mother–infant interaction, and infant developmental status.

Duration: Approximately **45–60 minutes**.

Phase II: Maternal Psychological Support and NICU Adjustment

Session 2: Understanding NICU Stress and Maternal Emotional Well-being

This session focused on helping mothers understand the emotional reactions that may accompany NICU hospitalization. The researcher discussed common feelings such as fear, sadness, guilt, anxiety, uncertainty, and loss of confidence.

The session emphasized:

- Understanding NICU-related maternal stress.
- Recognizing symptoms of postpartum depression.
- Expressing emotions appropriately.
- Developing positive coping strategies.
- Reducing feelings of guilt and helplessness.
- Seeking family and professional support.
- Recognizing when professional psychological assistance was needed.

The researcher used active listening, supportive communication, reassurance, and individualized counseling.

Duration: Approximately **45 minutes**.

Phase III: Infant-Care Education and Maternal Skill Development

Session 3: Basic Infant Care and Feeding

The researcher provided practical education regarding:

- Breastfeeding and appropriate feeding techniques.
- Feeding frequency and recognizing feeding cues.
- Identifying feeding difficulties.
- Appropriate burping.
- Hygiene and handwashing.
- Safe handling and positioning.
- Medication administration when prescribed.
- Maintaining a clean and safe home environment.

Demonstration and return-demonstration techniques were used to ensure that mothers could perform essential infant-care activities correctly.

Duration: Approximately **60 minutes**.

Session 4: Infection Prevention, Safety, and Recognition of Danger Signs

Mothers were trained to recognize signs requiring prompt medical attention, including:

- Difficulty or rapid breathing.
- Cyanosis or abnormal skin coloration.
- Fever or abnormal temperature.
- Poor feeding or refusal to feed.
- Repeated vomiting.
- Marked lethargy or decreased responsiveness.
- Convulsions.
- Reduced urine output.
- Signs of infection.

The session also covered hand hygiene, limiting unnecessary exposure to infection, safe sleeping practices, appropriate environmental temperature, and adherence to scheduled medical follow-up and immunization.

Duration: Approximately **45–60 minutes**.

Phase IV: Responsive Caregiving and Developmental Stimulation

Session 5: Mother–Infant Interaction and Responsive Caregiving

This session aimed to strengthen maternal responsiveness and promote positive mother–infant interaction. Mothers were taught to observe infant cues and respond appropriately to signs of hunger, discomfort, fatigue, alertness, and the need for social interaction.

The session included:

- Eye contact.
- Gentle touch.
- Talking and singing to the infant.
- Appropriate holding and comforting.
- Responding promptly and appropriately to crying.
- Recognizing signs of overstimulation.
- Encouraging positive emotional interaction.
- Promoting maternal confidence and bonding.

Duration: Approximately **45 minutes**.

Session 6: Infant Developmental Stimulation

The researcher explained the importance of early developmental support and provided age-appropriate stimulation activities targeting:

- Visual tracking.
- Auditory attention.
- Gentle motor stimulation.
- Reaching and grasping.
- Social interaction.
- Vocalization and communication.
- Appropriate play.
- Safe opportunities for exploration.

Mothers were instructed to provide stimulation according to the infant's corrected age, health status, tolerance, and developmental readiness while avoiding overstimulation.

Duration: Approximately **45–60 minutes**.

Phase V: Discharge Preparation, Home Settlement, and Follow-up

Session 7: Preparing for Home Settlement

This session was conducted before NICU discharge and focused on integrating the previously learned knowledge and skills into a practical home-care plan.

The researcher reviewed:

- The infant's individualized home-care requirements.
- Feeding plan.
- Medication schedule when applicable.
- Hygiene and infection prevention.
- Safe sleeping arrangements.
- Danger signs and emergency actions.
- Follow-up appointments.
- Immunization.
- Developmental stimulation.
- Maternal self-care and emotional well-being.
- Available family and community support.

The mother was encouraged to demonstrate important care procedures and explain the appropriate response to selected infant problems to confirm her readiness for discharge.

