# NEONATAL THERAPY SCIENCE: THE YEAR IN REVIEW 2019

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**BACKGROUND:** Previously published data have demonstrated that preterm infants experience a fall across marked centile lines for weight in early life with early poor head growth also reported. This study describes a single neonatal unit’s experience of longitudinal change in weight, head circumference (HC) and length in a cohort of preterm infants born <32 weeks’ gestation.

**METHODS:** Data were collected from a single neonatal unit between July 2012 and June 2017. This period followed the introduction of improved nutritional guidelines. Patients were grouped according to their gestational age at birth. Growth lines were constructed for weight, HC and length in each gestational age group from the median measures and compared with reference centile lines.

**RESULTS:** Data were analysed from 396 patients consisting of 2808, 1991 and 2004 measures for weight, HC and length, respectively. Longitudinal growth plots did not show an initial absolute weight loss in any of the subgroups. Across all groups, the mean change in SD score between birth and 36 weeks was 

\[ -0.27 \ (95\% \ CI \ -0.39 \ to \ -0.15) \]

**CONCLUSIONS:** This description of longitudinal growth in a cohort of preterm infants demonstrates that early postnatal growth failure is not inevitable, with most infants growing along a trajectory close to their birth centile. There is no evidence of a 2 marked centile line weight decrease or weight loss. These data provide evidence to suggest that extrauterine weight gain tracking centile lines can be achieved.


**BACKGROUND:** Infants born prematurely can display impairments that negatively impact the early years of their development. Compared to their peers born at term, preterm children have higher risks of cerebral palsy, sensory deficits, learning disabilities, cognitive and language deficits, as well as difficulties related to attention and behaviour. Following discharge, parents of preterm children are often supported through neonatal follow-up programs or by community health care practitioners. Through assessment and consultation, professionals foster parental resilience by teaching them about their child’s development. Research shows a large volume of literature on improving outcomes for preterm infants, but less attention has been given to the impact and potential importance of education of parents regarding the care they provide from the home.

**OBJECTIVE:** A scoping review was completed to determine the best practices for early intervention in premature children regarding the development of language skills during the preschool years.

**METHODS:** The review followed the guidelines for the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA).

**RESULTS:** Four general themes emerged from the review and included the importance of providing (1) parental training in the care of an infant born prematurely during neonatal intensive care unit stay; (2) education on the development of language and the importance of parental responsiveness; (3) provision of activities to support child language learning; and (4) overall and ongoing monitoring and support by qualified health professionals.

**CONCLUSIONS:** The conclusions drawn will provide guidance to health care professionals regarding the education of parents on best practices for stimulating language development in their child.


**IMPORTANCE:** Studies of socioeconomic status and neurodevelopmental outcome in very preterm neonates have not sensitively accounted for brain injury.

**OBJECTIVE:** To determine the association of brain injury and maternal education with motor and cognitive outcomes at age 4.5 years in very preterm neonates.

**DESIGN, SETTING, AND PARTICIPANTS:** Prospective cohort study of preterm neonates (24-32 weeks’ gestation) recruited August 16, 2006, to September 9, 2013, at British Columbia Women’s Hospital in Vancouver, Canada. Analysis of 4.5-year outcome was performed in 2018.
MAIN OUTCOMES AND MEASURES: At age 4.5 years, full-scale IQ assessed using the Wechsler Primary and Preschool Scale of Intelligence, Fourth Edition, and motor outcome by the percentile score on the Movement Assessment Battery for Children, Second Edition.

RESULTS: Of 226 survivors, neurodevelopmental outcome was assessed in 170 (80 [47.1%] female). Based on the best model to assess full-scale IQ accounting for gestational age, standardized β coefficients demonstrated the effect size of maternal education (standardized β = 0.21) was similar to that of white matter injury volume (standardized β = 0.23) and intraventricular hemorrhage (standardized β = 0.23). The observed and predicted cognitive scores in preterm children born to mothers with postgraduate education did not differ in those with and without brain injury. The best-performing model to assess for motor outcome accounting for gestational age included being small for gestational age, severe intraventricular hemorrhage, white matter injury volume, and chronic lung disease.

CONCLUSIONS AND RELEVANCE: At preschool age, cognitive outcome was comparably associated with maternal education and neonatal brain injury. The association of brain injury with poorer cognition was attenuated in children born to mothers of higher education level, suggesting opportunities to promote optimal outcomes.


OBJECTIVE: To characterize gaps and factors related to receipt of care within a medical home for toddler born preterm.

STUDY DESIGN: Participants were 202 caregivers of children born at <35 weeks of gestation. At 10-16 months of corrected age, caregivers completed the National Survey of Children's Health (2011/2012) medical home module and a sociodemographic profile. Care within a medical home comprised having a personal doctor/nurse, a usual place for care, effective care coordination, family-centered care, and getting referrals when needed. Gestational age and neonatal follow-up clinic attendance were abstracted from the medical record. The Bayley Scales of Infant and Toddler Development, Third Edition assessed developmental status. Log-binomial regression examined factors related to receiving care within a medical home.

RESULTS: Fifty-three percent (n = 107) of the children received care within a medical home. Low socioeconomic status (young caregiver: risk ratio [RR] = 0.73; 95% CI 0.55, 0.97; low education: RR= 0.69; 95% CI 0.49, 0.98) and delayed language (RR = 0.63; 95% CI 0.42, 0.95) were associated with a lower likelihood of receiving care within a medical home. Degree of prematurity and neonatal clinic follow-up participation were unrelated to receipt of care within a medical home.

CONCLUSIONS: Receipt of care within a medical home was lacking for nearly one-half of preterm toddlers, especially those with lower socioeconomic status and poorer developmental status. Discharge from a neonatal intensive care unit may be an optimal time to facilitate access to a primary care medical home and establish continuity of care.


IMPORTANCE: Birth weight (BW) is an important predictor of mortality and morbidity. At extremely early gestational ages (GAs), BW may influence decisions regarding initiation of resuscitation.

OBJECTIVE: To characterize outcomes of liveborn infants with a BW less than 400 g.

DESIGN, SETTING, AND PARTICIPANTS: This retrospective multicenter cohort study analyzed extremely preterm infants born between January 2008 and December 2016 within the National Institute of Child Health and Human Development Neonatal Research Network. Infants with a BW less than 400 g and a GA of 22 to 26 weeks were included. Active treatment was defined as the provision of any potentially lifesaving intervention after birth. Survival was analyzed for the entire cohort; neurodevelopmental impairment (NDI) was examined for those born between January 2008 and December 2015 (birth years with outcomes available for analysis). Neurodevelopmental impairment at 18 to 26 months' corrected age (CA) was defined as a Bayley Scales of Infant and Toddler Development, Third Edition, cognitive composite score less than 85, a motor composite score less than 85, moderate or severe cerebral palsy, gross motor function classification system score of 2 or greater, bilateral blindness, and/or hearing impairment. Data were analyzed from September 2017 to October 2018.

EXPOSURES: Birth weight less than 400 g.

MAIN OUTCOMES AND MEASURES: The primary outcome was survival to discharge among infants who received active treatment. Analysis of follow-up data was limited to infants born from 2008 to 2015 to ensure
children had reached assessment age. Within this cohort, neurodevelopmental outcomes were assessed for infants who survived to 18 to 26 months’ CA and returned for a comprehensive visit.

RESULTS: Of the 205 included infants, 121 (59.0%) were female, 133 (64.9%) were singletons, and 178 (86.8%) were small for gestational age. Almost half (101 of 205 [49.3%]) received active treatment at birth. A total of 26 of 205 infants (12.7%; 95% CI, 8.5-18.9) overall survived to discharge, and 26 of 101 actively treated infants (25.7%; 95% CI, 17.6-35.4) survived to discharge. Within the subset of infants with a BW less than 400 g and a GA of 22 to 23 weeks, 6 of 36 actively treated infants (17%; 95% CI, 6-33) survived to discharge. Among infants born between 2008 and 2015, 23 of 90 actively treated infants (26%; 95% CI, 17-36) survived to discharge. Two infants died after discharge, and 2 were lost to follow-up. Thus, 19 of 90 actively treated infants (21%; 95% CI, 13-31) were evaluated at 18 to 26 months’ CA. Moderate or severe NDI occurred in 14 of 19 infants (74%).

CONCLUSIONS AND RELEVANCE: Infants born with a BW less than 400 g are at high risk of mortality and significant morbidity. Although 21% of infants survived to 18 to 26 months’ CA with active treatment, NDI was common among survivors.


OBJECTIVE: The present study aimed to examine the predictor effects of neonatal, sociodemographic characteristics, and temperament assessed at 18-36 months of age on behavioral problems in 4- to 5-year-old children born preterm. METHODS: The sample comprised 70 children born preterm. The amount and the intensity of stress procedures during a stay in the neonatal intensive care unit were evaluated using the Neonatal Infant Stressor Scale. Temperament was assessed using the Early Childhood Behavior Questionnaire, and behavioral problems were assessed using the Child Behavior Checklist 11/2-5. Multiple linear regression analysis was performed.

RESULTS: Total behavioral problems were predicted by a child temperament of more negative affectivity and less effortful control, moderated by gestational age. Internalizing behavioral problems was predicted by more negative affectivity and less effortful control moderated by male sex and associated with lower gestational age. Externalizing behavior problems was predicted by less effortful control.

CONCLUSIONS: The main findings of the present study showed that the high immaturity at the birth of preterm infants, associated with temperament traits of more negative affectivity and less effortful control, increase the risk for future behavioral problems.


BACKGROUND: Owing to advances in the critical care of premature infants with bronchopulmonary dysplasia (BPD), BPD-associated pulmonary hypertension (PH) is becoming a growing concern. However, only few investigations were available on neurodevelopmental outcomes in preterm infants with PH. Therefore, this study aimed to identify the impact of PH on growth and neurodevelopment at 18-24 months of corrected age (CA).

METHODS: We retrospectively analyzed the medical records of 394 infants (aged < 28 weeks of gestation) admitted to the neonatal intensive care unit between 2005 and 2014. Among the surviving infants, 123 returned for follow-up evaluations including the Bayley Scales of Infant and Toddler Development, third Edition (Bayley-III) screening tests and growth assessment at 18-24 months of CA. Among the 81 infants with moderate or severe BPD, 20 met the criteria for PH. Baseline characteristics and outcomes were compared in infants who developed BPD-associated PH (PH group, n = 20) and moderate or severe BPD infants who did not develop PH (non-PH group, n = 61).

RESULTS: Compared to the non-PH group, the PH group showed significantly lower cognitive (85 vs. 95, p = 0.004), language (81 vs. 89, p = 0.040), and motor (88 vs. 94, p = 0.010) scores of the Bayley-III at 18-24 months of CA. Cognitive delay was found in 45.0% (9/20) of PH infants. In addition, z-scores of weight (1.4 ± 1.3 vs. -0.6 ± 1.1%, p = 0.011) and HC (1.2 ± 1.8 vs. 0.53 ± 1.0%, p = 0.035) were significantly lower in the BPD with PH group. With the subgroup analysis in infants with severe BPD only, the cognitive score was consistently lower and poorer and weight gain after discharge was identified in infants with PH and severe BPD.

CONCLUSION: PH was a worsening factor of non-optimal growth and poor neurodevelopmental outcome in preterm infants with BPD at 18-24 months of CA. Our findings suggest the importance of close developmental follow-up and recognition of that risk to help optimize the outcome of preterm infants with PH.

The primary aim of this viewpoint article is to examine recent literature on fetal and neonatal processing of music. In particular, we examine the behavioral, neurophysiological, and neuroimaging literature describing fetal and neonatal music perception and processing to the first days of term equivalent life. Secondly, in light of the recent systematic reviews published on this topic, we discuss the impact of music interventions on the potential neuroplasticity pathways through which the early exposure to music, live or recorded, may impact the fetal, preterm, and full-term infant brain. We conclude with recommendations for music stimuli selection and its role within the framework of early socioemotional development and environmental enrichment.


**OBJECTIVE:** To determine the efficacy of a hospital-based intervention that transitions into existing community support, in enhancing developmental outcomes at 2 years of corrected age in infants born at less than 32 weeks.

**STUDY DESIGN:** In total, 323 families of 384 infants born <32 weeks were randomized to receive intervention or care-as-usual. The intervention teaches parents coping skills, partner support, and effective parenting strategies over 4 hospital-based and 4 home-phone sessions. At 2 years of corrected age, maternally reported child behavior was assessed by the Infant and Toddler Social Emotional Adjustment Scale. Observed child behavior was coded with the Revised Family Observation Schedule. Cognitive, language, and motor skills were assessed with the Bayley Scales of Infant and Toddler Development III.

**RESULTS:** Mean gestational age of infants was 28.5 weeks (SD = 2.1), and mothers' mean age was 30.6 years (SD = 5.8). A total of 162 families (n = 196 infants) were allocated to intervention and 161 families (n = 188 infants) received care-as-usual. There was no significant adjusted difference between treatment groups on dysregulation (0.2; 95% CI -2.5 to 3.0, P = .9) externalizing (0.3; 95% CI -1.6 to 2.2, P = .8), internalizing (-1.5; 95% CI -4.3 to 1.3, P = .3), observed aversive (0.00; -0.04 to 0.04, P = .9), or nonaversive behavior (-0.01; 95% CI -0.05 to 0.03, P = .7). Intervention children scored significantly higher on cognition (3.5; 95% CI 0.2-6.8, P = .04) and motor skill (5.5; 95% CI 2.5-8.4, P < .001), and approached significance on language (3.8; 95% CI -0.3 to 7.9, P = .07).

**CONCLUSIONS:** Baby Triple P for Preterm Infants increases cognitive and motor skills but does not impact behavior. The results are evidence that hospital-based interventions can improve some developmental outcomes for infants <32 weeks.


**BACKGROUND:** Prematurity may be a risk factor for sensory processing difficulties. Limited research has investigated sensory processing in preterm infants in their first year of life, when sensory processing dysfunctions are more subtle and difficult to detect.

**AIMS:** The aims of this study were to investigate the association between prematurity and sensory processing and the associations between sensory processing and motor and cognitive development in infants at 12 months of age.

**STUDY DESIGN:** Cross-sectional study.

**SUBJECTS:** 45 infants allocated in two groups: control (37–41 weeks’ gestation) and preterm (<34 weeks’ gestation).

**OUTCOME MEASURES:** Sensory processing was assessed with the Test of Sensory Functions in Infants (TSFI). Motor and cognitive development was assessed with the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III).

**RESULTS:** Preterm group was associated with significant decrease in TSFI’s total (p < 0.01), reactivity to deep tactile pressure (p = 0.02) and vestibular stimulation reactivity (p = 0.03) scores. Bayley-III motor score was positive associated with TSFI score on oculomotor control domain (p = 0.03). Bayley-III cognitive score and TSFI scores were not significantly associated.

**CONCLUSIONS:** Prematurity negatively interferes with sensory processing, especially in tactile and vestibular domains, and better sensory processing in oculomotor control contributes to better motor performance at
12 months of age. It is important to consider sensory processing in early developmental evaluation and interventions to promote better developmental outcomes in preterm infants.


AIMS AND OBJECTIVES: To examine the changes in neuropsychomotor development and investigate the effect of feeding progression in Neonatal Intensive Care Unit (NICU) on neuropsychomotor outcomes in low-birthweight preterm infants within 9 months of corrected age.

BACKGROUND: Low-birthweight (LBW) preterm infants (<37 weeks of gestation and birthweight <2,500 g) are at a high risk for neuropsychomotor development delay. Therefore, exploring NICU practices related to neuropsychomotor development is important.

DESIGN: This is a retrospective hospital-based cohort study.

METHODS: This study included 196 LBW preterm infants who were admitted to the NICU between January 2014-March 2016 and attended the follow-up growth evaluation in the clinic after discharge. The neuropsychomotor development of preterm infants was assessed every 3 months to a corrected age of 9 months using the paediatric neuropsychomotor diagnostic scale (PNDS). Generalised linear mixed models (GLMM) were performed.

RESULTS: The total PNDS scores had a downward trend, but the difference on pairwise comparison was not statistically significant. In total, 18.1%, 15.2% and 9.7% of preterm infants were examined for neuropsychomotor disorders at 3, 6 and 9 months of corrected age, respectively. The result of GLMM showed that the early initiation of oral feeding with breast milk was associated with optimal neuropsychomotor development. The first 3 months of corrected age is the critical period for neurodevelopmental disorders.

CONCLUSIONS: This study showed the importance of the early initiation of oral feeding with breast milk as early as possible within the NICU setting and highlighted the importance of close developmental follow-up.

RELEVANCE TO CLINICAL PRACTICE: The early initiation of oral feeding with breast milk may be recommended to promote neuropsychomotor development of LBW preterm infants within the NICU setting. Early identification of neuropsychomotor developmental delays within the first 3 months may guide early interventions.


OBJECTIVE: To verify the short-term influence of the kangaroo position (KP) on the electromyography activity of preterm newborns.

METHOD: A clinical study was conducted in a kangaroo unit sector (secondary and tertiary care) in the city of Recife, Brazil, with 44 preterm infants randomized to intervention (n = 21) and control (n = 23) groups. The KP was performed through a band that supports the newborn against the adult’s thorax, in a prone and vertical position, and infants were dressed with few pieces of clothes, thus keeping skin-to-skin contact with the mother. Surface electromyography was used to investigate the muscle activity of the biceps brachii and hamstrings. The randomization of the groups was performed by the program R® (v. 3.3.1). The electromyography registrations were made at three different times: before the KP and after one and two hours of KP. In the control group, the registrations were performed at the times corresponding to those of the intervention group. The mean values of the electromyography activity among the times were analyzed by ANOVA for repeated measures and the Kruskal–Wallis test. The clinical trial was recorded in ClinicalTrials.gov (NCT02849665 - 07/28/2016).

RESULTS: In the intervention group (n = 21), there was a variation of the electromyography activity values between the three recording moments for both the biceps brachii and hamstrings. In the control group (n = 23), there was no statistical difference between the recording moments for both.

CONCLUSIONS: The KP increases the short-term electromyographic activity of the biceps brachii and hamstrings.