Duration: Approximately **60 minutes**.

Session 8: Post-Discharge Home/Community Follow-up and Evaluation

After discharge, the researcher maintained contact with the mother through scheduled telephone communication and/or home/community visits. This session focused on reinforcing the previously provided education and identifying difficulties encountered during home settlement.

The researcher reassessed:

- Maternal psychological status.
- Infant feeding and care.
- Home-care practices.
- Recognition of danger signs.
- Maternal–infant interaction.
- Developmental stimulation.
- Attendance at follow-up appointments.
- Maternal confidence in infant care.

Individualized feedback and reinforcement were provided according to the mother's needs. At the end of the intervention, the post-intervention assessment was completed, followed by the planned follow-up assessment to evaluate the sustainability of program effects. Maternal satisfaction with the program was also assessed.

Duration: Approximately **30–45 minutes per follow-up contact**, depending on maternal and infant needs.

Statistical Analysis

The collected data were coded, categorized, tabulated, and statistically analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.0. Data were first reviewed for completeness, consistency, and accuracy before statistical analysis. Descriptive statistics were used to summarize the characteristics of the studied mothers and infants. Frequencies and percentages were used to describe categorical variables, while means and standard deviations were used to summarize quantitative variables.

The total and percentage scores of maternal postpartum depression, infant-care knowledge, home-settlement practices, maternal–infant interaction, infant neurodevelopment, and maternal satisfaction were calculated according to the scoring systems of the respective study tools. For comparison of categorical paired

outcomes between the pre-intervention and post-intervention assessments, the **McNemar test** was used when the data consisted of two related categorical measurements. For comparisons involving three assessment points—pre-intervention, post-intervention, and follow-up—appropriate repeated-measures statistical procedures were used according to the measurement level and distribution of the data.

For quantitative outcomes measured at two related time points, the paired-samples t-test was used when the assumptions of parametric analysis were satisfied. For quantitative outcomes measured at three time points, repeated-measures analysis of variance (RM-ANOVA) was used for normally distributed data. When the assumptions of parametric analysis were not met, appropriate non-parametric alternatives, such as the Wilcoxon signed-rank test or Friedman test, were used. Appropriate correlation tests were used to examine the relationships between maternal postpartum depression, maternal caregiving practices, responsive mother–infant interaction, and infant neurodevelopmental outcomes. Pearson's correlation coefficient was used for normally distributed quantitative variables, whereas Spearman's rank correlation coefficient was used for ordinal or non-normally distributed variables. Where significant overall differences were detected across the three assessment periods, appropriate post-hoc pairwise comparisons were performed to determine the specific assessment periods responsible for the observed differences, with adjustment for multiple comparisons when required. The level of statistical significance was set at $p < 0.05$, while $p < 0.001$ was considered highly statistically significant. A p-value of ≥0.05 was considered statistically non-significant.

Results:

Table (1): Distribution of the Studied Mothers and Their Infants According to Sociodemographic and Clinical Characteristics (N = 100)

Characteristics	No.	%
Maternal age (years)		
<25	28	28.0
25–<35	47	47.0
≥35	25	25.0
Mean ± SD	**31.2 ± 6.4**	
Educational level		
Illiterate/read and write	21	21.0
Basic/secondary education	49	49.0
University education	30	30.0
Occupation		
Housewife	78	78.0
Working	22	22.0
Residence		
Rural village	100	100.0
Family type		
Nuclear	63	63.0
Extended	37	37.0
Parity		
Primipara	39	39.0
Multipara	61	61.0
Mode of delivery		
Cesarean section	58	58.0
Vaginal delivery	42	42.0
Infant sex		
Male	56	56.0
Female	44	44.0
Birth weight		
<1500 g	18	18.0
1500–<2500 g	57	57.0
≥2500 g	25	25.0
Duration of NICU stay		
<7 days	31	31.0
7–<14 days	44	44.0
≥14 days	25	25.0

Table (1) shows that nearly half of the studied mothers (47.0%) were aged 25–<35 years, with a mean age of 31.2 ± 6.4 years. Almost half of the mothers (49.0%) had basic or secondary education, while the majority were housewives (78.0%). Regarding obstetric characteristics, 61.0% of mothers were multiparous and 58.0% delivered by cesarean section. Concerning infant characteristics, slightly more than half of the infants were males (56.0%), while 57.0% had birth weights ranging from 1500 to <2500 g. Regarding NICU hospitalization, 44.0% of infants stayed in the NICU for 7–<14 days.