OBJECTIVE(S): Investigate associations between 18 and 22-month corrected age hand function, adverse findings on serial cranial ultrasound (CUS) and near-term brain MRI (ntMRI), and Bayley-III scores in extremely preterm (EPT) toddlers.

STUDY DESIGN: Cohort analysis of Neonatal Research Network SUPPORT NEURO data. Associations between brain abnormalities, hand function, and Bayley-III scores were examined using chi-square and generalized linear mixed effect model analyses.

RESULTS: A total of 433 children were included. Sixteen percent had hand function deficits; these were associated with late CUS (p < 0.001) abnormalities, white matter abnormality (WMA) on ntMRI (p < 0.001), and Bayley-III scores. Six percent had CP. Fourteen percent of children without and 50% of those with CP had hand function abnormalities.

CONCLUSIONS: Late CUS findings and severity of WMA were significantly associated with hand function deficits. Hand function deficits were nearly three times more common than CP and may be a useful marker of early brain insult and predictor of preterm birth effects on development.


OBJECTIVE: To compare cognitive, motor, behavioral, and functional outcomes of adolescents born with a congenital heart defect (CHD) and adolescents born preterm.

STUDY DESIGN: Adolescents (11-19 years old) born with a CHD requiring open-heart surgery during infancy (n = 80) or born preterm ≤29 weeks of gestational age (n = 128) between 1991 and 1999 underwent a cross-sectional evaluation of cognitive (Leiter International Performance Scale-Revised), motor (Movement Assessment Battery for Children-II), behavioral (Strengths and Difficulties Questionnaire), and functional (Vineland Adaptive Behavior Scale-II) outcomes. Independent samples t tests and Pearson χ2 or Fisher exact tests were used to compare mean scores and proportions of impairment, respectively, between groups.

RESULTS: Adolescents born with a CHD and adolescents born preterm had similar cognitive, motor, behavioral, and functional outcomes. Cognitive deficits were detected in 14.3% of adolescents born with a CHD and 11.8% of adolescents born preterm. Motor difficulties were detected in 43.5% of adolescents born with a CHD and 50% of adolescents born preterm. Behavioral problems were found in 23.7% of adolescents in the CHD group and 22.9% in the preterm group. Functional limitations were detected in 12% of adolescents born with a CHD and 7.3% of adolescents born preterm.

CONCLUSIONS: Adolescents born with a CHD or born preterm have similar profiles of developmental deficits. These findings highlight the importance of providing long-term surveillance to both populations and guide the provision of appropriate educational and rehabilitation services to better ameliorate long-term developmental difficulties.


OBJECTIVE: To investigate development and predictors of mental health problems from five to eleven years of age in children born extremely preterm (EP).

METHOD: In a national Norwegian cohort of children born before a gestational age of 28 weeks or with a birthweight <1000 g mental health was assessed by parents at five and eleven years of age using The Strengths and Difficulties Questionnaire. A Total Difficulties Score ≥ 90th percentile (TDS90) for a reference group was used as a measure of a mental health problem. Of 338 eligible EP children, 162 (48%) attended at both ages.

RESULTS: The rate of TDS90 was 52 (32%) at five and 37 (23%) at eleven years of age (p = 0.025). Of the 52 children with TDS90 at five years, 25 had TDS90 at eleven years of age, and of 37 children with TDS90 at eleven, 25 had TDS90 at five years of age. Mental health problems and an IQ of 70–84 at five years were independent predictors of TDS90 at eleven years of age.

CONCLUSION: The rate of mental health problems decreased from five to eleven years, but individual stability was moderate. Mental health problems and intellectual function in the lower normal range at preschool age were independent predictors of later mental health problems.

OBJECTIVE: To evaluate the association between neonatal neurobehavioral state and oral feeding outcomes following congenital heart disease (CHD) surgery.

STUDY DESIGN: This single center retrospective cohort study described neonates undergoing cardiac surgery evaluated perioperatively with the Neonatal Intensive Care Unit Network Neurobehavioral Scale (NNNS). We compared NNNS attention scores, which evaluates neonates’ ability to orient and fixate on stimuli, with the feeding outcomes percentage of feeds taken orally at discharge and time to reach full oral feeds using regression analyses. Models were constructed for both preoperative and postoperative NNNS evaluations.

RESULTS: Between August 2015 and October 2017, 124 neonates underwent 89 preoperative and 97 postoperative NNNS evaluations. In multivariable Cox regression, higher preoperative NNNS attention scores were associated with a shorter time to achieve full oral feeds (hazard ratio 1.4; 95% CI 1.0–2.0; P = .047). This relationship was not seen for post-operative NNNS attention scores or percentage of oral feeds at discharge. Depending on the model, younger age at surgery, increased ventilator days, increased length of stay, and single or 2-ventricle anatomy with aortic arch obstruction were associated with lower percentage of oral feeds at discharge and/or delay in full oral feeds.

CONCLUSIONS: Higher neonatal attention before cardiac surgery is associated with improved feeding outcomes. Prospective assessment of neonatal neurobehavioral state may be a novel approach to predict and target interventions to improve feeding outcomes in CHD. Future studies should examine the impact of intrinsic neurodevelopmental delay vs environmental adaptation on the neurobehavioral state of neonates with CHD.


Having a preterm infant is challenging for parents and families, with increased risk of psychological stress. Being separated from an infant, and dealing with the disruption to family life can impact on the development of parent – infant interaction and early bonding. These early interactive experiences are important in the development of communication skills. The antecedents for receptive and expressive language development can be supported and shaped in the neonatal unit. As preterm infants are at risk of speech, language and communication difficulties, providing parents with information about language development and strategies to promote communication are essential to integrate into neonatal care. This systematic review identified only five papers which investigated parent – infant interaction and the specific attributes associated with providing a good communication environment on the NICU. Due to the small number and differing outcome measures, a full meta –analysis was not possible. The authors recommend a clearer distinction between language and communication literature alongside investigations which have studied bonding and improving mental health for carers post pre-term birth.


AIM and OBJECTIVES: To analyse short term outcomes of preterm neonates discharged on gavage feeds.

MATERIALS AND METHODS: Retrospective Cohort study of discharged neonates on gavage feeds.

OUTCOME MEASURES: To access mortality rate within 8 weeks after discharge and duration of hospital stay, re-admissions rates and anthropometry indices on follow-up.

RESULTS: There were no differences between the early- and routine-discharge groups in the mortality [1 (2%) vs 3 (6.2%), p=0.06] following discharge and re-admission rates[6(12.5) vs 5(10.4%)].There was significant difference in the duration of stay in the two treatment groups (17 days vs. 28 days, p 0.02). At 38 weeks post-menstrual age, the rate of weight gain (mean 30 vs 33 g/kg/day, p=0.06) and head circumference growth (38.9 vs 39.5 cm, p=0.10) were similar in both groups.

CONCLUSION: Early discharge of stable preterm infants on gavage feeding resulted in a reduction in length of hospitalization

The primary objective of this study was to describe cognitive and pre-academic skills of children born preterm (< 30 weeks gestational age) at preschool age. A secondary objective was to relate cognitive functioning at preschool age to developmental scores obtained using the Bayley Scales of Infant and Toddler Development—Third Edition (Bayley III) administered at 18–28 months chronological age. Participants were 21 children born preterm who participated in an initial study and returned for follow-up assessment at 42–66 months. Measures administered at the preschool-age visit included the Differential Abilities Scale—2nd Edition (DAS-II) and the myiGDiS Early Literacy and Early Numeracy measures. Most children fell below benchmark standards for early literacy and numeracy skills on the myiGDiS at preschool age. Frequency of skill levels below benchmark varied from 65 to 95% for early literacy and 70–95% for early numeracy tasks. A subset of the children (n = 16) had Bayley III scores available from a research visit at 18–28 months corrected age. Among those, cognitive composite scores were associated with verbal, but not nonverbal reasoning on the DAS-II at preschool age, and only for those with significant delays on the Bayley III. Results indicated that at preschool age, children’s average cognitive scores on the DAS-II were > 1 SD below the mean across verbal (SS = 82.67; SD = 23.76) and nonverbal (SS = 80.20; SD = 23.65) domains. Practical implications of early screening for specific academic skill difficulties in early childhood settings for children born preterm are presented.


BACKGROUND: Preterm birth, defined as birth before the completion of 37 weeks of gestation, is a multifactorial global epidemic with psychosocial, economic, and physical ramifications affecting the child, family, and community at large. Toxic stress—the results of exposure to adverse childhood experiences—results in changes to brain structure and function that negatively affects future health.

OBJECTIVES: The aim of this study was to apply the eco-bio-developmental (EBD) model of poverty and preterm birth to the cross-sectional data of the 2016 National Survey of Children’s Health to evaluate the associations between poverty, toxic stress, and prematurity on neurodevelopmental and educational outcomes.

METHODS: A subset of data representing children ages 6-11 years old (n = 15,010) from the 2016 National Survey of Children’s Health was used for multivariate analysis of demographic variables and neurodevelopmental and educational outcome variables. Pearson’s chi-square, logistic regression, and interaction effects explored the relationships between prematurity, toxic stress, and poverty.

RESULTS: Children in this sample born preterm had a higher incidence of toxic stress, poverty, developmental delay, learning disability, intellectual disability, speech/language disorders, attention-deficit disorder (ADD)/attention-deficit/hyperactivity disorder (ADHD), autism, and special education/early intervention plans. The combination of poverty, toxic stress, and preterm birth significantly increased the risk of these conditions. After accounting for gender, insurance coverage, race, and parental education, children in the sample born preterm were more likely to experience developmental delay, intellectual disability, speech/language disorder, learning disability, and ADD/ADHD. Toxic stress increased the incidence of ADD/ADHD and autism in both the preterm and full-term samples.

DISCUSSION: The negative effect of poverty and toxic stress on children born preterm, as depicted by the eco-bio-developmental model, is supported by this analysis. Healthcare providers are encouraged to address the tripartite vulnerability resulting from prematurity, poverty, and toxic stress.


BACKGROUND: Fidgety general movements have high predictive validity for later cerebral palsy (CP) but their temporal organisation requires further understanding for assessment accuracy.

AIMS: To describe the occurrence of and temporal trends in fidgety movements, and whether they differ between infants born preterm and at term.

STUDY DESIGN: Cohort study.

SUBJECTS: We assessed 155 EP/ELBW infants and 185 term-born infants born extremely preterm (EP; <28 weeks’ gestation) and/or extremely low birthweight (ELBW; <1000 g birthweight) or at term (37–42 weeks’ gestation) in the state of Victoria, Australia.

OUTCOME MEASURES: Parents of infants submitted up to two videos at 12–13+6 and/or 14–16+6 weeks’ corrected age of infants’ general movements. Videos were scored using the Prechtl General Movements
Assessment (GMA) (fidgety) and classified as normal or absent/abnormal. Infants with at least one normal GMA were classified as normal. Individual GMA trajectories were analysed over time using logistic regression.

RESULTS: Overall, infants born EP/ELBW were more likely to have absent/abnormal fidgety movements than term-born infants (23% versus 3%, odds ratio [OR] 8.50 (95% confidence interval [CI] 3.48–20.8, \( p < 0.001 \)). Fewer EP/ELBW and term-born infants showed absent/abnormal fidgety movements with each week of increasing age (EP/ELBW OR 0.46, 95% CI 0.25–0.84, \( p = 0.01 \); term-born OR 0.35, 95% CI 0.16–0.8, \( p = 0.01 \); interaction, \( p = 0.53 \)).

CONCLUSIONS: Absent/abnormal fidgety movements are more prevalent in infants born EP/ELBW than at term. Fidgety movements normalise with older age in both infants born EP/ELBW and at term between 12 and 16+6 weeks’ corrected age.


BACKGROUND: Neurodevelopmental outcome in preterm infants has been of great importance in recent decades. We determined the prevalence of abnormal neurodevelopmental outcomes and associated risk factors of very-low-birth-weight (VLBW) preterm infants at 2 and 5 years of age.

METHODS: We conducted a population-based, prospective cohort study of VLBW preterm infants born between 2002 and 2009 in Taiwan. Sociodemographic, neonatal data, and neurological assessments at 2 and 5 years of age were obtained from the database of Taiwan Premature Infant Follow-up Network.

RESULTS: Of the 6549 VLBW preterm infants included in the study, 5407 (82.56%) survived to discharge; 4105 and 1427 participated in follow-up assessments at age 2 and 5 years, respectively. At age 5 years, 76.87% (1097/1427), 12.05% (172/1427), and 8.76% (125/1427) of children had normal, borderline, and abnormal neurocognitive outcomes, separately. Among the enrolled children, 1385 were followed at both 2-year and 5-year-old. Among the 233 children with abnormal neurodevelopmental outcomes at age 5 years, nearly one-fifth (18.03%, 42/233) had normal or borderline neurodevelopmental outcomes at age 2 years. Among the 154 children with borderline neurodevelopmental outcomes at age 5 years, 71.43% (110/154) had normal or borderline neurodevelopmental outcomes at age 2 years. The risk factors significantly associated with disadvantageous (worsening or remaining unimproved) neurodevelopmental outcomes were lower gestational age, cystic periventricular leukomalacia, and paternal or maternal education ≤12 years.

CONCLUSION: Almost one-fifth of VLBW preterm children with abnormal neurodevelopmental outcomes at age 5 years had normal or borderline neurologic and developmental assessments at age 2 years. For the high risk group such as VLBW preterm children, serial follow-up assessments beyond 2 years of age may be warranted and the eligibility of early intervention service should be revised by the government so proper and targeted intervention can be implemented at earlier age.


BACKGROUND: Adequate nutrition is essential for optimal neurodevelopment to preterm infants. Our aim was to evaluate the impact of caloric deprivation on Bayley-III scales performance at 18–24 months of corrected age, in a cohort of preterm infants.

METHODS: We prospectively enrolled infants with gestational age <30 weeks and birth weight <1500 g. Apart from a whole cohort analysis, we performed a subgroup analysis between infants received inadequate calories (<85 Kcal/kg/day) during the first two weeks of age, compared to a standard nutrition group. All infants underwent a Bayley-III assessment at 18–24 months of corrected age.

RESULTS: From the 63 preterm infants analysed, 25% had caloric deprivation compared to 75% with adequate nutrition. Caloric deprived infants were of lower gestational age and birth weight, and received a lower amount of enteral feeding during the first 14 days of age. There were no differences between the two groups regarding the common neonatal co-morbidities. Caloric deprived infants had significantly lower composite index scores at 18–24 months of corrected age. Caloric deprivation, late onset sepsis, necrotizing enterocolitis, and bronchopulmonary dysplasia were significant risk factors of neurodevelopmental impairment.

CONCLUSION: Several neonatal factors affect the neurodevelopmental outcome of preterm infants, and nutrition may pose an important role.

OBJECTIVE: To evaluate the relationship of parent-reported child behaviors on the Child Behavior Checklist (CBCL) to cognition, language, and motor skills on the Bayley Scales of Infant and Toddler Development - III (Bayley-III) in toddlers born extremely preterm.

STUDY DESIGN: Toddlers born extremely preterm (gestational ages 22 0/7 to 26 6/7 weeks) were tested at 22-26 months corrected age with Bayley-III while parents completed the CBCL. Socio-demographic variables and medical history were recorded. Linear regression models were used to assess the relationship of Bayley-III cognitive, motor, and language scores with CBCL scores, adjusting for medical and socio-demographic factors.

RESULTS: Internalizing, affective, and pervasive development problem behavior scores on the CBCL correlated significantly with lower Bayley-III cognitive, language, and motor scores on unadjusted and adjusted analyses. Although externalizing and anxiety problems were significantly associated with cognitive and language scores on unadjusted analysis, the relationships were not significant after adjusting for socio-economic factors. CBCL scores were similar for boys and girls, with the exception of the pervasive developmental problem scale; boys had significantly more problems than girls (p = 0.02).

CONCLUSIONS: This study showed that parent reported behavior problems were related to lower cognitive, language, and motor development in toddlers born extremely preterm. Early findings of behavioral problems in toddlers born extremely premature may help identify children at greater risk for later learning difficulties. Adding a measure of behavior to the evaluation of these children may help better understand factors that can contribute to delays, especially in cognition and language.


OBJECTIVE: To evaluate neurodevelopmental outcomes of preterm infants with need for Child Protective Services (CPS) supervision at hospital discharge compared with those discharged without CPS supervision.

STUDY DESIGN: For infants born at <27 weeks of gestation between 2006 and 2013, prospectively collected maternal and neonatal characteristics and 18- to 26-month corrected age follow-up data were analyzed. Bayley-III cognitive and language scores of infants with discharge CPS supervision were compared with infants without CPS supervision using regression analysis while adjusting for potentially confounding variables, including entering CPS after discharge from the hospital.

RESULTS: Of the 4517 preterm infants discharged between 2006 and 2013, 255 (5.6%) were discharged with a need for CPS supervision. Mothers of infants with CPS supervision were significantly more likely to be younger, single, and gravida ≥3; to have less than a high school education; and to have a singleton pregnancy and less likely to have received prenatal care or antenatal steroids. Despite similar birth weight and medical morbidities, the CPS group had longer hospital stays compared with the non-CPS group. In adjusted analysis, cognitive scores were points lower (β = −1.94; 95% CI, −3.88 to −0.08; P = .04) in the CPS at discharge group compared with the non-CPS group. In children who entered CPS supervision after hospital discharge (an additional 106 infants), cognitive scores were 4 points lower (β = −4.76; 95% CI, −7.47 to −2.05; P < .001) and language scores were 5 points lower (β = −4.93; 95% CI, −8.00 to −1.86; P = .002).

CONCLUSION: Extremely preterm infants discharged from the hospital with CPS supervision or entering CPS postdischarge are at increased risk for cognitive delay at 2 years of age. Opportunities exist to interven and potentially improve outcomes in this vulnerable group of children.


OBJECTIVES: To examine factors associated with fathers’ early parenting behaviors (including very preterm [VPT] birth, familial social risk, child sex, and child medical risk), and the relationship between fathers’ early parenting behaviors and later child development.

STUDY DESIGN: Participants were 81 VPT (born <30 weeks of gestation) and 39 full-term father-child dyads. Parenting behaviors (sensitivity, structuring, nonintrusiveness, nonhostility) were assessed at 12 months of corrected age using the Emotional Availability Scales, with scores ranging from 1 (low) to 7 (high). At 24 months of corrected age, child cognitive, language, motor, and social-emotional development were assessed. Results are presented as (regression coefficients; 95% CIs).
RESULTS: There was little evidence that VPT birth, familial social risk, or child medical risk were associated with fathers’ parenting behaviors. Fathers of girls tended to be more sensitive (0.42; 0.18, 0.65), less intrusive (0.36; 0.04, 0.70), and less hostile (0.26; 0.01, 0.50) compared with fathers of boys. Higher structuring was associated with more optimal cognitive (3.29; 1.25, 5.34), and language development (4.69; 2.26, 7.14). Higher sensitivity was associated with more optimal language development 3.35 (0.95, 5.75), and more intrusive behavior was associated with more externalizing symptoms (-1.68; -3.06, -0.31).

CONCLUSIONS: Early parenting did not differ between fathers with VPT and full-term children, but fathers’ parenting did vary according to child sex. Fathers’ early parenting was associated with future neurodevelopment, reinforcing the need to support fathers’ parenting, and include fathers in early intervention programs.


OBJECTIVE: To compare neurodevelopmental outcomes in linear growth-restricted (LGR) infants born <29 weeks with and without weight gain out of proportion to linear growth.

STUDY DESIGN: We compared 2-year neurodevelopmental outcomes between infants with and without LGR and between LGR infants with and without weight gain out of proportion to linear growth. The outcomes were Bayley-III cognitive, motor, and language scores, cerebral palsy, Gross Motor Function Classification System (GMFCS) level ≥ 2, and neurodevelopmental impairment.

RESULTS: In total, 1227 infants were analyzed. LGR infants were smaller and less mature at birth, had higher BMI, and had lower Bayley-III language scores (82.3 vs. 85.0, \(p < 0.05\)). Among infants with LGR, infants with high BMI had lower language scores compared with those with low-to-normal BMI (80.8 vs. 83.3, \(p < 0.05\)), and were more likely to have GMFCS level ≥2 and neurodevelopmental impairment.

CONCLUSION: Among infants with LGR, weight gain out of proportion to linear growth was associated with poorer neurodevelopmental outcomes.


BACKGROUND: The landmark findings of the Mother–Infant Transaction Program (MITP) showing improved neurodevelopment of preterm infants following parent-sensitivity training delivered in the neonatal intensive care unit have not been consistently replicated. This study evaluated an MITP-type intervention in terms of neurobehavioural development to preschool age.

METHODS: A randomised controlled trial involved 123 very preterm and extremely preterm infants allocated to either a parent-sensitivity intervention (PremieStart, \(n = 60\)) or to standard care (\(n = 63\)). When children were 2 and 4.5 years corrected age, parents completed the Child Behavior Checklist (CBCL). General development was assessed at 2 years with the Bayley Scales of Infant Development (Bayley-III). At 4.5 years, cognitive functioning was assessed with the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-III) and executive functioning with the NEPSY-II.

RESULTS: There were no significant between-group differences in behaviour problems at 2 or 4.5 years, general development at 2 years, or cognitive and executive functioning at 4.5 years.

CONCLUSION: Advances in the quality of neonatal intensive care may mean that MITP-type interventions now have limited additional impact on preterm infants’ long-term neurobehavioural outcomes. The gestational age of infants and the exact timing of intervention may also affect its efficacy.


Extremely preterm infants are at increased risk of motor impairment. The Canadian Neonatal Follow-Up Network (CNFUN) afforded an opportunity to study the outcomes of extremely preterm children. The purpose of this study was to compare 18-month corrected age (CA) motor outcomes of extremely preterm infants with parent-reported functional outcomes at 3 years CA. CNFUN data of 1376 infants were used to conduct chi-square analyses to compare Bayley-III motor scores (composite, gross, and fine motor) at 18 months CA with parent-reported Ages and Stages Questionnaire motor scores (gross and fine motor) at 3 years CA. The correlation of motor scores at 18-months CA with parent-reported gross and fine motor scores at 3 years CA was also examined. We found that 1 in 5 infants scoring within or above the average range on the Bayley-III
had parent-reported functional fine and gross motor difficulties at 3 years CA. Bayley-III scores were only moderately correlated with functional motor outcomes. Results of the study suggest that the Bayley-III at 18 months CA was able to detect the majority of infants with motor problems, but not all; therefore, ongoing follow-up of extremely preterm infants is required. The Bayley-III motor composite score has greater clinical utility compared to sub-scale scores.


AIM: To describe a randomized controlled trial protocol designed to evaluate the effectiveness of mobile health based Preterm Home Care Program (mHealthPHCP) known as “NeoRaksha” mobile health application in improving parent-infant-interaction, growth and development of preterms.

DESIGN: A prospective, randomized controlled clinical trial. The protocol is approved and funded by Department of Biotechnology, Government of India on 2 August 2016.

METHODS: A total of 300 preterm-mother dyads admitted to neonatal intensive care unit of a tertiary care hospital will be recruited and randomized to intervention and control group. The intervention group would receive mobile health based Preterm Home Care Program and the control group would receive standard preterm care. Intervention group will be followed up at home by community health workers known as Accredited Social Health Activist who will be trained in using the NeoRaksha mobile health application. Preterms outcomes will be assessed during follow-up at hospital.

DISCUSSION: Supporting continuity of preterm care is vital as parents and preterms experience transition from Neonatal Intensive Care unit to their home. Empowering mothers and community health workers by integrating mobile technology into health care can help promote healthy preterms, enhance development outcomes and follow-up, which in turn can reduce the mortalities, morbidities, and disabilities associated with prematurity.

IMPACT: The results of this study could open up new horizons in integrating hospital and home based preterm care through technology, which paves way to scale up the model across the countries.


BACKGROUND: Neonatal intensive care practices have resulted in marked improvements in the survival of premature infants; however, they remain at significant risk for adverse neurodevelopmental outcomes. The impact of current nutritional practices on brain development following early extra-uterine exposure in premature infants is not well known.

METHODS: We performed a systematic review to investigate nutritional effects on postnatal brain development in healthy term and prematurely born infants utilizing advanced magnetic resonance imaging tools.

RESULTS: Systematic screen yielded 595 studies for appraisal. Of these, 22 total studies were selected for inclusion in the review, with findings summarized in a qualitative, descriptive fashion.

CONCLUSION: Fat and energy intake are associated with improved brain volume and development in premature infants. While breast milk intake and long-chain polyunsaturated fatty acid supplementation has been proven beneficial in term infants, the impact in preterm infants is less well understood.


OBJECTIVE: The objective of this study is to examine the relationship between neonatal risk factors and feeding difficulties (FDs) in the NICU and the impact of FD on neurodevelopmental (ND) outcome in ELGA infants.

STUDY DESIGN: Two hundred and eighteen ELGA infants (59 FDs and 159 no-FDs) were compared for neonatal morbidities, feeding milestones, and Bayley-III scores at 8 and 20 mo CA. Multiple regression analyses adjusted for the effect of risk factors on FD and ND outcome.

RESULTS: Twenty-seven percent of infants had FD. Postmenstrual age (PMA) at start of oral feeds was the only predictor of FD. At 8 mo CA, FD was the strongest predictor of cognitive <85 ($p = 0.018$) and motor index <70 ($p = 0.019$). In linear regression, PMA at start of oral feeds was the only predictor of 8 mo cognitive and motor index ($p = 0.006$). FD did not predict ND outcome at 20 months CA.
CONCLUSION: FDs are common in ELGA infants and are associated with worse cognitive and motor outcomes in the first year of life.


The purpose of this study was to compare the sensory-processing patterns of preterm and term children at 6 years of age. The sensory profile (SP; W. Dunn, 1999) was used to evaluate sensory-processing patterns. We compared the section and factor SP scores of 118 preterm children with those of 158 term children at 6 years of age. Preterm children were significantly different from their term peers in all section and factor scores except the sedentary factor. Birth weight, gestational age, and days spent in the neonatal intensive care unit were correlated with sensory-processing issues. The sensory-processing abilities of preterm children should be evaluated at the age of 6 years and occupational therapy interventions should be implemented when necessary.


OBJECTIVE: The objective of this study is to explore developmental outcomes at five years after early-onset fetal growth restriction (FGR).

STUDY DESIGN: Retrospective data analysis of prospective follow-up of patients of three Dutch centres, who participated in a twenty centre European randomized controlled trial on timing of delivery in early-onset FGR. Developmental outcome of very preterm infants born after extreme FGR is assessed at (corrected) age of five.

RESULTS: Seventy-four very preterm FGR children underwent follow-up at the age of five. Mean gestational age at birth was 30 weeks and birth weight was 910 g. 7% had a Bayley score <85 at two years. Median five years’ FSIQ was 97, 16% had a FSIQ < 85, and 35% had one or more IQ scores <85. Motor score ≤ 7 on movement ABC-II (M-ABC-II-NL) was seen in 38%. Absent or reversed end-diastolic flow, gestational age at delivery, birthweight and neonatal morbidity were related to an FSIQ < 85. Any abnormal IQ scale score was related to birthweight, male sex and severity of FGR, and abnormal motor score to male sex and bronchopulmonary dysplasia (BPD).

CONCLUSIONS: Overall, median cognitive outcome at five years was within normal range, but 35% of the children had any abnormal IQ score at age five, depending on the IQ measure, and motor impairment was seen in 38% of the children. GA at delivery, birthweight, EDF prior to delivery and neonatal morbidity were the most important risk factors for cognitive outcomes.


BACKGROUND: Infants born very preterm are at higher risk of long-term neurodevelopmental problems than children born at term. Although there are increasing numbers of reports on outcomes from international cohorts of premature infants, a Swiss national report on infants after 2 years of age is lacking.

AIMS OF THE STUDY: To describe neurodevelopmental outcomes at early school age of preterm children born in Switzerland with a special focus on the cognitive abilities.

METHODS: This prospective national cohort study included children born alive before 30 weeks of gestation in 2006. At 5 years of age, children underwent a neurological examination and intelligence testing with the Kaufman Assessment Battery for Children first edition (K-ABC). We assessed the mental processing composite score (MPC) and its subscales to explore specific cognitive deficits. The primary outcome was cognitive impairment (MPC score <1 standard deviation from the normative mean), motor impairment (cerebral palsy), or sensory impairment (any visual or hearing deficiency). The need for early intervention or therapies and the association of perinatal factors with cognitive impairment were secondary and tertiary outcomes. Logistic regression models were used to analyse associations between neonatal factors and cognitive outcome.

RESULTS: Of 289 survivors, 235 were assessed. Of the 199 children with results obtained from the K-ABC, 42 (21%) showed cognitive impairment and 80 (40%) showed impairment in short-term memory. Cerebral palsy was diagnosed in 14 (6%), and visual and auditory impairment in 36 (15%) and 12 (5%) children, respectively; 63 (27%) needed early intervention or therapies. Cognitive impairment was associated with low socioeconomic
status, but not with gestational age, small birthweight for gestational age, bronchodyplasia, or significant brain injury. A total of 146 children (63%) survived without any impairment.

CONCLUSION: This is the first study to report neurodevelopmental outcomes at early school age in a Swiss cohort. The majority had favourable outcomes, but 21% of children demonstrated cognitive impairment, which was most pronounced in short-term memory. Our findings were similar to those of international cohorts and indicate that preterm children born before 300/7 gestational weeks, especially those living in unfavourable social environments, are at an increased risk of cognitive impairment and need close monitoring beyond early school age.


One hundred and nine preterm infants were studied to examine the relative effects of biologic/neurologic factors (length of hospital stay, 18 month cognitive status) and environment (socioeconomic status) on cognition in the toddler (18 months) and preschool periods (3 years). Length of hospital stay was significantly related to toddler cognitive outcome, and less so to preschool outcome. Socioeconomic status predicted only preschool cognitive outcome and not toddler outcome. Cognitive status at 18 months significantly predicted 3 year outcome, and there was relatively little change between those periods. Together, cognitive status at 18 months and socioeconomic status significantly predicted preschool IQ, accounting for 34% of the variance. Results showed that perinatal biologic risks became less salient while socioeconomic status became increasingly important at the preschool period. Relative lack of change in cognitive status indicated the importance of early cognitive evaluation in preterm infants.


PURPOSE: This study aimed at assessing the effect of short duration Skin to skin contact (SSC) (5 days) on premature infants’ short-term physiological and behavioral outcomes.

DESIGN AND METHODS: A quasi-experimental control group design was utilized. 89 stable premature infants were allocated to either an interventional or control group.

RESULTS: Results showed that in comparison to the control group, newborns in the SSC group demonstrated higher weight gain (g/day) from day 3–5 of practicing SSC (53.7 g Vs. 32.6 g; P < .05), experienced significantly fewer numbers of apneas (48% Vs. 33.3%; P = .001), and were less likely to use formula feeding (60% Vs. 90%) and more likely to use mixed feeding (formula and breastfeeding) at discharge (33.3% Vs. 10%). Significant differences were also found in the crying, and sleeping patterns of the infants; infants of mothers who practiced SSC were less likely to cry in a continuous pattern and more likely to experience good sleep than infants in the control group.

CONCLUSIONS: The study highlights the importance of the early and short duration of SSC for premature infants.

PRACTICE IMPLICATIONS: The initiation of SSC in the first few days of life may have a significant influence on the newborn’s short-term outcomes.


BACKGROUND: There is a special concern regarding substance using pregnant women due to the possible adverse effects on the infant. While the immediate effects of prenatal substance exposure are well known, the long-term data on the infants’ neurodevelopment is inconclusive.

AIMS: The purpose of this study was to assess early neurobehavior of infants of mothers with substance use using the Dubowitz examination and to follow their neuromotor development until one year of age.

STUDY DESIGN AND SUBJECTS: Ninety-five pregnant women with a recent history of substance use were recruited and followed up at the maternity outpatient clinic. Follow-up data was collected from hospital records and maternal interviews. The Dubowitz neurological examination was performed to the 54 clinically healthy term infants. The results were converted into optimality scores and compared to normative values from clinically healthy term infants derived from a separate normative population. The infant’s neuromotor development was followed up to one year of age.

RESULTS: Only 7% of the infants born to women with recent or current substance use reached optimal scores (<30.5) in the Dubowitz neurological examination compared to 95% reported in normative population. Sixty-
three percent of the newborns needed follow-up based on physiotherapeutic assessment of neurobehavior. By 12 months of age, the neuromotor status of 88% (n = 30) of these infants was found normal.

CONCLUSIONS: A high percentage of infants of mothers who were referred prenatally to hospital due to substance use showed suboptimal neurological findings during their first days of life.


Very premature children (<33 weeks of gestational age (GA)) experience greater academic difficulties and have lower, though normal-range, intelligence quotients (IQs) versus their full-term peers. These differences are often attributed to GA or familial socio-economic status (SES). However, additional factors are increasingly recognized as likely contributors. Parental stress after a child’s premature birth can present as post-traumatic stress disorder (PTSD) symptoms and can in turn reinforce difficulties in parent-child interaction pattern. Following a longitudinal design, we studied the interplay between a premature child’s perinatal history and maternal PTSD symptoms on intelligence abilities assessed at 11 years of age. Thirty-three very preterm and 21 full-term mother-children dyads partook in the study. Children’s perinatal risk was evaluated at hospital discharge, maternal PTSD symptoms were assessed when the children were 18 months old, and children’s IQ was measured at 11 years old. IQ was significantly lower for preterm than full-term children, without reliable influences from perinatal risk scores. However, lower maternal PTSD symptoms predicted higher IQ in preterm children. This preliminary study highlights the importance detecting maternal PTSD symptoms after a preterm birth and suggests interventions should target reducing maternal PTSD symptoms during early childhood to enhance very preterm children’s intelligence development.


BACKGROUND: South Asia contributes substantially to global low birth weight population (i.e. those with birth weight < 2500 g). Synthesized evidence is lacking on magnitude of cognitive and motor deficits in low birth weight (LBW) children compared to those with normal birth weight (NBW) (i.e. birth weight ≥ 2500 g). The meta-analysis aimed to generate this essential evidence.

METHODS: Literature search was performed using PubMed and Google Scholar. Original research articles from south Asia that compared cognitive and/or motor scores among LBW and NBW individuals were included. Weighted mean differences (WMD) and pooled relative risks (RR) were calculated. All analyses were done using STATA 14 software.

RESULTS: Nineteen articles (n = 5999) were included in the analysis. Children < 10 years of age born LBW had lower cognitive (WMD -4.56; 95% CI: -6.38, − 2.74) and motor scores (WMD -4.16; 95% CI: -5.42, − 2.89) compared to children with NBW. Within LBW children, those with birth weight < 2000 g had much lower cognitive (WMD -7.23, 95% CI; − 9.20, − 5.26) and motor scores (WMD -6.45, 95% CI; − 9.64, − 3.27).

CONCLUSIONS: In south Asia, children born LBW, especially with < 2000 g birth weight, have substantial cognitive and motor impairment compared to children with NBW. Early child development interventions should lay emphasis to children born LBW.


BACKGROUND: Motor development occurs throughout periods of motor skills’ acquisition, adjustment and variability. The objectives of this study were analyzed and compare biological and health characteristics and motor skill acquisitions’ trajectories of preterm and full-term infants during the first year of life.

METHODS: 2,579 infants (1361 preterm) from 22 states were assessed using the Alberta Infant Motor Scale. Multivariate General Linear Model, t-tests, ANOVA, and Tukey tests were used.

RESULTS: An Age x Groups significant interaction was found for motor scores. Follow up tests revealed that full-term infants presented higher scores in prone, supine, sitting and standing postures that require trunk control from 9 to 10 months of age; although, this advantage was observed for sitting from the second month of life.

DISCUSSION: During the first trimester preterm infants demonstrate higher scores in the supine and standing postures. Regarding motor trajectories, from newborn to 12 months, the periods of the higher motor acquisition was similar between full-term and preterm infants for prone (3-to-10 months), supine (1-to-6
months), and standing (6-to-12 months). However, for sitting posture full-term infants demonstrated higher periods of acquisitions from the first to 7 months of life, whereas for preterm infants a shorter period was observed (3-to-7 months).