Table (2): Distribution of the Studied Mothers According to Level of Postpartum

Depressive Symptoms Before, Immediately After, and at Follow-up of the Nursing Program (N = 100)

EPDS Level	Pre-intervention No. (%)	Post-intervention No. (%)	Follow-up No. (%)
Minimal/low symptoms	15 (15.0)	62 (62.0)	59 (59.0)
Borderline symptoms	25 (25.0)	25 (25.0)	27 (27.0)
Probable depression	60 (60.0)	13 (13.0)	14 (14.0)
EPDS total score	12.4 ± 4.1	6.8 ± 3.2	7.1 ± 3.3
Repeated Measures ANOVA	F = 92.64	**P-value**	p < 0.001

Test: Friedman/appropriate repeated categorical analysis = 68.42, p < 0.001**, Repeated Measures ANOVA=(F = 92.64, p < 0.001)

Table (2) demonstrates a marked improvement in maternal postpartum depressive symptoms following implementation of the collaborative nursing program. Before the intervention, 60.0% of mothers had probable depressive symptoms, compared with only 13.0% immediately after the intervention. The proportion with minimal/low depressive symptoms increased from 15.0% before the intervention to 62.0% after the intervention. At follow-up, the proportion with probable depression remained relatively low at 14.0%, while 59.0% of mothers continued to demonstrate minimal/low symptoms. The statistically significant difference (**p < 0.001**).

The table shows also, a significant reduction in postpartum depressive symptoms following the intervention. The mean EPDS score decreased from 12.4 ± 4.1 pre-intervention to 6.8 ± 3.2 immediately post-intervention, with a slight increase to 7.1 ± 3.3 at follow-up. The improvement was largely maintained over time. Repeated Measures ANOVA showed a highly statistically significant difference across the three assessments (F = 92.64, p < 0.001).

Table (3): Distribution of the Studied Mothers According to Their Infant-Care Knowledge Levels Before and After the Nursing Program (N = 100)

Knowledge Level	Pre-intervention No. (%)	Post-intervention No. (%)	Follow-up No. (%)
Poor	52 (52.0)	6 (6.0)	8 (8.0)
Fair	31 (31.0)	17 (17.0)	18 (18.0)
Good	17 (17.0)	77 (77.0)	74 (74.0)
Total	**100 (100.0)**	**100 (100.0)**	**100 (100.0)**

χ^2 = **71.36 -p < 0.001****

p < 0.001 = highly statistically significant

Table (3) indicates a clear improvement in mothers' infant-care knowledge following the collaborative nursing program. Before the intervention, more than half of the mothers (52.0%) had poor knowledge, whereas only 17.0% had good knowledge. After implementation, the proportion with good knowledge increased substantially to 77.0%, while poor knowledge decreased to 6.0%. At follow-up, good knowledge remained high at 74.0%, with only 8.0% of mothers classified as having poor knowledge. The statistically significant difference (**p < 0.001**).

Table (4): Distribution of the Studied Mothers According to Their Home-Settlement and Infant-Care Practices Before and After the Nursing Program (N = 100)

Practice Level	Pre-intervention No. (%)	Post-intervention No. (%)	Follow-up No. (%)
Unsatisfactory	69 (69.0)	9 (9.0)	11 (11.0)
Satisfactory	31 (31.0)	91 (91.0)	89 (89.0)
Total	**100 (100.0)**	**100 (100.0)**	**100 (100.0)**

Test: χ^2 = 62.74, p < 0.001**

p < 0.001 = highly statistically significant

Table (4) shows that the proportion of mothers demonstrating satisfactory infant-care and home-settlement practices increased markedly from 31.0% before the intervention to 91.0% immediately after the intervention. At follow-up, satisfactory practices remained high at 89.0%. Conversely, unsatisfactory practices decreased from 69.0% at baseline to 9.0% after

the intervention and remained relatively low at 11.0% during follow-up. The statistically significant difference (**p < 0.001**).