**CONCLUSION:** Although the periods of higher motor acquisitions were similar, full-term infants demonstrated higher scores in more control-demanding postures. Intervention for preterm infants need goes beyond the first months of life and includes guidance to parents to promote motor development strategies to achieve control in the higher postures.


Predicting language performances after preterm birth is challenging. It is described in the literature that early exposure to the extrauterine environment can be either detrimental or advantageous for neurodevelopment. However, the emphasis mostly lies on the fact that preterm birth may have an unfavorable effect on numerous aspects of development such as cognition, language, and behavior. Various studies reported atypical language development in preterm born children in the preschool years but also in school-aged children and adolescents. This review gives an overview of the course of language development and examines how prematurity can lead to atypical linguistic performances. In this paper, we mainly focus on environmental and neurophysiological factors influencing preterm infant neuroplasticity with potential short- and long-term effects on language development. Further research, however, should focus on examining the possible benefits that early exposure might entail.

**OBJECTIVES:** Moderate-risk neonates (MRNs) are newborns who usually remain hospitalized in neonatal intensive care units (NICU) after birth. Although they have low rates of mortality, morbidity burden may be significant and involve neurological risk. The aim of this study was to estimate the prevalence of neurodevelopmental disorders and the influence of biological and socio-environmental factors on the neurodevelopment of MRN.

**METHODS:** A cross-sectional study was performed on a sample of 162 MRNs aged 2–24 months, who remained in NICU ≥ 72 h after birth, with gestational age (GA) ≥ 34 weeks, birth weight ≥ 1500 g, and normal neurological and clinical examinations by the time of hospital discharge. Four neurodevelopmental areas were assessed using the Argentinian test PRUNAPE: language (LG), fine and gross motor skills (FM and GM), and personal-social skills (PS). Data from biological (gestational, perinatal and postnatal) and socio-environmental factors were collected through parental questionnaires.

**RESULTS:** Thirty-four percent of infants failed the test. Gross motor was the most affected area (14.2%), followed by LG (11.7%), FM (7.4%), and PS (4.3%). Among gestational factors global failure was associated with drugs and alcohol consumption (p ≤ 0.029). Language was associated with maternal smoking (p = 0.007; OR 3.5), FM (p = 0.009; OR 13.0), and GM (p = 0.002; OR 10.6) with drug use, and both LG (p = 0.000; OR 22.6) and GM (p = 0.007; OR 16.2) with alcohol consumption during pregnancy. Infants born by cesarean had a higher risk of failure than those born by vaginal delivery (p = 0.049; OR: 2.2), as well as infants with pathological complementary diagnosis (p = 0.001; OR 2.7). Mechanical ventilation was associated with FM disorders (p = 0.025; OR 4.2). Children with siblings had a higher risk of failing the test than only children (p = 0.041; OR 2.0).

**CONCLUSIONS:** Rate of neurodevelopmental disorders in MRN exceeds widely that of the general population. GM was the most affected area. Maternal addictions, cesarean birth, pathological complementary studies, MV, and having siblings are factors associated with failure in the screening.


**OBJECTIVE:** To assess the outcomes in actively managed extremely preterm infants after admission to a neonatal intensive care unit.

**STUDY DESIGN:** Retrospective cohort of 255 infants born at 22-25 weeks of gestation between 2006 and 2015 at a single study institution. Infants were excluded for congenital anomaly, death in delivery room, or parental request for palliation (n = 7). Neurodevelopmental outcomes were analyzed for 169 of 214 survivors (78.9%) at 18-22 months of corrected age. Outcomes were evaluated using the Mann-Whitney U, χ², or Fisher exact test,
where appropriate. In addition, cognitive scores of the Bayley Scales of Infant-Toddler Development (3rd edition) were assessed using generalized estimating equations.

**RESULTS:** Seventy infants born at 22-23 weeks of gestation (22 weeks, n = 20; 23 weeks, n = 50) and 178 infants born at 24-25 weeks of gestation (24 weeks, n = 79; 25 weeks, n = 99 infants) were included. Survival to hospital discharge of those surviving to NICU admission was 78% (55/70; 95% CI, 69%-88%) at 22-23 weeks and 89% (159/178; 95% CI, 84%-93%) at 24-25 weeks; \( P = .02 \). No or mild neurodevelopmental impairment in surviving infants was 64% (29/45; 95% CI, 50%-77%) at 22-23 weeks and 76% (94/124; 95% CI, 68%-83%; \( P = .16 \)) at 24-25 weeks.

**CONCLUSIONS:** Although survival was lower in infants born at 22-23 weeks than at 24-25 weeks of gestation, the majority of survivors in both groups had positive outcomes with no or mild neurodevelopmental impairments. Further evaluation of school performance is warranted.


**BACKGROUND:** Maternal shift work is associated with preterm delivery, small-for-gestational-age new-borns, childhood obesity and future behavioural problems. However, the adverse effects on and interactions of maternal shift work with infant neurodevelopment remain uncertain. Therefore, we examined the associations between maternal-shift-work status and infant neurodevelopmental parameters.

**METHODS:** The Taiwan Birth Cohort Study is a nationwide birth cohort study following representative sampled mother–infant pairs in 2005. The participants’ development and exposure conditions were assessed by home interviews with structured questionnaires at 6 and 18 months of age. Propensity scores were calculated with predefined covariates for 1:1 matching. Multivariate conditional logistic regression and the Cox proportional-hazards model were used to examine the association between maternal-shift-work status and infant neurodevelopmental-milestone-achievement status.

**RESULTS:** In this study, 5637 term singletons were included, with 2098 cases selected in the propensity-score-matched subpopulation. Persistent maternal shift work was associated with increased risks of delays in gross-motor neurodevelopmental milestones [aOR = 1.36, 95% confidence interval (CI) = 1.06–1.76 for walking steadily], fine-motor neurodevelopmental milestones (aOR = 1.39, 95% CI = 1.07–1.80 for scribbling) and social neurodevelopmental milestones (aOR = 1.35, 95% CI = 1.03–1.76 for coming when called upon). Moreover, delayed gross-motor and social development were identified in the propensity-score-matched sub-cohort.

**CONCLUSIONS:** This study shows negative associations between maternal shift work and delayed neurodevelopmental-milestone achievement in the gross-motor, fine-motor and social domains at 18 months. Future research is necessary to elucidate the possible underlying mechanisms and long-term health effects.


**BACKGROUND:** The study is intended to fill the knowledge gap about the neuropsychology and neuromotor developmental outcomes, and identify the perinatal risk factors for late preterm infants (LPIs 34~36 weeks GA) born with uncomplicated vaginal birth at the age of 24 to 30 months.

**METHODS:** The parents/guardians of 102 late preterm infants and 153 term infants, from 14 community health centers participated in this study. The Modified Checklist for Autism in Toddlers (M-CHAT) questionnaire, the Chinese version of Gesell Development Diagnosis Scale (GDDS), and the Sensory Integration Schedule (SIS), a neurological examination for motor disorders (MD) were carried out. Infants screening positive to the M-CHAT were referred to specialist autism clinics.

**RESULTS:** Forty-six LPIs (45.1%) scored low in GDDS. Nine LPIs (8.8%) scored positive on M-Chat. 8.8% of LPIs (9 out of 102) were diagnosed MD (p < 0.05). Compared with their full-term peers, LPIs had statistically lower scores in GDDS and the Child Sensory Integration Checklist. LPIs who had positive results on M-CHAT showed unbalanced abilities in every part of GDDS. Risk factors of twin pregnancies, pregnancy induced hypertension and premature rupture of membranes had negative correlation with GDDS (all p < 0.05). Birth weight and gestational age were positively correlated with GDDS.

**CONCLUSIONS:** LPIs shall be given special attention as compared to normal deliveries, as they are at increased risk of neurodevelopment impairment, despite being born with no major problems. Some perinatal factors such as twin pregnancies, and pregnancy induced hypertension etc. have negative effects on their neurodevelopment. Regular neurodevelopmental follow-up and early intervention can benefit their long term outcomes.

The aim of this study was to compare the social competence, motor development, and cognition of late preterm infants (LPIs) with full-term infants. Several studies in the recent past indicated that LPIs are at high risk of social development problems. We compared the development of motor skills, cognition, and social competency of LPIs with full-term infants at between 2 and 2.5 years old. The Chinese versions of the Gesell Development Diagnosis scale and the Normal Development of Social Skills from Infants to Junior High School Children scale were used for the assessment. LPIs were not more socially competent than their full-term counterparts. Each skill—namely, adaptability, gross motor, fine motor, language, and personal-social responses—was separately associated with the total level of social skills. It was found that gross motor skills had a positive correlation with the self-help and locomotive abilities, and fine motor skills had a positive association with locomotion abilities. LPIs had risk factors due to their delayed social skills in areas including motor disorders and physiological and perinatal factors. LPIs under three were at a higher risk of impairment in social competency. Therefore, it is recommended that they be monitored regularly to identify the development of social and cognitive disorders at an early stage.


**AIM:** The aim of the study was to assess general spontaneous motor development in the neonatal phase in groups of neonatal high-risk preterm infants who were differentiated by post-conceptional (PCo) age until term age.

**METHOD:** The sample included 54 preterm infants (<32 weeks of gestational age) with low birthweight and neurological injuries of both sexes. The General Movements Assessment (GMA) was used to evaluate motor development from 30 to 40 weeks of PCo age, using the General Movements Optimality Score (GMOS). Between-group and within-group comparisons were performed.

**RESULTS:** Significant differences in GMOS scores and the upper extremities score, specifically in the neck and trunk, were found between 30 and 33 weeks, 34 and 36 weeks, and 38 and 40 weeks of PCo age. Preterm infants had gradually higher GMOSs from 30 weeks of PCo age to term age (38–40 weeks of PCo age). No significant differences in general movements were found between 30 and 33 and 34 and 36 weeks of PCo age.

**CONCLUSION:** The preterm infants presented poor spontaneous motor movements, assessed by the GMOS, but gradual improvement was observed from 30 weeks of PCo age until term age.

**PURPOSE:** Communication disorders are a hallmark feature of 22q11.2 deletion syndrome (22q11DS). Complex feeding and swallowing difficulties are also frequently present in children with this syndrome. Every speech subsystem may be affected in 22q11DS, leading to a variety of speech sound, motor speech, resonance, and/or voice disorders. Language delays and persisting social/pragmatic deficits are also common.

**CONCLUSION:** The speech-language pathologist is key to both the diagnosis and treatment of speech-language difficulties and feeding/swallowing disorders in children with 22q11DS, from birth through adulthood. This tutorial provides a current overview of communication and feeding/swallowing disorders associated with 22q11DS and strategies for assessment and treatment. The role of the pediatric speech-language pathologist in the management of children with this syndrome across a variety of settings is discussed.


**BACKGROUND:** Rehabilitation specialists are an integral part of the team in the neonatal intensive care unit (NICU). New approaches to rehabilitation practice in the NICU have evolved over the past decade that aim to promote child health and development.

**AIMS:** The aim of this study was to describe the current roles of the occupational therapist (OT), physical therapist (PT) and speech-language pathologist (SLP) in Canadian NICUs as compared to the roles documented in an earlier national survey conducted 15 years ago.

**METHODS:** A telephone survey was conducted across Canadian NICUs and each telephone interview was recorded by a research assistant. In total, 42 questionnaires were completed across 25 health care institutions.

**RESULTS:** Eighty percent of the PT, 93.7% of OT and 50% of SLP provided direct services to neonates in the NICU. The results demonstrated that the therapists were involved with case discussion (85.7%), decision-making (97.6%), referrals to other services (97.6%) and discharge planning (97.6%). Splinting (87.5%) and feeding (100%) were most often carried out by OT, whereas chest physiotherapy (65%) and range of motion (100%) were predominantly provided by PT. Changes in the role of rehabilitation specialists over the last decade predominantly included enhanced collaboration with the NICU team, more frequent use of standardized outcome measures and use of interventions supported by evidence.

**CONCLUSION:** In comparison with results of the previous survey of rehabilitation practices in Canadian NICUs, rehabilitation specialists now have more dedicated time in the NICU and more frequently use standardized measures and apply interventions that are supported by recent scientific studies.


**INTRODUCTION:** The high rate morbidity associated with preterm birth, which gestational period is less than 37 weeks, frequently demands the hospitalization of the newborn in neonatal intensive care units (NICUs). The period of hospitalization triggers in the parent’s feelings of insecurity, sadness, stress, and anxiety. The multi-professional staff that accompanies the newborn and his family plays a key role in supporting parents. Occupational Therapists have developed comprehensive and interactive programs to help parents deal with anxiety about the baby’s hospitalization in the NICU by conducting activity groups.

**OBJECTIVE:** To know the contributions of Occupational Therapy groups in the anxiety levels of mothers with preterm newborns admitted in the NICU.

**METHOD:** Forty mothers of hospitalized newborns who met the inclusion and exclusion criteria participated in the study. The State-Trait Anxiety Inventory (STAI) was applied with an I-STAI scale (A-state) before and after the performance of the activity group. Finally, a Focal Group with a semi-structured interview was carried out.

**RESULTS:** The inventory showed reductions in scores for items such as “I feel anxious” (p <0.001), “I feel nervous” (p = 0.008) and “I am worried” (p <0.001), which was corroborated by the analysis of the mothers’ report in the focal group.
CONCLUSION: The interaction between the mothers provided by the Occupational Therapy groups and the execution of activities directed to the experienced context contribute to reducing the anxiety felt by the mothers during the hospitalization of the child in the NICU.


INTRODUCTION: Preterm and low-birth-weight newborns may present immaturity in the functions of sucking, swallowing and breathing, speech therapists inserted in the hospital focus on the development of newborns’ oral sensorimotor system, promoting a safe transition from tube feeding to breastfeeding and contributing to improving the quality of life of the child population. The present study aimed to analyze the development of oral functions, oral feeding transition time and breastfeeding of preterm and low-birth-weight newborns under Speech-Language Pathology care.

METHODS: A prognostic study carried out at a maternity hospital, based on the data collected from 121 filed medical records of newborns attended between September 2015 to July 2017. The Kaplan–Meier method, the Log Rank test and the Pearson correlation test were used for data analysis, considering a significance level of 0.05 (95%).

RESULTS: It was observed that the lower the gestational age and the birth weight of newborns, the more speech therapy services were required until the establishment of exclusive OF; also, the transition time and the average time of using the orogastric tube were inversely proportional to the gestational age at birth. The non-nutritive sucking technique was the most used for stimulation, and 78.5% of the NBs were discharged from the hospital on exclusive breastfeeding.

CONCLUSION: Moderate to late preterm and low-birth-weight newborns are able to more quickly acquire the oral sensorimotor system functional pattern, and there are indications that Speech-Language Pathology care reduces the transition time to oral feeding, thus increasing the success rate of exclusive breastfeeding.


PURPOSE: This randomized controlled double-blinded experimental study was carried out to determine the effects of the daily exercise program on bone mineral density and cortisol level in preterm infants with VLBW matched for birth weight, gestation week, and gender.

DESIGN AND METHODS: The study was carried out with preterm infants (n = 24) hospitalized in the NICU of a tertiary hospital. Ethical committee approval, institutional permission, parental written consent were obtained. A daily exercise program was implemented in preterm infants in the exercise group for 30 days, once a day, and continuing for 7–10 min. Before and after the study the following were evaluated in preterm infants in the exercise and control group: anthropometric measurements, tibia speed of sound (SOS) for bone mineral density, serum cortisol levels.

RESULTS: Serum cortisol levels (p = 0.05) were decreased, bone SOS values in the exercise group were increased (p = 0.009), after the study. The difference between pre-, post-study bone SOS and serum cortisol values of infants in the exercise group were high (p > 0.05). Percentage increases in anthropometric values in the exercise group were higher than the control group after the study (for all; p > 0.05).

CONCLUSIONS: The daily exercise program has positive effect on bone SOS and serum cortisol values in preterm infants. Neonatal nurses can implement the daily exercise program in clinical practice.


Premature infants experience various health problems such as instability of vital signs, difficulty eating and disturbance sleep-wake status. The objective of this literature review is to identify the benefits of music therapy for the stability of physiological functions, increased sucking behavior, and sleep in premature infants undergoing treatment in Neonates Intensive Care Unit (NICU). This article is a literature review using Scienidirect, SageGroup, Springer, ProQuest, Google Scolars, and EBsco electronic sources from 2008-2018. Keywords used “Music Therapy” are then selected for full text articles for review. The results of the analysis of 7 articles that fit the inclusion criteria found that music therapy has an effect on a more stable physiological function, maintaining sleep in infants, and increasing sucking in premature infants. The conclusions and recommendations of this article are the use of appropriate music therapy can improve the health status of treated infants so it is recommended as one of the nursing interventions in the NICU room.

Although there has been a considerable reduction in the number of neonatal deaths in NICUs during the last two decades, the management of critically ill infants who are continuously exposed to various risk factors has remained a matter of major concern. Exposure to these stressors has a detrimental effect on the growth and neurodevelopment of critically ill preterm infants. As most of these causes are preventable, it is important to adopt proven quality improvement initiatives in order to improve neonatal care outcomes. The objective of this review is to identify the recent available evidence on the proven quality improvement initiatives in the NICU to improve neonatal health care outcomes.

An extensive literature search was conducted for the English language articles in the EMBASE and MEDLINE databases. A total of 300 articles were retrieved with the keyword search. Further attempts were made to search the reference lists of retrieved articles to identify the relevant studies. The title and abstracts of the retrieved references were screened for relevance, and 29 studies were included in this review.

Some of the proven quality improvement initiatives to improve the neonatal care outcomes in NICU include measures such as maintaining hand hygiene, maintenance and optimization of the central line, improving mother-infant interaction, reducing the risk of bronchopulmonary dysplasia and hypothermia, reducing the exposure of infants to various stressors, and implementing the family-centered care approach.


**OBJECTIVE:** To assess the effect of range-of-motion exercise program on bone mineralization and somatic growth of very low birth weight (VLBW) infants.