Table (5): Distribution of the Studied Mothers According to Their Responsive Mother–Infant Interaction Before, After, and at Follow-up (N = 100)

Responsive Interaction	Pre-intervention No. (%)	Post-intervention No. (%)	Follow-up No. (%)
Poor	48 (48.0)	8 (8.0)	10 (10.0)
Moderate	36 (36.0)	20 (20.0)	19 (19.0)
Good	16 (16.0)	72 (72.0)	71 (71.0)
Total	**100 (100.0)**	**100 (100.0)**	**100 (100.0)**

Test: χ^2 = 66.85, p < 0.001**

p < 0.001 = highly statistically significant

Table (5) demonstrates considerable improvement in responsive mother–infant interaction following the intervention. Before the nursing program, 48.0% of mothers demonstrated poor responsive interaction and only 16.0% demonstrated good interaction. Following the intervention, good responsive interaction increased to 72.0%, whereas poor interaction decreased to 8.0%. At follow-up, 71.0% of mothers continued to demonstrate good interaction. The statistically significant difference (**p < 0.001**) was observed.

Table (6): Distribution of Infants According to Overall Neurodevelopmental Level Before, After, and at Follow-up (N = 100)

Neurodevelopmental Level	Pre-intervention No. (%)	Post-intervention No. (%)	Follow-up No. (%)
At risk/significant concern	43 (43.0)	12 (12.0)	14 (14.0)
Suspected developmental delay	34 (34.0)	21 (21.0)	20 (20.0)
Appropriate/normal	23 (23.0)	67 (67.0)	66 (66.0)
Total	**100 (100.0)**	**100 (100.0)**	**100 (100.0)**

Test: χ^2 = 58.91, p < 0.001**

p < 0.001 = highly statistically significant

Table (6) reveals improvement in the overall neurodevelopmental status of the infants following implementation of the collaborative nursing program. At baseline, 43.0% of infants were classified as having developmental risk or significant concern, while only 23.0% demonstrated development appropriate for age. Following the intervention, the proportion with appropriate neurodevelopment increased to 67.0%, whereas the proportion classified as at risk decreased to 12.0%. At follow-up, 66.0% continued to demonstrate development appropriate for age. The statistically significant difference (**p < 0.001**).

Table (7): Mean Scores of Infants Across Different Neurodevelopmental Domains Before, After, and at Follow-up (N = 100)

Developmental Domain	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	Follow-up Mean ± SD	F	p-value
Gross motor	61.4 ± 11.2	76.8 ± 9.4	75.9 ± 9.7	48.62	<0.001**
Fine motor/adaptive	59.8 ± 12.1	75.1 ± 10.2	74.3 ± 10.5	43.75	<0.001**
Language/communication	56.7 ± 13.4	73.5 ± 10.8	72.4 ± 11.1	39.84	<0.001**
Social-emotional	60.2 ± 12.6	78.4 ± 9.3	77.2 ± 9.8	55.37	<0.001**
Cognitive/sensory	58.9 ± 12.0	75.6 ± 9.7	74.8 ± 10.1	47.16	<0.001**
Overall neurodevelopment	**59.4 ± 10.8**	**75.9 ± 8.6**	**74.9 ± 9.0**	**61.28**	**<0.001****

p < 0.001 = highly statistically significant

Table (7) shows significant improvements across all assessed developmental domains. The mean overall neurodevelopmental score increased from 59.4 ± 10.8 before the intervention to 75.9 ± 8.6 immediately after the program and remained relatively high at 74.9 ± 9.0 during follow-up. The largest improvement was observed in the social-emotional domain, which increased from 60.2 ± 12.6 to 78.4 ± 9.3. All domains demonstrated statistically significant changes (**p < 0.001**).

Table (8): Distribution of Mothers According to Their Satisfaction with the Collaborative NICU-to-Home Nursing Program (N = 100)

Satisfaction Level	No.	%
Low	3	3.0
Moderate	10	10.0
High	87	87.0
Total	**100**	**100.0**

Table (8) demonstrates a high level of maternal satisfaction with the collaborative NICU-to-home nursing program. The majority of mothers (87.0%) reported a high level of satisfaction, while 10.0% reported moderate satisfaction and only 3.0% reported low satisfaction.

Table (9): Correlation between Maternal Postpartum Depression, Infant-Care Practices, Responsive Interaction, and Infant Neurodevelopment at Follow-up (N = 100)

Variables	Infant-care practices	Responsive interaction	Infant neurodevelopment
Maternal postpartum depression	**r = −0.46, p <0.001**	**r = −0.51, p <0.001**	**r = −0.38, p <0.001**
Infant-care practices	—	**r = 0.62, p <0.001**	**r = 0.47, p <0.001**
Responsive interaction	—	—	**r = 0.55, p <0.001**

Table (9) demonstrates statistically significant relationships among the major study outcomes at follow-up. Maternal postpartum depressive symptoms showed a significant negative correlation with infant-care practices, responsive mother–infant interaction, and infant neurodevelopment. In contrast, infant-care practices demonstrated significant positive correlations with responsive interaction and infant neurodevelopment. Responsive mother–infant interaction was also positively correlated with infant neurodevelopment (**p < 0.001**).

Note: *p < 0.05 = statistically significant; **p < 0.001 = highly statistically significant.*

Discussion

The present study was conducted to evaluate the effect of a collaborative nursing program extending from NICU care to home settlement on maternal postpartum depression and infant neurodevelopment among mothers and their infants in rural communities. The findings highlighted the importance of providing continuous, family-centered nursing support during the transition from neonatal intensive care to home care. Mothers of infants admitted to the NICU may experience considerable psychological distress because of concerns about their infant's health, separation from the infant, uncertainty regarding prognosis, and the increased demands of post-discharge care. Therefore, structured nursing interventions that combine psychological support, education, discharge preparation, and post-discharge follow-up may contribute to improving maternal adaptation and caregiving confidence **(Hodgson et al., 2025).**

The findings of the present study also supported the importance of integrating maternal psychological care with interventions aimed at infant care and early developmental support. Maternal postpartum depressive symptoms may negatively affect maternal responsiveness, caregiving practices, mother–infant interaction, and the provision of appropriate developmental stimulation. In contrast, supportive nursing programs that address maternal emotional needs while strengthening knowledge, caregiving skills, responsive interaction, and recognition of infant developmental needs may facilitate a more positive transition from NICU hospitalization to home settlement. This integrated approach is consistent with the nurturing-care framework, which emphasizes responsive caregiving, early learning, safety,

adequate nutrition, and caregiver well-being as interconnected components of healthy early childhood development (WHO, UNICEF, & World Bank Group, 2018). Recent evidence has also indicated that supportive nursing interventions can reduce psychological distress among mothers of neonates admitted to NICUs, further supporting the value of continuity-based nursing care across hospitalization and the post-discharge period **(Zhang & Dong, 2026).**

The findings of the present study revealed that the majority of the studied mothers were aged 25–<35 years, were housewives, and had a moderate educational level. More than half of the infants were delivered by cesarean section, and most infants had birth weights ranging from 1500 to <2500 g, while a considerable proportion remained in the NICU for 7–<14 days. These characteristics may reflect the clinical and social circumstances commonly associated with neonatal intensive care admission and the increased caregiving demands experienced by mothers after discharge. The findings were consistent with **Abebe et al., (2025)** emphasized that mothers of preterm and low-birth-weight infants frequently require additional education, emotional support, and preparation for continued care following hospital discharge. However, differences in maternal age, educational level, delivery mode, and infant birth weight reported across studies may be explained by variations in healthcare settings, inclusion criteria, socioeconomic characteristics, and the clinical profile of NICU populations.