**STUDY DESIGN:** A total of 36 VLBW infants were randomized into 18 VLBW infants receiving range-of-motion exercise and 18 VLBW control infants receiving tactile stimulation for 4 weeks. Laboratory investigations were performed at baseline and postexercise and included serum calcium, serum phosphorus (s.P04), magnesium, alkaline phosphatase (ALP), urinary calcium/phosphate ratio, and serum carboxy-terminal cross-linked telopeptide of type 1 collagen (CTX). Dual-energy X-ray absorptiometry was performed at the end of the exercise protocol to measure bone mineral content, bone mineral density (BMD), bone area, lean mass, and fat mass.

**RESULTS:** The weight and the rate of weight gain were significantly higher \((p < 0.001)\) in the exercise group compared with controls postexercise. Also, higher s.P04, lower ALP, and lower urinary calcium/phosphate ratio were observed postexercise in the exercise group \((p = 0.001, p = 0.005, \text{and } p = 0.04, \text{respectively})\) whereas, serum CTX showed no difference between the two groups \((p = 0.254)\). Postexercise BMD significantly improved in the exercise group \((p < 0.001)\) compared with controls.

**CONCLUSION:** Although the sample size was small, we may be able to suggest favorable effects of range-of-motion exercise versus tactile stimulation on bone metabolism, BMD, and short-term growth in VLBW infants.


**PURPOSE:** The aim of the current study was to review neuromuscular development, summarize the current body of evidence describing the use of neuromuscular electrical stimulation (NMES) therapy in infants, and identify possible contraindications for the use of NMES in the neonate and young infant.

**METHOD:** After a review of the literature describing neuromuscular development, we created a timeline of the developmental processes. Key milestones were determined, and a literature search was conducted to identify potential effects of electrical stimulation on this process.

**RESULTS:** Current evidence supporting the use of NMES in the pediatric population is limited and of poor quality. Contraindications of the use of NMES in the neonate and young infant were identified, including (a) inhibited expression of the neural cell adhesion molecule that is vital for neuromuscular development, (b) alteration of muscle fiber type metabolic profile away from intended muscle fiber type morphology, and (c) interruption of postsynaptic acetylcholine receptor synthesis during neuromuscular junction development.

**CONCLUSION:** The use of NMES for the treatment of dysphagia in the neonate and young infant may influence early neuromuscular development in a manner that is not currently well understood. Future research is needed to further understand the effects of NMES on the developing neuromuscular system.
INTRODUCTION: Preterm birth has major medical, psychological and socioeconomic consequences worldwide. Music therapy (MT) has positive effects on physiological measures of preterm infants and maternal anxiety, but rigorous studies including long-term follow-up are missing. Drawing on caregivers’ inherent resources, this study emphasises caregiver involvement in MT to promote attuned, developmentally appropriate musical interactions that may be of mutual benefit to infant and parent. This study will determine whether MT, as delivered by a qualified music therapist during neonatal intensive care unit (NICU) hospitalisation and/or in home/municipal settings following discharge, is superior to standard care in improving bonding between primary caregivers and preterm infants, parent well-being and infant development.

METHODS AND ANALYSIS DESIGN: international multicentre, assessor-blind, 2x2 factorial, pragmatic randomised controlled trial; informed by a completed feasibility study.

PARTICIPANTS: 250 preterm infants and their parents.

INTERVENTION: MT focusing on parental singing specifically tailored to infant responses, will be delivered during NICU and/or during a postdischarge 6-month period.

PRIMARY OUTCOME: changes in mother–infant bonding at 6-month corrected age (CA), as measured by the Postpartum Bonding Questionnaire.

SECONDARY OUTCOMES: mother–infant bonding at discharge and at 12-month CA; child development over 24 months; and parental depression, anxiety and stress, and infant rehospitalisation, all over 12 months.


Advances in neonatal care have improved survival of premature and critically ill infants; and while rates of some long-term neurodevelopmental problems in survivors have improved, such as cerebral palsy, there are others such as learning and behavioural difficulties that have not. The goal of improving long term neurodevelopmental morbidity has led to an increased focus on improving developmental care not only in neonatal long term follow-up clinics but within the NICU itself to capture the period of earliest brain neuroplasticity. The application of a systematic approach to improve practice is considered the most effective strategy for implementing neuroprotective developmentally supportive care. The content of this paper incorporates evidence-based systematic reviews to guide clinicians in the application of developmentally supportive interventions.


OBJECTIVES: St. Michael’s Hospital launched a volunteer cuddling program for all infants admitted into the neonatal intensive care unit in October 2015. The program utilizes trained volunteers to cuddle infants when caregivers are not available. This was a pilot study to assess the impact of a volunteer cuddle program on length of stay (LOS) and feasibility of implementation of the program.

METHODS: A mixed methods approach was utilized to measure both quantitative and qualitative impact. A pilot cohort study with a retrospective control group assessed the feasibility of implementing a volunteer cuddling program for infants with neonatal abstinence syndrome (NAS). Length of stay was used as a surrogate marker to measure the impact of cuddling on infants being treated for Neonatal Abstinence Syndrome. Focus groups using semi-structured interviews were conducted with volunteers and nurses at the end of the pilot study.

RESULTS: LOS was reduced by 6.36 days (U=34, P=0.072) for infants with NAS in the volunteer cuddling program. Focus groups with both bedside nurses and program volunteers described a positive impact of cuddling programs on infants, families, staff, and volunteers alike.

CONCLUSIONS: The study results suggest that the volunteer cuddling program may reduce LOS in infants with NAS and have potential economic savings on hospital resources. However, larger prospective cohort studies are needed to confirm these results.

OBJECTIVE: Neonatal abstinence syndrome (NAS) has risen drastically over the past decade. Infants with NAS experience extreme discomfort and developmental delays when going into withdrawal. Management includes multiple supportive and nonpharmacologic therapies as first-line treatments in an effort to reduce or prevent the need for medication management. Acupuncture has demonstrated efficacy in adults experiencing withdrawal from addictions, as well as for treating many other conditions in pediatric patients who have similar symptoms to withdrawal. The purpose of this review is to evaluate the safety and efficacy of acupuncture for neonates in withdrawal.

MATERIALS AND METHODS: This review was guided by the Arksey and O’Malley methodological framework, and analysis was performed based on a social ecological model. The PRISMA [Preferred Reporting Items for Systematic Reviews and Meta-Analyses] statement was used to organize selected publications, and a flow chart was created to display the search process. PubMed, EMBASE, Cumulative Index to Nursing and Allied Health Literature, and the Cochrane Databases were searched for relevant publications.

RESULTS: Acupuncture appears to be safe and effective for reducing withdrawal symptoms in infants, and, thus, should be considered as an additional nonpharmacologic treatment option for NAS.


PURPOSE: Sitting delays in infants born preterm compound cognitive and language deficits. This retrospective study examines differences in prematurity-related risk and compares developmental outcomes between sitters and nonsitters at 6 months' adjusted age.

METHODS: A total of 105 graduates of the neonatal intensive care unit met inclusion criteria. Infant demographic and medical risk profiles and 6-month Bayley Scales of Infant Development-3rd edition (BSID-III) cognitive and language scores were retrieved. Infants who sat with hands free greater than 60 seconds were classified as “sitters.”

RESULTS: Sixty-nine percent of the sample were nonsitters and were born earlier, had lower birth weights, were chronologically older at follow-up, and spent more days with respiratory support. BSID-III scores were significantly higher in sitters but did not differ by gender, multiple birth, head ultrasound results, payment type, or race/ethnicity.

CONCLUSION: Sitting abilities at 6 months' adjusted age are associated with prematurity risk factors. Cognitive and language scores differ significantly between sitters and nonsitters.


OBJECTIVE: To evaluate the effects of massage therapy on total serum bilirubin (TSB) levels and frequency of defecation, urination, and feeding in newborns who receive phototherapy for indirect hyperbilirubinemia.

DESIGN: A randomized controlled clinical trial.

SETTING: Ankara University Cebeci Research and Training Hospital and 29 May State Hospital in Ankara, Turkey.

PARTICIPANTS: Fifty full-term newborns with indirect hyperbilirubinemia who underwent phototherapy.

METHODS: The newborns were randomly allocated to an intervention group (n = 25) or a control group (n = 25). Newborns in the intervention group received massage therapy throughout the duration of phototherapy for 15 minutes twice per day; newborns in the control group received routine care during phototherapy. Every 24 hours, TSB levels were measured, and the mean values of frequency of defecation, urination, and feeding were also calculated for each newborn.

RESULTS: We found no differences in the characteristics of the newborns or in TSB levels between groups at enrollment. After treatment, TSB levels were lower in the intervention group (p < .001). Frequencies of defecation, urination, and feeding were significantly greater in the intervention group than in the control group.

CONCLUSION: Massage therapy had significant effects on TSB levels, feeding, breastfeeding, defecation, and urination in newborns who received phototherapy for indirect hyperbilirubinemia. Massage therapy can be added as routine care for full-term newborns with hyperbilirubinemia under phototherapy and may be an effective supplementary intervention.

Developmental care interventions, which may promote preterm infant’s neurodevelopment during the hospitalization in the Neonatal Intensive Care Unit, should be implemented and integrated to care delivered by nurses, other healthcare professionals, and parents. These interventions may have an impact on the preterm infants’ developing brain and optimize their short and long-term health outcomes. Based on a previous narrative overview, more high-quality research is still needed in this field. Nevertheless, best practice of developmental care can still be recommended to improve today’s neonatal clinical practice. The aim of this article is to provide both practice and research recommendations according to the seven categories of developmental care interventions in the neonatal intensive care unit: family-centered care, sleep protection, assessment and management of pain, infant positioning, optimized infant-driven feeding, administration of human milk, and control of the environmental light and noise.


**PURPOSE:** The purpose of this study was to investigate physicians’ and nurses’ perspectives on the challenges of implementing the FCC in the neonatal intensive care unit.

**DESIGN AND METHOD:** The study employed a qualitative design to conduct five focus groups with 25 nurses and 15 physicians (n = 40). All of the nurse participants identified as female; 73% held a bachelor’s degree in nursing and 59% had been working as a neonatal nurse for >10 years. Of the physicians, 55% identified as male, 43% held positions as neonatologists and 39% had a minimum of 3 years of experience in neonatal intensive care.

**RESULTS:** Three themes, *power imbalance*, *psychosocial issues*, and *structural limitation*, and related sub-themes were constructed using thematic analyses.

**CONCLUSION:** The implementation of family-centered care in the neonatal intensive care unit in Iran is shaped by the health care provider, cultural, legal and operational challenges. To optimize effective and sustained implementation, these influential factors must be addressed.

**IMPLICATIONS:** Organizational, managerial and operational changes are required for FCC implementation. Nurses and physicians are well-positioned as leaders and facilitators of family-centered care implementation within the neonatal intensive care unit.


**OBJECTIVE:** To examine whether a brief reaching training with sticky mittens was effective to improve reaching behavior in newly reaching preterm infants.

**METHODS:** In this randomized controlled trial, twenty four 5-month-old (±16-week-old corrected age) preterm infants were randomly allocated into experimental or control groups. Infants were assessed three times in a single session: pretraining (immediately before training), posttraining (immediately after training), and retention (4 min after the posttraining). During training, infants in the experimental group wore open fingers Velcro covered mittens. Training consisted of one 4-minute session of stimulated reaching using Velcro covered toys. Controls did not receive the training. During assessments, infants were placed in a baby chair and toys without Velcro were offered at their midline for 2 min. Number of total reaches, proximal adjustments and distal adjustments of reaching were primary outcomes. Grasping was a secondary outcome.

**RESULTS:** Groups were similar in the pretraining. In the posttraining, trained infants performed greater amount of total reaches and bimanual reaches than untrained infants. Greater amount of bimanual reaches in trained infants was maintained in the retention test. Distal adjustments and grasping outcome were not influenced by the training.

**CONCLUSIONS:** A brief-term training with open fingers sticky mittens benefited reaching behavior and favored retention of increased bimanual reaches in newly reaching late preterm infants. However, it was not sufficient to influence hand openness and early grasping.

The present study aims to describe the benefits of physiotherapist insertion on the profile of low risk preterm infants admitted to a neonatal intensive care unit. Retrospective case-control study with consultation of medical records of preterm infants admitted in 2006/2007 without physical therapy (PREF) and in 2009/2010 with physical therapy for up to 8h/day (POSF). We included 61 preterm infants in the PREF period and 93 preterm infants born at ≥1000g, SNAP-PE II <40, with ventilatory support time ≥24h. Maternal and newborn profiles, length of stay, invasive and noninvasive mechanical ventilation and oxygen therapy were verified. Descriptive analysis, Mann Whitney test, t-test, chi-square and Fisher tests were performed, considering p≤0.05. There was a significant difference between gestational ages [PREF: 230.5 (± 16.5) / POSF: 226 (± 15); p = 0.05], sepsis frequency [PREF: 6 (10%) / POSF: 30 (32%); p <0.01], respiratory distress syndrome [PREF: 11 (18%) / POSF: 43 (46%); p <0.01], need for resuscitation in the delivery room [PREF: 10 (16%) / POSF: 32 (34%); p = 0.02], need for orotracheal intubation [PREF: 8 (13%) / POSF: 26 (28%); p = 0.05], noninvasive ventilation time [PREF: 0.1 ± 0.4 days / POSF: 0.8 ± 2.3 days; p <0.01], invasive ventilation time [PREF: 0.4 ± 1.3 days / POSF: 1.3 ± 3.3 days; p = 0.04], continuous positive airway pressure [PREF: 1.5 ± 1.0 days / POSF: 2.7 ± 3.8 days; p = 0.04].


With opioid use in North America rising, there is a growing incidence of neonatal abstinence syndrome (NAS). Infants with NAS experience withdrawal signs that interfere with their occupational performance in activities of daily living. This scoping review aims to identify the non-pharmacologic interventions currently used in the treatment of infants with NAS that fall within the scope of the occupational therapy profession. Searching three databases, articles were independently reviewed by two authors to meet defined inclusion criteria. Forty-five articles were included, and the interventions identified and organized according to the Person-Environment-Occupation Model. The non-pharmacologic interventions identified fall within the scope of the occupational therapy profession. Initiating occupational therapy services in an acute care setting may have the potential to improve occupational performance and engagement for these infants from an early age.


Since 2009 the recommendations for speech and language therapy (SALT) staffing levels on neonatal units specified an ‘access to’ model, leading to a wide discrepancy in delivery of services across the UK. A comparative quality improvement project (QIP) was delivered in 2017–2018 to determine if regular integrated presence versus historical ‘access to’ SALT service could influence best practice on a level 2 neonatal unit. Provision of 0.4wte Band 7 SALT to a 18 bed unit over 7 months was agreed. Findings showed a quantifiable increase in referral rates, patterns, and SALT initial assessment response times during QIP. A range of best practice developmental and therapeutic SALT interventions was recorded during QIP, previously not achievable with historical ‘access to’ model. This QIP could be used to provide evidence of the justified need for regular presence and integrated SALT on a neonatal unit.


BACKGROUND: The following article constitutes an effort to make explicit an experience in neonatology within the framework of the exercise of occupational therapy, a discipline belonging to the health sciences. The occupational therapist (OT) in the Neonatal Intensive Care Unit in which he participates in an interdisciplinary health group. Exalts the interaction of person-environment-occupation-performance. Encourage self-regulation of the baby. Encourage family participation in co-participation in routine activities.

OBJECTIVE: To determine the realities and knowledge about the practice of OT in the Neonatal Intensive Care Unit (NICU) by the occupational therapist in the interaction between the baby, the occupation, the caregivers and the environment of the NICU.

METHODS: A systematic exploratory review of the performance of the OT in the NICU was made. Results: The results transcended the thematic variables, the theories, the methods, the approaches, the characteristics of the baby, the occupations, and the contexts of the management of the premature baby.
CONCLUSION: The education in concepts concerning the occupation of the baby, the interaction with her/his environment and her/his caregivers, the procedures, the guide for the stimulation as the modification of the physical, temporal and social environment facilitate the self-regulation of the baby and we will all be working in pro of your recovery.


Despite evidence of short- and long-term benefits of developmental care, several studies have documented nurses’ lack of knowledge and skills related to developmental care concepts. This study aims to enhance neonatal nurses’ abilities to acquire care practices (knowledge and skills) regarding Developmental Supportive Care (DSC). A nonrandomized before and after intervention design was adopted to improve the knowledge and skills of staff nurses in DSC practices for preterm infants in Level III B NICU. The study included 50 level III B NICU nurses (25 in interventional group, 25 in control group) located within a tertiary care hospital in India. A significant increase in the mean knowledge score was seen among participants in the intervention group (pre-test: 16.6 ± 3.1, post-test: 29.9 ± 4.1, p = 0.01) but not in the control group (pre: 16.4 ± 2.2, post: 18.6 ± 3.6, p = 0.98). The improvement in the skills of providing DSC among neonatal nurses was also higher in the intervention group (106.4 ± 7.4) relative to the control group (65.8 ± 3.6), p < 0.01, at 0.05 level of significance. The Developmental Supportive Care Program (DSCP) had a significant impact in improving the knowledge and skills of nurses in providing care and preventing complications in preterm infants.


AIMS AND OBJECTIVES: This qualitative study explored the experiences of neonatal nurses with facilitating closeness between parents and babies with congenital abnormalities in the neonatal intensive care unit (NICU).

BACKGROUND: Babies with congenital abnormalities often require admission to the neonatal intensive care unit. Parents may experience emotional distancing from their baby, due to their response to their baby’s congenital abnormality, as well as physical separation due to the baby’s hospitalisation in the NICU. NICU nurses can help facilitate the development of closeness between babies and parents in the NICU.

METHOD: This qualitative interpretive description study involved face-to-face, semi-structured interviews with twelve neonatal nurses following which the data collected were thematically analysed. The consolidated criteria for reporting qualitative research (COREQ) checklist were used in preparing this paper.

RESULTS: Three major themes emerged from the analysis—“Everyone copes differently,” “You have to focus on what is the normal thing” and “It’s very much an individualised approach.” Participants often felt unprepared to care for babies with congenital abnormalities and implemented coping mechanisms to overcome the emotional labour they experienced. Skin-to-skin cuddles were considered the most beneficial strategy for parents to develop closeness with their baby. Participants recognised that they sometimes “pushed” parents into engaging with their baby. Participants highlighted the importance of individualised, supportive care for these parents.