The present study demonstrated a marked reduction in maternal depressive symptoms following implementation of the collaborative nursing program. This statistically significant improvement indicates that integrating psychological support with education, discharge preparation, and continuous post-discharge nursing follow-up may have contributed to improving maternal emotional well-being. These findings were consistent with **Cîmpian et al. (2025)**, whose meta-analysis demonstrated that supportive nursing interventions could reduce depression and anxiety among mothers of neonates admitted to NICUs. Similarly, the study by **Stein et al., (2026)** emphasized the importance of integrating maternal mental-health support into maternal and newborn services. In contrast, some studies have reported persistent depressive symptoms after NICU discharge, particularly when mothers have limited social support, prolonged infant hospitalization, or ongoing concerns regarding infant health. Such differences may be related to variation in intervention duration, family support, severity of infant illness, and availability of community-based follow-up services.

The present study showed a substantial improvement in maternal knowledge concerning infant care. Before implementation of the program, more than half of the mothers had poor knowledge, whereas after the intervention the majority demonstrated good knowledge. This improvement may be attributed to the structured educational content, repeated demonstrations, individualized explanations, and reinforcement during discharge preparation and post-discharge follow-up. The findings were in agreement with **Gomaa et al., (2026)** emphasizing parental education regarding feeding, warmth, hygiene, infection prevention, recognition of danger signs, and appropriate follow-up for preterm and low-birth-weight infants. The findings were also consistent with the nurturing-care framework by **Soysal Cimen et al., (2022)** recognizes caregiver knowledge and capacity as essential components of effective responsive care. Conversely, differences reported in other studies may be related to variations in mothers' educational levels, previous experience with infant care, cultural practices, and the intensity of educational interventions.

The findings demonstrated a significant improvement in mothers' home-settlement and infant-care practices. The proportion of mothers with satisfactory practices increased after the intervention and remained high at follow-up. This improvement may be related to the program's emphasis on practical training rather than information alone, including feeding, hygiene, medication administration, safe sleep, monitoring of infant condition, recognition of danger signs, developmental stimulation, and appropriate healthcare seeking. These findings were consistent with **Alobaysi & Jahan, (2022)** emphasize caregiver preparation before discharge and continued support after discharge for vulnerable newborns . They also correspond with **Buccini, (2026)** stated regarding the principles of nurturing care and emphasize caregivers' ability to provide responsive, safe, and developmentally supportive environments for infants. However, differences from studies reporting lower post-discharge adherence may be explained by differences in follow-up intensity, availability of family support,

maternal literacy, and access to healthcare services in rural communities.

The present study revealed significant improvement in maternal–infant interaction and responsive parenting following the intervention. The proportion of mothers demonstrating good interaction increased after implementation, with a similar level maintained during follow-up. This finding suggests that repeated nursing guidance regarding eye contact, verbal interaction, appropriate touch, recognition of infant cues, comforting, responsive feeding, and developmentally appropriate stimulation may have strengthened mothers' ability to respond sensitively to their infants.

The findings were consistent with the **WHO, UNICEF, and World Bank Group (2018)**, which identified responsive caregiving as a central component of nurturing care and emphasized the importance of caregiver responsiveness to children's signals. They were also consistent with WHO guidance on early childhood development, which recommends opportunities for responsive interaction and early learning from the earliest stages of life **(WHO, 2020).** In contrast, some mothers may continue to experience difficulties with responsive interaction because of persistent psychological distress, infant medical problems, fatigue, or limited family support, which may explain differences between studies.

The present study demonstrated significant improvement in infant neurodevelopmental outcomes across gross motor, fine motor/adaptive, language and communication, social-emotional, and cognitive/sensory domains. The overall neurodevelopmental score increased after the program and remained relatively stable during follow-up. The improvement may be associated with the program's emphasis on responsive caregiving, developmental stimulation, appropriate interaction, feeding support, and early recognition of developmental concerns. These findings were consistent with **Liu et al., (2025)** that emphasize early identification of developmental difficulties and provision of appropriate supportive interventions during early childhood. They were also consistent with the nurturing-care framework, by **Popplestone et al., (2026)** recognizes responsive caregiving and opportunities for early learning as important determinants of healthy child development. Nevertheless, some studies may report less pronounced developmental improvement because neurodevelopment is influenced by multiple biological and environmental factors, including gestational age, birth weight, neonatal complications, duration of hospitalization, and the infant's underlying medical condition.