CONCLUSIONS: Neonatal nurses require increased education about congenital abnormalities and individualised care to support them in caring for babies with congenital abnormalities.

RELEVANCE TO CLINICAL PRACTICE: Further research is needed on parental experience of developing closeness with a baby with a congenital abnormality in the NICU.


To improve the neurodevelopmental outcome in infants with high grade intraventricular haemorrhage and cramped-synchronised (CS) general movements (GMs). Four very preterm infants with intraventricular haemorrhage grade III (n = 3) or intraventricular haemorrhage with apparent periventricular haemorrhagic infarction (n = 1) were diagnosed with CS GMs at 33 to 35 weeks postmenstrual age. A few days later MIT-PB [Movement Imitation Therapy for Preterm Babies], an early intervention programme, was commenced: the instant an infant showed CS movements, the therapist intervened by gently guiding the infant’s limbs so as to manoeuvre and smoothen the movements, thereby imitating normal GM sequences as closely as possible (at
least for 10 min, 5 times a day, with increasing frequency over a period of 10 to 12 weeks). After a period of consistent CS GMs, the movements improved. At 14 weeks postterm age, the age specific GM pattern, fidgety movements, were normal in three infants, one infant had abnormal fidgety movements. At preschool age, all participants had a normal neurodevelopmental outcome. This report on four cases demonstrates that mimicking normal and variable GM sequences might have a positive cascading effect on neurodevelopment. The results need to be interpreted with caution and replication studies on larger samples are warranted. Nonetheless, this innovative approach may represent a first step into a new intervention strategy.


BACKGROUND: Kangaroo care (KC) improves bonding and neonatal health outcomes worldwide. However, concerns for patient safety, interrupted workflow, and parent readiness continued to impede KC in a level IV neonatal intensive care unit (NICU). Its current policy did not recommend using more than 1 staff member during patient transfer. In addition, NICU staff and parents lacked skills training and education regarding the feasibility of routine KC.

PURPOSE: A KC pathway was developed and integrated within a multifaceted, champion-based, simulated educational training program for NICU staff and families to promote earlier and more frequent KC by increasing their knowledge and comfort with this practice.

METHODS: Patient data collected before and after the study determined the frequency, timing, and mode of respiratory support during KC. Pre- and posttest surveys evaluated nurses’ knowledge and comfort level with KC.

RESULTS: The frequency of KC occurred 2.4 times more after the intervention. The percentage of KC episodes for intubated patients nearly doubled. The posttest survey scores for nursing knowledge and comfort level also markedly improved.

IMPLICATIONS FOR PRACTICE: The KC pathway ameliorated feelings of discomfort by depicting criteria and instructions for safe practice. Multidisciplinary champions were invaluable in assisting the nursing staff with patient transfer during KC.

IMPLICATIONS FOR RESEARCH: More dose–response studies are needed to maximize the clinical benefits of KC in developed countries.

BACKGROUND: Oropharyngeal administration of mother’s Colostrum in early days has an immunoprotective effect in preterm infants.

OBJECTIVES: Our aim was to study the effect of oropharyngeal administration of mother’s milk (OPAMM) on decreasing the incidence ofnosocomial sepsis.

METHODS: In a pilot prospective randomized study on preterm (<32 weeks gestation and 1500 g weight) infants, we compared OPAMM practice (applying 0.2 mL of mother’s colostrum or milk prior to gavage feeding until full oral feeding is reached) with regular gavage feeding. The primary outcome was incidence of culture-proven nosocomial sepsis. Secondary outcomes included bacterial colonization of the gastrointestinal tract, feeding intolerance, time to reach full feeding, incidence of necrotizing enterocolitis, ventilator-associated pneumonia, duration of respiratory support, incidence of bronchopulmonary dysplasia (BPD), length of hospital stay, and neonatal mortality.

RESULTS: The outcomes of 200 neonates (100 in each group) were analyzed. OPAMM practice did not significantly reduce the incidence of culture proven nosocomial sepsis (8% vs 13%, P = 0.35). Infants in the OPAMM group had a significantly lower growth of Klebsiella species in the oropharyngeal pouch, borderline lower incidence of ventilator-associated pneumonia, shorter duration of oxygen therapy, less episodes of feeding intolerance, reached full feeding earlier, and had a shorter length of hospital stay. OPAMM practice did not affect the incidence of necrotizing enterocolitis, BPD, or neonatal mortality.

CONCLUSION: OPAMM prior to gavage feeding does not reduce the incidence of nosocomial sepsis but had beneficial effects on early achievement of feeding, and early hospital discharge in preterm very low-birth-weight infants.


CONTEXT: Having premature and very low birth weight infants in the Neonatal Intensive Care Unit (NICU), is disempowering for mothers as they lost autonomy over their behavior and lost autonomy over beginning to establish a close relationship with their neonates. Mothers highly value Breastfeeding/breast milk feeding as it is the ‘one thing that only the mother can do to protect and improve their neonates’ health.

AIM: Evaluate the effect of colostrum feeding intervention on the clinical and nutritional outcomes of very low birth weight infant.

METHODS: A quasi-experimental research design utilized to achieve the aim of this study. A convenient sample of 80 mothers of very low birth weight infants subjected to colostrum feeding intervention program. Their 80 very low birth weight infants (divided randomly into two groups) study and control groups to examine the effect of the colostrum feeding intervention on their clinical and nutritional outcomes versus artificial milk feeding. Three research tools used that were structured interview questionnaire, mothers’ practice observation checklist, and very low birth weight clinical and Nutritional outcomes’ record.

RESULTS: the study reveals a significant improvement of mother knowledge and practices after colostrum feeding intervention at post and follow up compared to their pre-intervention level. The study also revealed a statistically significant difference in all clinical and nutritional outcomes between infants of the study and control groups.

CONCLUSION: A significant improvement in mothers’ knowledge and practice regarding colostrum feeding intervention. The study group of very low birth weight infants had a rapid growth rate, better nutritional outcomes, lesser complications compared with the control group. The study recommended tailored intervention programs for mother that expecting a very low birth weight infant. Besides, policies for training midwives at maternity centers and hospitals early to initiate colostrum feeding. Further research with larger sample size recommended to determine if early colostrum administration can affect positively on very low birth weight infants outcomes.

BACKGROUND: Very preterm infants (< 32 weeks gestation) have a relatively high nutrient requirement for growth and development. The composition of human milk is often inadequate to ensure optimal growth so it is common to fortify human milk for very preterm infants with nutrient fortifiers based on bovine milk. However, there are concerns that bovine milk-based fortifiers may increase the risk of feeding intolerance, necrotizing enterocolitis and late-onset sepsis. We hypothesize that a bovine colostrum-based product is a suitable alternative to bovine milk-based products when used as a fortifier to human milk in very preterm infants.

METHODS/DESIGN: In an open-label multicentre randomised controlled pilot trial, 200 very preterm infants (26 + 0 to 30 + 6 weeks gestation at birth) will be randomly allocated to a bovine colostrum-based or a bovine milk-based fortifier added to mother’s own milk and/or human donor milk. Outcomes are growth rate, incidence of necrotizing enterocolitis and late-onset sepsis, a series of paraclinical endpoints, and practical feasibility of using the novel fortifier for very preterm infants.

DISCUSSION: The optimal enteral diet and feeding regimen for very preterm infants remain debated; this clinical trial will document the feasibility, safety and preliminary efficacy of using bovine colostrum, rich in nutrients and bioactive factors, as a novel fortifier for human milk to very preterm infants. Data on infant growth, metabolism, gut function and immunity will be assessed from clinical data as well as blood and stool samples.


BACKGROUND AND OBJECTIVES: In very low birth weight (VLBW) newborns, parenteral nutrition (PN) is delivered via a peripheral venous catheter (PVC), a central venous catheter (CVC), or a peripherally inserted central venous catheter (PICC). Up to 45% of PICCs are accompanied by complications, the most common being sepsis. A PVC is an unstable PN delivery technique requiring frequent change. The growth and neurodevelopment of VLBW newborns may be disturbed because of catheters used for early PN delivery and complications thereof. The aim of the conducted study was to evaluate the effect of two PN delivery techniques (PICC and PVC) on anthropometric parameters and neurodevelopment of VLBW newborns.

MATERIALS AND METHODS: A prospective randomized clinical trial was conducted in VLBW (≥750<1500 g) newborns that met the inclusion criteria and were randomized into two groups: PICC and PVC. We assessed short-term outcomes (i.e., anthropometric parameters from birth until corrected age (CA) 36 weeks) and long-term outcomes (i.e., anthropometric parameters from CA 3 months to 12 months as well as neurodevelopment at CA 12 months according to the Bayley II scale).

RESULTS: In total, 108 newborns (57 in the PICC group and 51 in the PVC group) were randomized. Short-term outcomes were assessed in 47 and 38 subjects, and long-term outcomes and neurodevelopment were assessed in 38 and 33 subjects of PICC and PVC groups, respectively. There were no differences observed in anthropometric parameters between the subjects of the two groups in the short-and long-term. Mental development index (MDI) < 85 was observed in 26.3% and 21.2% (p = 0.781), and psychomotor development index (PDI) < 85 was observed in 39.5% and 54.5% (p = 0.239) of PICC and PVC subjects, respectively.

CONCLUSIONS: In the short- and long-term, no differences were observed in anthropometric parameters of newborns in both groups. At CA 12 months, there was no difference in neurodevelopment in both groups.


AIM: Moderate–late preterm (MLPT) babies account for over 80% of preterm babies born world-wide. Many MLPT babies require early nutritional support while full sucking feeds are established, but there is little evidence to guide practice. We aimed to determine current practice in Australia and New Zealand.

METHODS: An electronic survey was sent to neonatal clinical directors within the Australia and New Zealand Neonatal Network requesting dissemination to colleagues involved in the care of MLPT babies (32–35+6 weeks’ gestation). The questionnaire asked about respondents’ nutritional management of MLPT babies and included scenarios for both moderate- (MPT) and late preterm (LPT) babies.

RESULTS: There were 83 respondents. While waiting for mothers’ milk to meet prescribed fluid volumes, 61% (MPT) to 53% (LPT) of respondents would provide dextrose 10% as the first nutritional support, with 15% (MPT) to 38% (LPT) providing infant formula. Of clinicians providing 10% dextrose, 31% (MPT) to 49% (LPT) were happy to do so for ≥3 days, with 5% comfortable doing so for 5 days in moderately preterm babies,
before providing additional support. This additional support was infant formula in 73% (MPT) to 90% (LPT) of respondents.

CONCLUSIONS: There is variation in the nutritional management of MLPT infants amongst neonatal clinicians, likely due to the lack of evidence from randomised controlled trials on which to base clinical practice. The majority of clinicians are happy providing only dextrose 10% for up to 2–3 days despite this form of nutritional support containing only carbohydrate.


BACKGROUND: Reflexology means the application of the manual the pressure to specific points of the feet called "reflex points" that are believed to correspond to other parts of the body. The study aimed to assess the effect of reflexology strategy on the mother’s breast milk volume and their premature weight gain.

DESIGN: An experimental design was used to conduct the study. A convenience sample of 120 Primiparous mothers and their preterm infants was chosen based on systematic simple random.

METHODS: Three tools were designed by the researchers to collect the necessary data to implement the reflexology strategy framework. 1.Structured interview questionnaire sheet, 2. Assessment observational checklist sheet for Premature using 2 scales: A. Transitioning from tube feeds to oral feeds, B. The Preterm Infant Breastfeeding Behavior Scale, three Evaluation Phase observational checklist based on Mother-Infant-Breastfeeding Progress Tool (MIBPT):

STATISTICAL ANALYSIS: The collected data were coded, analyzed, figured and tabulated using frequencies and percentage, mean, standard deviation & chi-square tests.

RESULTS: There were a statistically significant difference and marked improvement in reflexology group total scores of feeding performance (P < 0.001) after intervention for 6 weeks approved of reflexology strategy. Reflexology group majority (88.3%) demonstrated good breastfeeding as compared to (55.2%) in the study group.

CONCLUSION: The present study highlights the effect of reflexology strategy on the mother’s satisfaction, breast milk volume, and their premature weight gain. On the other hand, intervention accelerates the early transition of premature from the tube feeding to breastfeeding and discharge from the hospital.

RECOMMENDATION: In-service education program could be designed and implemented in the pediatric field to enable the nurses to apply reflexology strategy to improve empower early transitioning of the preterm from tube feeds to breastfeeding and early discharge. Reflexology strategy is non-pharmacological, simple, noninvasive and cheap technique would be welcomed by the nurses, physicians and mothers.


OBJECTIVE: To determine the diagnostic accuracy of videofluoroscopy (VFSS) and endoscopy (FEES) in detecting laryngeal penetration and tracheal aspiration in bottle-fed young infants in the NICU.

STUDY DESIGN: VFSS and FEES findings of 22 infants were compared to each other and to a composite reference standard in this prospective study. Sensitivity, specificity, positive and negative predictive values were calculated for each assessment.

RESULT: Agreement between VFSS and FEES was high (92%) for aspiration and moderate (56%) for penetration, with FEES detecting more instances of penetration. Compared to the composite reference standard, FEES had greater sensitivity and a higher negative predictive value for penetration than VFSS. Because of the low prevalence of aspiration, diagnostic accuracy could not be determined for aspiration for either assessment.

CONCLUSION: FEES appears to be more accurate in detecting penetration in this population, and both assessments are valuable tools in a comprehensive feeding and swallowing evaluation.


OBJECTIVE: To identify the existing literature on mothers’ perception towards the impact of expressing breast milk for their premature infant in the neonatal intensive care unit.

METHOD: Guided by the PRISMA Statement review checklist, a systematic review of the Scopus and Web of Science database has identified 10 related studies. The articles were assessed and analyzed after evaluated
using The Joanna Briggs Institute Critical Appraisal tools (JBI). Thematic analysis was obtained after using Nvivo software as a tool for data analysis by author.

RESULT: Further review of these articles resulted in three main themes—maternal changes during expressing breast milk, pumping challenges and impact of motivation factors to initiating lactation.

CONCLUSION: Expressing breast milk should be recognized as an important way to restructure motherhood with a preterm infant in NICU. However, maintaining expressed breast milk during preterm infants’ treatment period in NICU may increase stress and difficulties for some mothers. Some recommendations are emphasized in relation to the need for more qualitative studies in this issue, which is to have a specific and standard systematic review method for guiding research synthesis in context of climate change adaptation.


OBJECTIVES: To compare the impact of Baby-Friendly designation vs rates of in-hospital breastfeeding initiation on breastfeeding outcomes at 3, 6, and 12 months postdischarge.

STUDY DESIGN: Breastfeeding outcome data from the 2018 Centers for Disease Control (CDC) Breastfeeding Report Card were used as a basis for determining outcomes from the corresponding 2015 birth cohort. Linear regression models were used to determine the strength of association of breastfeeding initiation and Baby-Friendly hospital penetrance and attainment of postdischarge breastfeeding rates. All hospital births from all 50 states, 3 territories, and the District of Columbia were included in the study.

RESULTS: Statewide breastfeeding initiation rates were positively associated with targeted breastfeeding outcomes. Similar associations were not found for Baby-Friendly hospital designation penetrance.

CONCLUSIONS: To attain the Healthy People 2020 breastfeeding objectives, future public policy initiatives should consider the interaction of population demographics, individual hospital programs, and public health strategies used to support breastfeeding in states reporting high breastfeeding initiation rates.


BACKGROUND: The benefits of human milk for hospitalized preterm infants are well documented, but the extent to which current human milk diets adequately support growth is uncertain. OBJECTIVES: 1) To quantify differences in weight gain and head growth between very preterm infants fed human milk compared with infant formula; and 2) to describe trends in the magnitude of these differences over time.

METHODS: We studied infants from 777 US NICUs in the Vermont Oxford Network database. We included all surviving infants 23-29 weeks of gestation or 401-1500 g birth weight (maximum gestational age 32 wk) and excluded infants discharged >42 weeks of gestation or with congenital anomalies. In diet-growth analyses, we included infants born 2012-2016 (n = 138,703) to reflect current practice. In trend analyses, we included a 10-y cohort (n = 263,367). We categorized diet at NICU discharge/transfer as: 1) human milk only (no formula or fortifier); 2) human milk with formula or fortifier (mixed); or 3) infant formula only. Outcomes were weight and head circumference z-score change from birth to discharge relative to a fetal reference.

RESULTS: Diet at discharge/transfer was human milk only for 18,274 (6.6%), mixed for 121,621 (44%), and formula only for 137,067 (49%). Weight deviated more from the fetal reference for infants fed both human milk diets compared with formula only (weight z-score change for infants fed human milk only, -0.88; mixed, -0.82; formula only -0.80; P < 0.0001 for diet overall). There were also differences by diet in head z-score change (human milk only, -0.52; mixed, -0.49; formula only, -0.45; P < 0.0001 for diet overall). The magnitude of these differences has diminished substantially over 10 y.

CONCLUSIONS: Very preterm infants receiving human milk compared with infant formula diets have a slower weight gain and head growth at hospital discharge.


Preterm infants are at increased risk of alterations in brain structure and connectivity, and subsequent neurocognitive impairment. Breast milk may be more advantageous than formula feed for promoting brain development in infants born at term, but uncertainties remain about its effect on preterm brain development and the optimal nutritional regimen for preterm infants. We test the hypothesis that breast milk exposure is associated with improved markers of brain development and connectivity in preterm infants at term equivalent age. We collected information about neonatal breast milk exposure and brain MRI at term
equivalent age from 47 preterm infants (mean postmenstrual age [PMA] 29.43 weeks, range 23.28-33.0). Network-Based Statistics (NBS), Tract-based Spatial Statistics (TBSS) and volumetric analysis were used to investigate the effect of breast milk exposure on white matter water diffusion parameters, tissue volumes, and the structural connectome. Twenty-seven infants received exclusive breast milk feeds for ≥75% of days of in-patient care and this was associated with higher connectivity in the fractional anisotropy (FA)-weighted connectome compared with the group who had < 75% of days receiving exclusive breast milk feeds (NBS, p = 0.04). Within the TBSS white matter skeleton, the group that received ≥75% exclusive breast milk days exhibited higher FA within the corpus callosum, cingulum cingulate gyri, centrum semiovale, corticospinal tracts, arcuate fasciculi and posterior limbs of the internal capsule compared with the low exposure group after adjustment for PMA at birth, PMA at image acquisition, bronchopulmonary dysplasia, and chorioamnionitis (p < 0.05). The effect on structural connectivity and tract water diffusion parameters was greater with ≥90% exposure, suggesting a dose effect. There were no significant groupwise differences in brain volumes. Breast milk feeding in the weeks after preterm birth is associated with improved structural connectivity of developing networks and greater FA in major white matter fasciculi.


BACKGROUND: Preterm very-low-birth-weight (≤1500 g) infants exhibit disproportionate weight-for-length growth in the Neonatal Intensive Care Unit.

LOCAL PROBLEM: High frequency of body mass index (BMI) > 90th centile at discharge and 1-year postnatal age associated with elevated blood pressure and serum leptin in infancy and adolescence.

METHODS: Single-institution quality improvement project in appropriately grown infants born at 23\(^{0/7}\)-28\(^{6/7}\) weeks gestational age and discharged home.

INTERVENTION: Adjustable feeding protocol based on valid serial length measurements (board or caliper).

RESULTS: The average monthly percentage of weight-for-length disproportion at discharge decreased from 13% in Epoch 1 to 0% in Epoch 2 (P < 0.05). Although the average Z-score for BMI at discharge was lower in Epoch 2 versus Epoch 1 (P < 0.01), this was absent by 1 year follow-up (P = 0.91).

CONCLUSIONS: Adjustable feedings plus use of accurate serial length measurements decreases weight-for-length disproportion at hospital discharge but not at 1 year.


OBJECTIVE: To evaluate the clinical effect of pacifier use on orogastric tube-fed preterm infants. METHODS: The non-blinded randomised controlled study was conducted between October 2014 and November 2015 at the neonatal intensive care unit of a large public-sector hospital in Ankara, Turkey, and comprised preterm infants aged 31-36 gestational weeks with a birth weight of 1000g or above who had no congenital or neurological disease and were fed by orogastric tube. Through computer-generated simple randomisation, the subjects were divided into pacifier (intervention) and non-pacifier (control) groups. SPSS 17 was used to analyse data and compare the groups.

RESULTS: There were 28 subjects; 14(50%) in each of the two groups. There was no difference between the groups in terms of gender, gestational age, birth weight, length, and head circumference (p>0.05). There was no difference in the weekly head, length, or girth measurements in the groups (p>0.05). In terms of daily weight gain, the intervention group gained 7g more than the control group (p<0.05). The suction action of the pacifier group started earlier than the control group (p<0.001).

CONCLUSIONS: Preterm infants using pacifiers started total oral feeding earlier, gained more weight, and were discharged earlier than the control group.


BACKGROUND: Studies show that 40% to 70% of premature infants exhibit both immature and atypical feeding ability. To establish thresholds of performance and develop efficacious treatments for initiating and advancing oral feedings, we must first identify the nutritive sucking performance measures impacted by preterm birth.

AIMS: To compare objective measures of neonatal nutritive sucking between full term and preterm infants at hospital discharge.
STUDY DESIGN AND METHODS: This was a prospective observational study including full term (FT; N = 32) and preterm (PT; N = 44) infants. Nutritive sucking performance at discharge was assessed. The outcome measures of interest were means and coefficients of variability of nutritive sucking peak amplitude, frequency, duration, and smoothness, and feeding-related length of stay.

RESULTS: There was a significant difference in sucking performance between groups; FT infants demonstrated significantly lower mean suck frequency, with longer suck duration and greater suck smoothness as compared to PT. PT infants had significantly less variability in suck amplitude and frequency as compared to FT, while FT infants had significantly less variability in suck smoothness as compared to PT. Post hoc regression analyses found suck frequency alone accounted for 28% of the variance in feeding length of stay for PT; suck smoothness alone accounted for 34% of the variance in feeding length of stay for FT.

CONCLUSIONS: Suck frequency may be an important intervention target for PT infants having difficulty transitioning to oral feeding. Suck smoothness may be a sensitive marker for identifying infants at high risk for feeding challenges.


BACKGROUND: There are emerging evidences that support more aggressive feeding advancement among preterm infants. Our NICU had conservative feeding advancement guidelines that delayed enteral feeding and prolonged central line use. We aimed to reduce time to full feeds among infants born ≤ 32 0/7 weeks from 12.8 days to 8 days.

METHODS: A multidisciplinary team implemented evidence-based feeding guidelines using quality improvement methods. Days to full enteral feeds, central line days, necrotizing enterocolitis (NEC) rates, and extrauterine growth restriction (EUGR) rates were analyzed.

RESULTS: Average days to full enteral feeds decreased from 12.8 to 7.7 days and from 17.5 to 9.1 days for infants born ≤ 32 0/7 weeks and ≤ 28 0/7 weeks respectively, without significant change in NEC rate. Central line days decreased by 35%. Insignificant improvement in EUGR rate was found.

CONCLUSIONS: Faster feeding advancement guidelines led to earlier full enteral feeds and reduced central line utilization without increasing complications.


INTRODUCTION: Non-nutritive sucking (NNS) plays an important role in stabilizing the preterm, providing oral muscle training opportunity for nutritive sucking (NS). We aim to determine if the prototype tested allows a precise evaluation of suction pattern characteristics (rhythmic structure and pressure). We also aim to investigate the role of maturation in the variation of NNS an NS pattern in preterm infants.

METHODS: The patented prototype is non-invasive, low-cost and easily applicable to clinical ecological practice, measures the pressure exerted on a pacifier in newborn’s mouth. Samples were acquired continuously during a 10-minute period in 12 preterm (mean gestational age [GA] 29.9 ± 1.6 weeks) and 4 term neonates (GA 39.5 ± 1.4 weeks). Bursts, suctions per burst, pauses, suction frequency and pressure were analyzed to describe temporal structure and dynamic characteristics of NNS.

RESULTS: The NNS pattern was characterized by bursts duration 4.3 ± 2.2 s, number of sucks per burst 7.4 ± 3.2, sucking frequency 2.1 ± 0.4 Hz and sucking pressure 10.3 ± 4.5 mmHg. There were significant differences between the preterm and term groups in NNS sucking frequency (2.1 Hz vs 1.6 Hz; p = 0.008).

CONCLUSION: The device is non-invasive and can easily be used in clinical practice in low GA newborns, in an ecological environment. It allows the evaluation of NNS patterns maturation and, at the same time, the use of the device pacifier promotes NNS, which is important in the process of acquiring feeding autonomy in preterm infants.


BACKGROUND: Olfactory maturation is essential for successful oral feeding. Previous studies have suggested that olfactory stimulation with maternal breast milk may expedite oral feeding skills in the premature infant; however, the optimal developmental window to utilize this intervention and sex-specific responses to stimuli are largely unknown.
OBJECTIVES: To determine individual responses to olfactory stimulation with mother’s own milk (MOM) on feeding outcomes in premature newborns.

MATERIALS AND METHODS: Infants born between 28 0/7 and 33 6/7 weeks’ gestation (n = 36) were randomized to receive either MOM or water (sham) stimulus during the learning process of oral feeding. Clinical and feeding outcomes were recorded. Statistical analyses examined the effect of stimulation with MOM on feeding outcomes stratified for age and sex.

RESULTS: Overall, there was no significant difference between sham infants compared with MOM infants in mean postmenstrual age of full oral feeds (sham: 35 5/7 versus MOM 36 0/7; p = 0.37). However, when stratified by gestational age (GA), infants born <31 weeks' gestation who received MOM stimulation learned to feed sooner than controls (p = 0.06), whereas infants born ≥31 weeks’ gestation learned to feed later than controls (p = 0.20) with a significant interaction (p = 0.02) between the stimulus (MOM versus sham) and dichotomized GA (<31 versus ≥31 weeks). There were no sex differences in response to olfactory stimulus.

CONCLUSIONS: Infants born <31 weeks’ GA who received MOM stimulation learned to feed sooner than control infants and the impact of MOM is significantly different between infants born before or after 31 weeks GA. These data suggest there may be an optimal time in development to utilize maternal breast milk to expedite oral feeding maturation in the premature newborn.


Full-term infants with congenital heart defects (CHD) are at high risk for developmental and feeding difficulties secondary to a complex combination of immature neurological structures, early surgical intervention, postsurgical complications, and disruption in typical care. Infants with CHD often present with neurobehavioral immaturity that resembles that of premature infants, resulting in difficulties in achieving stability in the physiological and behavioral subsystems. This results in poor arousal, muscle tone abnormalities, and poor state regulation, which affect their ability to achieve oral feeding readiness and progress in their oral feeding skills. In fact, a significant number of infants with CHD require supplemental tube feeding upon hospital discharge to meet their nutritional needs. However, despite these unique barriers, the feeding experience for infants with CHD is frequently overlooked and the focus tends to be on higher level oral motor and swallowing skills and volume intake.

Given the growing evidence of neurological immaturity and subsequent neurodevelopmental delays in this population, it is crucial for therapists to recognize neurobehavioral stability as a foundation for a complex neuromotor activity such as oral feeding. This article will discuss how to utilize infant neurobehavioral intervention as part of feeding treatment for children with CHD to help develop appropriate neural pathways for oral feeding.


OBJECTIVE: Despite evidence to support breastfeeding, rates remain low in women on opioid maintenance therapy (OMT). The goal of this review was to synthesize current knowledge regarding interventions to promote breastfeeding in women on OMT.

STUDY DESIGN: A systematic search of databases including PubMed, CINAHL, PsycINFO, Embase, Scopus, Web of Science, and the Cochrane database of systematic reviews was conducted. Key words included breastfeeding, lactation, opioid use disorder, and opioid maintenance therapy. Risk of bias was assessed by two reviewers.

RESULT: Four quasi-experimental studies met inclusion criteria. Improved rates of breastfeeding reached statistical significance in all four. Three studies had moderate to serious risk of bias related to confounding variables. Interventions shared common features, including an integrated approach, a well-prepared multidisciplinary team, nonseparation of mother and newborn, and patient centered care.

CONCLUSIONS: Further research should explore barriers and facilitators to breastfeeding in this vulnerable population.


BACKGROUND: Observational data have shown that slow advancement of enteral feeding volumes in preterm infants is associated with a reduced risk of necrotizing enterocolitis but an increased risk of late-onset sepsis. However, data from randomized trials are limited.
**METHODS:** We randomly assigned very preterm or very-low-birth-weight infants to daily milk increments of 30 ml per kilogram of body weight (faster increment) or 18 ml per kilogram (slower increment) until reaching full feeding volumes. The primary outcome was survival without moderate or severe neurodevelopmental disability at 24 months. Secondary outcomes included components of the primary outcome, confirmed or suspected late-onset sepsis, necrotizing enterocolitis, and cerebral palsy.

**RESULTS:** Among 2804 infants who underwent randomization, the primary outcome could be assessed in 1224 (87.4%) assigned to the faster increment and 1246 (88.7%) assigned to the slower increment. Survival without moderate or severe neurodevelopmental disability at 24 months occurred in 802 of 1224 infants (65.5%) assigned to the faster increment and 848 of 1246 (68.1%) assigned to the slower increment (adjusted risk ratio, 0.96; 95% confidence interval [CI], 0.92 to 1.01; P = 0.16). Late-onset sepsis occurred in 414 of 1389 infants (29.8%) in the faster-increment group and 434 of 1397 (31.1%) in the slower-increment group (adjusted risk ratio, 0.96; 95% CI, 0.86 to 1.07). Necrotizing enterocolitis occurred in 70 of 1394 infants (5.0%) in the faster-increment group and 78 of 1399 (5.6%) in the slower-increment group (adjusted risk ratio, 0.88; 95% CI, 0.68 to 1.16).

**CONCLUSIONS:** There was no significant difference in survival without moderate or severe neurodevelopmental disability at 24 months in very preterm or very-low-birth-weight infants with a strategy of advancing milk feeding volumes in daily increments of 30 ml per kilogram as compared with 18 ml per kilogram.


**OBJECTIVES:** The objectives describe the frequency that inadequate oral feeding (IOF) is the reason why moderately preterm (MPT) infants remain hospitalized and its association with neonatal morbidities.

**STUDY DESIGN:** Prospective study using the NICHD Neonatal Research Network MPT Registry. Multivariable logistic regression was used to describe associations between IOF and continued hospitalization at 36 weeks postmenstrual age (PMA).

**RESULT:** A total of 6017 MPT infants from 18 centers were included. Three-thousand three-seventy-six (56%) remained hospitalized at 36 weeks PMA, of whom 1262 (37%) remained hospitalized due to IOF. IOF was associated with RDS (OR 2.02, 1.66–2.46), PDA (OR 1.86, 1.37–2.52), sepsis (OR 2.36, 95% 1.48–3.78), NEC (OR 16.14, 7.27–35.90), and BPD (OR 3.65, 2.56–5.21) compared to infants discharged and was associated with medical NEC (OR 2.06, 1.19–3.56) and BPD (OR 0.46, 0.34–0.61) compared to infants remaining hospitalized for an alternative reason.

**CONCLUSION:** IOF is the most common barrier to discharge in MPT infants, especially among those with neonatal morbidities.


To answer the clinical question ‘Among late preterm infants are there any interventions that improve the rates of breastfeeding and the use of breast milk compared with current practice?’ MEDLINE via Ovid, Embase via Ovid, the Maternity and Infant Care Database and the Cochrane Library were searched for relevant articles. Articles were excluded if they did not discuss specific interventions to improve breastfeeding, for example, if they only commented on factors such as age, race and education. Articles were also excluded if they were not specific to the late preterm infant population. A total of 516 articles were found and screened by title and abstract independently by two reviewers. The full text of 17 articles was independently reviewed. The reference lists of these full-text articles were screened, and 14 abstracts were subsequently reviewed. The final analysis included three studies. There is limited high-quality research evidence for interventions to improve breastfeeding in late preterm infants. In the absence of robust academic research, clinical practice should be guided by clinical expertise and involve a multidisciplinary team, including qualified lactation consultants. While it seems reasonable for hospitals to support interventions that improve breastfeeding in term infants, managing late preterm infants as healthy term infants without additional specialist support may result in high breastfeeding failure rates among late preterm infants.


Oral feeding competence is a critical milestone needed for proper growth and development in preterm infants. Commonly, the oral feeding process is conceptualized as an infant’s ability to coordinate suck–swallow–
breathe. However, oral feeding is a highly complex multisystem process. In this article, an oral feeding model is presented that takes into consideration the intrinsic and extrinsic factors that influence oral feeding performances. The intrinsic neurophysiologic factors include the musculoskeletal, gastrointestinal, respiratory, cardiovascular, behavioral, and neurologic systems. The extrinsic environmental factors include the physical surroundings, NICU policies, parental attributes, health care practitioners, and feeding equipment. The objectives of this article are to (1) describe the intrinsic and extrinsic factors affecting oral feeding performance of preterm infants in the NICU, (2) introduce a conceptual model of oral feeding that displays the relationship between these factors, and (3) provide a reference guide for health care practitioners to refer to when evaluating an infant’s oral feeding performance.


**OBJECTIVE:** Preterm infants are at risk of encountering oral feeding difficulties which impede on the transition to independent oral feeds. The objective of this study was to identify a pivotal period where regressions are most likely to occur during their oral feeding progression.

**STUDY DESIGN:** This is a retrospective study on 101 infants born <35 weeks’ gestation. The sample was separated into two groups, infants who experienced a regression during their oral feeding progression and those who did not. A pivotal period was defined as a time frame where setbacks (a decrease in oral feed attempts by one) are most likely to occur at the start (1–2 oral feed attempts per day), middle (3–5 oral feed attempts per day), or end (6–8 oral feed attempts per day) of the oral feeding progression.

**RESULT:** Eighty-two percent of infants experienced setbacks; 45% of all setbacks occurred at the middle time frame (p = 0.03). Infants’ degree of maturity and enteral tube feeding intolerances were associated with increased occurrence of setbacks (p = 0.04).

**CONCLUSION:** The midpoint in the oral feeding progression is a pivotal period where setbacks are most likely to occur. This time frame can be used by clinicians to evaluate oral-motor skills for earlier provision of interventions to reduce the occurrence of oral feeding difficulties in this high-risk population.


**BACKGROUND:** Kangaroo mother care (KMC) is an effective way to reduce mortality and morbidity of low-birth-weight babies. KMC feeding aims at the establishment of exclusive breastfeeding (EBF) for every baby. This study was conducted to analyze the actual feeding pattern and factors influencing it.

**METHODS:** Babies getting KMC were prospectively observed and the data related to feeding practice were collected. At discharge, the babies were divided into two groups: EBF and non-EBF. Different factors were compared between these groups.

**RESULTS:** Among 387 babies, 63.56% were on EBF. Postnatal counseling, early contact and initiation of feeding, early expression of breast milk, and first feeding with EBM played a pivotal role behind the establishment of EBF (P < 0.0001). Longer duration of KMC marginally helped in EBF (P = 0.0445).

**CONCLUSION:** To establish EBF in KMC, the promotional measures should be taken since birth even when the baby was critically sick and separated from the mother and KMC was not initiated yet.


**OBJECTIVE:** Given the increase in the birth and survival rate of the premature infants, a need for supportive health care services becomes more evident. The goal of the present study was to examine the effectiveness of the Premature Infant Oral Motor Intervention (PIOMI) in the feeding progression and early intervention. This study was a double-blind randomized clinical trial.

**METHODS:** This clinical trial included premature infants in the neonatal intensive care units (NICUs) of two hospitals in Tehran, who were randomly assigned into intervention and control group, each containing 15 infants. The PIOMI was administered to the intervention group in the course of 10 days. The infants in the control group received routine nursing services. Repeated measures ANOVA (RMA) were analyzed. The postmenstrual age and weight of the participants were examined at the time points of accomplishing one, four, and eight oral feedings a day and at the time of hospital discharge.
**RESULTS:** The intervention group reached the first oral feeding (with a mean of 7.2 days) and eight oral feeding (with a mean of 13.47 days) earlier than the control group. The length of hospital stay in intervention group was significantly shorter ($P = 0.03$). RMA wasn’t statistically significant between groups for weight ($F: 0.76$, $P: 0.39$, $\eta^2: 0.03$); but within-subjects test showed that change of the weight over time and for interaction of time and group was significant ($F: 74.437$, $P < 0.001$, $\eta^2: 0.727$). The effect size of infants’ age in the measurement times was 91%.