The present study showed that the majority of mothers reported high satisfaction with the collaborative NICU-to-home nursing program. This high level of satisfaction may be explained by the continuity of care, clear discharge instructions, emotional support, accessibility of nurses, home/community follow-up, and practical guidance regarding infant care and developmental stimulation. The findings were consistent with **Hagen et al., (2019)** supporting family involvement, effective communication, parental education, and continuity of care during the transition from hospital to home **(WHO, 2022).** High satisfaction may also indicate that mothers perceived the program as responsive to their practical and emotional needs during a particularly stressful period. However, satisfaction may vary between studies according to healthcare accessibility, communication quality, cultural expectations, staffing resources, and the degree to which mothers are involved in decision-making.

The present study identified significant relationships between maternal depressive symptoms and caregiving outcomes at follow-up. Maternal depression was negatively correlated with infant-care practices, maternal–infant interaction, and infant neurodevelopment, whereas infant-care practices were positively correlated with responsive interaction and neurodevelopment. These findings suggest that maternal emotional well-being, caregiving behavior, and infant developmental experiences may be interconnected. The results were consistent with **Tecik & Çınar, (2026)** considers caregiver well-being and responsive caregiving as interconnected elements that influence children's development. They also support the **WHO (2020)** emphasis on integrated interventions that address caregiver mental health together with responsive care and early learning. However, these correlations should be interpreted as associations rather than proof of causality, because infant clinical characteristics, family support, socioeconomic factors, and other environmental conditions may also influence both maternal psychological status and infant developmental outcomes.

Overall, the findings of the present study indicated that a collaborative nursing program extending from NICU hospitalization to home settlement was associated with improvements in maternal psychological well-being, infant-care knowledge, caregiving practices, responsive mother–infant interaction, and infant neurodevelopment, with most improvements maintained at follow-up. The findings support the concept that NICU care should not end at hospital discharge but should be connected with structured family education, psychological support, developmental guidance, and community-based follow-up. This integrated approach is consistent with WHO recommendations for continuity of maternal and newborn care and with the nurturing-care framework, which emphasizes the combined importance of caregiver well-being, responsive caregiving, health, nutrition, safety, and early learning **(WHO, 2022; WHO, UNICEF, & World Bank Group, 2018).** Nevertheless, because the study used a one-group quasi-experimental design, the observed improvements should be interpreted cautiously, as changes over time cannot be attributed exclusively to the intervention without a comparison group.

Conclusion

Based on the findings of the present study, the study concluded that the collaborative nursing program extending from NICU care to home settlement was associated with significant improvement in maternal psychological well-being, infant-care knowledge and practices, responsive mother–infant interaction, and infant neurodevelopment. Most improvements were maintained at follow-up, and the majority of mothers reported high satisfaction with the program. These findings support the importance of continuity of nursing care from NICU hospitalization through home and community follow-up, particularly in rural communities.

Recommendations

Based on the findings of the present study, the following recommendations are suggested:

- Implementing collaborative NICU-to-home nursing programs for mothers and infants.
- Routinely screen mothers for postpartum depressive symptoms before and after discharge.
- Providing structured education on infant feeding, hygiene, safety, danger signs, and home care.
- Integrating responsive parenting and developmental stimulation into discharge education.
- Strengthening home, telephone, or community-based nursing follow-up after NICU discharge.
- Training nurses in maternal mental-health support, developmental surveillance, and family-centered care.
- Establishing referral pathways for mothers or infants requiring specialized psychological, pediatric, or developmental services.
- Conducting larger controlled studies with longer follow-up to confirm the effectiveness and sustainability of the program.

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