**CONCLUSION:** The results revealed that PIOMI is a fruitful method for premature infants. We suggest that PIOMI can be integrated in feeding rehabilitation programs of the premature infants born with gestational age of as young as 26-29 weeks, and applied at 29 weeks postmenstrual age (PMA).


**BACKGROUND:** Premature birth is associated with feeding difficulties due to inadequate coordination of sucking, swallowing, and breathing. Nonnutritive sucking (NNS) and oral stimulation interventions may be effective for oral feeding promotion, but the mechanisms of the intervention effects need further clarifications.

**PURPOSE:** We reviewed preterm infant intervention studies with quantitative outcomes of sucking performance to summarize the evidence of the effect of interventions on specific components of sucking.

**METHODS:** PubMed, CINAHL, MEDLINE, EMBASE, and PSYCOLIST databases were searched for English language publications through August 2017. Studies were selected if they involved preterm infants, tested experimental interventions to improve sucking or oral feeding skills, and included outcome as an objective measure of sucking performance. Specific Medical Subject Headings (MeSH) terms were utilized.

**RESULTS:** Nineteen studies were included in this review: 15 randomized, 1 quasi-randomized, and 3 crossover randomized controlled trials. Intervention types were grouped into 6 categories (i) NNS, (ii) NNS with auditory reinforcement, (iii) sensorimotor stimulation, (iv) oral support, (v) combined training, and (vi) nutritive sucking. Efficiency parameters were positively influenced by most types of interventions, though appear to be less affected by trainings based on NNS alone.

**IMPLICATIONS FOR PRACTICE:** These findings may be useful in the clinical care of infants requiring support to achieve efficient sucking skills through NNS and oral stimulation interventions.

**IMPLICATIONS FOR RESEARCH:** Further studies including quantitative measures of sucking performance outcome measures are needed in order to best understand the needs and provide more tailored interventions to preterm infants.


Breast milk is the preferred form of nutrition for all infants and has been shown to reduce morbidity and improve health outcomes in preterm infants. However, mothers of preterm infants face many challenges initiating and sustaining breastfeeding within the neonatal unit. This scoping review examines evidence-based practices which aim to improve breastfeeding rates in preterm infants at the time of hospital discharge. A literature review identified 17 articles which are included in this review. Supporting evidence was found for the implementation of kangaroo mother care and/or skin-to-skin care, peer counsellors, provision of oropharyngeal colostrum in early infancy and use of donor human milk banks. However, overall it is apparent that high quality research including systematic review and data synthesis in the form of meta-analysis is required in this area to reach sound conclusions regarding recommendations of different interventions. This scoping review provides an important foundation for further research into this area.


Mother’s own milk (MOM) reduces the risk of morbidities in very low birth weight (VLBW) infants. When MOM is unavailable, donor breastmilk (DM) is used, with unclear impact on short- and long-term growth. This retrospective analysis compared anthropometric data at six time points from birth to 20⁻24 months corrected age in VLBW infants who received MOM supplements of preterm formula ($n = 160$) versus fortified DM ($n = 161$) during neonatal intensive care unit (NICU) hospitalization. The cohort was 46% female; mean birth weight and gestational age (GA) were 998 g and 27.3 weeks. Multilevel linear growth models assessed changes in
growth z-scores short-term (to NICU discharge) and long-term (post-discharge), controlling for amount of DM or formula received in first 28 days of life, NICU length of stay (LOS), birth GA, and sex. Z-scores for weight and length decreased during hospitalization but increased for all parameters including head circumference post-discharge. Short-term growth was positively associated with LOS and birth GA. A higher preterm formula proportion, but not DM proportion, was associated with slower rates of decline in short-term growth trajectories, but feeding type was unrelated to long-term growth. In conclusion, controlling for total human milk fed, DM did not affect short- or long-term growth.


We explored parental feeding practices, feeding issues during the first 2 years of life, and the relationship between feeding issues and levels of maternal distress in preterm infants. Four hundred twenty mothers (239 with preterm infants, 181 with full-term infants) participated in the study. The Behavior-Based Feeding Questionnaire for Infants With Premature History and the Parenting Stress Index–Chinese Version were used as the two outcome measures. The results indicated that preterm infants had different feeding experiences compared with their full-term counterparts. They tended to start solid food later in life and had limited experiences in food variation. Parenting stress was prevalent in parents with preterm infants and was associated with the frequency of feeding issues, especially at later ages when supplementary foods were being introduced.


**BACKGROUND:** Premature infants have difficulties in transitioning from gavage to breastfeeding. Targeted interventions to support breastfeeding in premature infants in the neonatal intensive care unit are scarce.

**PURPOSE:** This pilot study evaluates the effectiveness of nonnutritive sucking at the mother’s breast in premature infants to facilitate breastfeeding performance and exclusive breastfeeding.

**METHODS:** The study design constituted a single-blinded randomized control trial, with 9 participants randomly allocated into experimental (n = 4) and control (n = 5) groups. The intervention, nonnutritive sucking at the mother’s breast thrice a day for 5 minutes, till nutritive breastfeeding was started, was done in addition to standard care, which was nonnutritive sucking on a finger during gavage feeds. The control group received only standard care. Nonnutritive sucking was assessed using "Stages of Nonnutritive Sucking Scale," and breastfeeding performance was assessed using the "Preterm Infant Breastfeeding Behavior Scale" by a blinded assessor unaware of the infants’ allocation.

**RESULTS:** Five infants in the control arm and 4 in the intervention arm completed the study. The infants in the intervention group showed faster transition to mature stages of nonnutritive sucking (P = .05) and had longer sucking bursts during breastfeeding (P = .06) than those in the control group. There was no difference in the rates of exclusive breastfeeding at 6 months in the intervention and control groups.

**IMPLICATIONS FOR PRACTICE:** Early initiation of nonnutritive sucking at the mother’s breast in very preterm infants is a safe and effective intervention to facilitate maturation of oral feeding and breastfeeding behavior.

**IMPLICATIONS FOR RESEARCH:** Nonnutritive sucking at the mother’s breast can be explored as an intervention, with a larger sample, to facilitate exclusive breastfeeding and to establish intervention fidelity.


This study aimed to describe and compare breastfeeding progression, infants’ feeding behaviours, maternal feeding difficulties, and mothers’ usage of breastfeeding interventions for singleton late preterm (LPT) and term infants. A further aim was to identify associated factors for exclusive breastfeeding at breast at 1 month in LPT infants. This was a cohort study where mothers of LPT infants from a neonatal unit (n = 60), LPT infants from a maternity unit (n = 62), and term infants from a maternity unit (n = 269) answered a questionnaire approximately 1 month after delivery. Findings showed no significant differences in exclusive breastfeeding at breasts between LPT infants admitted to the neonatal unit compared with the maternity unit, during the first week at home (38% vs. 48%), or at 1 month of age (52% vs. 50%). Term infants were more likely to be exclusively breastfed at the breast (86% and 74%, p < 0.05) compared with LPT infants. Multiple regression analysis showed that usage of a nipple shield, not feeding breast milk exclusively during the first week at home, or feeding less than 10 times per day at 1 month were statistically significant for not exclusively
breastfeed at the breast. A protective factor was the mothers' experience of having an abundance of milk during the first week at home. In conclusion, LPT infants are less likely to be exclusively breastfed at the breast than term infants, highlighting the need for further research to guide interventions aimed at optimising exclusive breastfeeding rates.


**OBJECTIVE:** Higher rates of adverse outcomes have been reported for early term (37 0 to 38 6 weeks) versus full term (≥ 39 0 weeks) infants, but differences in breastfeeding outcomes have not been systematically evaluated. This study examined breastfeeding initiation and exclusivity in early and full term infants in a large US based sample.

**METHODS:** This secondary analysis included 743 geographically- and racially-diverse women from the Measurement of Maternal Stress Study cohort, and 295 women from a quality assessment at a hospital-based clinic in Evanston, IL. Only subjects delivering ≥ 37 weeks were included. Initiation of breastfeeding (IBF) and exclusive breastfeeding (EBF) were assessed via electronic medical record review after discharge. Associations of IBF and EBF with early and full term delivery were assessed via univariate and multivariate logistic regression.

**RESULTS:** Among 872 women eligible for inclusion, 85.7% IBF and 44.0% EBF. Early term delivery was not associated with any difference in frequency of IBF (p = 0.43), but was associated with significantly lower odds of EBF (unadjusted OR 0.61, 95% CI 0.466, 0.803, p < 0.001). This association remained significant (adjusted OR 0.694, 95% CI 0.515, 0.935, p = 0.016) after adjusting for maternal diabetes, hypertensive disorders of pregnancy, cesarean delivery, maternal age, race/ethnicity, parity, Medicaid status, NICU admission, current smoking, and delivery hospital.

**CONCLUSIONS FOR PRACTICE:** Despite comparable breastfeeding initiation frequencies, early term infants were significantly less likely to be exclusively breastfed compared to full term infants. These data suggest that women with early term infants may benefit from counselling regarding the potential for breastfeeding difficulties as well as additional breastfeeding support after delivery.


**BACKGROUND:** Advancements in neonatal intensive care have markedly improved survival in preterm infants. These neonates need hospitalization due to immaturity of the respiratory and digestive systems. The timing of initiating proper feeding for premature infants admitted to neonatal intensive care units (NICUs) is an important challenge for physicians, parents, and nurses. Herein, we sought to investigate the effect of the Premature Infant Oral Motor Intervention (PIOMI) on the early onset of oral feeding in preterm infants.

**METHODS:** This clinical trial was conducted on 40 preterm infants born at a gestational age between 28-32 weeks, who were admitted to the NICU of Ali-ibn Abi Talib Hospital, Zahedan, Iran, in 2012. The subjects were randomly assigned to an intervention group and a control group. In the intervention group, oral motor therapy was applied using the premature infant oral motor intervention (PIOMI) for five minutes by one researcher daily 15 minutes before gavage feeding for seven days. Both groups received routine care consisting of swaddling, reducing light , implantation, kangaroo care, and mother's presence , while the control group did not receive any oral motor intervention. The groups were compared in terms of feeding readiness using the preterm oral feeding readiness assessment scale (PTOFRAS), timing of initiating oral feeding , and length of hospital stay.

**RESULTS:** In the intervention group, independent feeding was achieved significantly earlier than the control group (P=0.034) and length of hospital stay was shorter relative to the control group (P=0.027) Mean score changes PTOFRAS in the control group were( 5.8 )and in the intervention group ( 11.30)

**CONCLUSION:** Use of the PIOMI to develop oral motor skills is beneficial to the early initiation of oral feeding, earlier feeding. and reducing the length of stay . Therefore, using this method can be effective in treating preterm infants and reducing treatment costs.


**AIM:** The aim of this study is to evaluate a feeding regimen routinely providing >180 ml/kg/d fortified human milk to very preterm infants and impact on in-hospital growth, osteopenia, and neurodevelopment.
METHOD: Retrospective population-based descriptive study of infants <30-week gestation admitted within 24 h of birth and discharged during the 6-year period 2005-2010. Growth and neurodevelopment was assessed until 2 years corrected age, and cerebral palsy up to 4 years corrected age.

RESULTS: Ninety-nine infants below 30-week gestation were admitted within 24 h of birth during the 6-year period, of which 84 (85%) survived to discharge. Two infants had surgical necrotizing enterocolitis, both survived to 2 years follow up. Seventy-eight infants (mean 27 weeks) had complete growth data until discharge. Full enteral feeds were tolerated after mean 10 d. Average milk volumes were 193 ml/kg/d from 15 to 42 d of life. Rates of weight below 10th centile were 10% at birth and 14% at discharge. Head circumference Z-scores were stable from birth to discharge. Blood values did not indicate osteopenia. Increasing head circumference Z-scores were associated with improved language development.

CONCLUSIONS: This high enteral feeding volume regimen was associated with low rates of in-hospital growth restriction and good head growth. High enteral volume intake seems safe and may improve nutritional status of very preterm infants.


OBJECTIVE: To evaluate the effect of the Premature Infant Oral Motor Intervention (PIOMI) on preterm newborns' feeding efficiency and rates of improvement across Days 1, 3, and 5 of oral feeding in a Thai NICU.

DESIGN: Randomized controlled trial.

SETTING: A 20-bed special neonatal ward and 8-bed NICU in urban Thailand.

PARTICIPANTS: Stable newborns (N = 30) born between 26 and 34 weeks postmenstrual age (PMA) without comorbidities.

METHODS: After they reached 32 to 34 weeks PMA, participants were randomly assigned to groups. The experimental group (n = 15) received the PIOMI once daily for 7 consecutive days, and the control group (n = 15) received routine care only. After oral feedings were initiated, the mean volume (MV) of oral intake of two consecutive oral feedings was calculated on Days 1, 3, and 5 to assess feeding efficiency and compare the groups.

RESULTS: The MV of oral intake (percentage of prescribed feeding) was significantly greater in the experimental group versus the control group on all days of measurement. The MV consumed on Day 1 of oral feeding was 44.9% ± 7.33% in the experimental group versus 29.7% ± 9.55% in the control group (P < .001), 53.9% ± 8.01% versus 30.4% ± 11.07% on Day 3 (P < .001), and 61.7% ± 7.44% versus 34.8% ± 8.76 on Day 5 (P < .001). The rate of improvement was also accelerated in the intervention group.

CONCLUSION: The improved feeding efficiency that we found in our participants is consistent with results from other published studies and supports the use of the PIOMI as an effective oral motor therapy for newborns ages 32 to 34 weeks PMA.


OBJECTIVE: To determine predictors of nutritive-sucking in babies < 34 weeks and estimate the appropriate preterm sucking readiness (PTSR) score as an indicator of readiness of nutritive-sucking.

METHODS: Prospective longitudinal observational study conducted in Neonatal unit of a referral hospital attached to Medical College. Forty-nine inborn babies of 28-34 weeks’ gestation and on full gavage feeds were enrolled.

RESULTS: (a) Nutritive-sucking was achieved at a median age of 14 days (Range 7–50). (b) Low birth weight (LBW) (< 1531.1 ± 142.8) and lesser gestational age (GA) (< 32.8 ± 1) were poor predictors (p < 0.05) and have a significant independent negative association (Correlation birth weight (BW) - 0.022, GA – 2.217) with age at which established nutritive-sucking was achieved. (c) PTSR score of ≥9 had the best prediction for achievement of nutritive-sucking at 14-days of life, with a sensitivity of 92.3% and specificity of 100%.

CONCLUSION: PTSR score is a sensitive and specific tool to predict the readiness for nutritive-sucking in preterm babies < 34 weeks.

OBJECTIVE: To compare neurodevelopmental outcomes in preterm infants at 18 to 26 months corrected age (CA) who did versus did not achieve full oral feedings at 40 weeks postmenstrual age (PMA).

STUDY DESIGN: This retrospective study included infants born between 2010 and 2015 with gestational age <32 weeks and followed between 18 and 26 months CA. Achievement of full oral feedings was defined as oral intake >130 mL/kg/d for >72 hours by 40 weeks PMA. Incidence of cognitive, language, or motor delay, or cerebral palsy at 18 to 26 months CA was compared in multivariable analyses for infants in the two feeding groups.

RESULTS: Of 372 included infants, those achieving full oral feedings had lower incidence of any adverse neurodevelopmental outcome ($p < 0.001$) compared with those who did not achieve full oral feedings. In multivariable analyses, achievement of full oral feedings by 40 weeks PMA was associated with decreased odds of cognitive, language, and motor delays, cerebral palsy, and any adverse neurodevelopmental outcome at follow-up.

CONCLUSION: Achievement of full oral feedings by 40 weeks PMA was associated with better adjusted neurodevelopmental outcomes at 18 to 26 months CA. Inability to fully feed orally at 40 weeks PMA may be a simple, clinically useful marker for risk of adverse neurodevelopmental outcomes.


AIM: Breastfeeding is associated with IQ, school attendance and income. Despite the known benefits of breastfeeding, the rate of exclusive breastfeeding up to 6-months is low globally. We examined the effect of short-term breastfeeding on long-term IQ.

METHODS: In this secondary analysis of the prospective Cork BASELINE Birth Cohort Study, children were categorised as predominantly breastfed ($n = 288$) versus exclusively formula-fed ($n = 254$) at 2-months of age. Infants ($n = 404$) receiving mixed-feeding were excluded. Outcome was assessed using the KBIT II at 5-years. Multivariable linear regression was used to adjust for confounding variables.

RESULTS: Following adjustment for confounding variables, children, predominately breastfed at 2-months of age, demonstrated increased overall IQ (2.00 points (95% CI: 0.35 to 3.65); $p = 0.018$) and non-verbal IQ at 5-years of age (1.88 points (95% CI: 0.22 to 3.54); $p = 0.027$) compared to those never breastfed. No significant relationship was found with verbal IQ ($p = 0.154$).

CONCLUSION: A significant increase in composite and non-verbal IQ at 5-years of age was associated with short-term breastfeeding. This study adds to a growing body of evidence that short-term breastfeeding promotes healthy cognitive development.


OBJECTIVE: To explore the clinical significance of early premature infant oral motor intervention (PIOMI) in the prognosis of premature infants.

STUDY DESIGN: Infants were randomly divided into an intervention group ($n = 78$) and a control group ($n = 73$). PIOMI was given to the intervention group 15 to 30 minutes before feeding once a day for 14 days. The whole procedure lasted 15 minutes, including oral stimulation and nonnutritive sucking. Oral feeding ability and neuromotor development were evaluated using the Preterm Infant Oral Feeding Readiness Assessment (PIOFRA) scale and Infant Neurological International Battery (Infanib) scale.

RESULTS: The PIOFRA score was higher in the intervention group and increased with time, showing a group-time interaction effect. The intervention group exhibited a higher feeding efficiency, a shorter transition time from assisted oral feeding to independent oral feeding, and lower body weight at achievement of independent oral feeding. The percentages of infants with a normal score on the Infanib scale were higher in the intervention group at 3 and 6 months of age, and an abnormal ratio was lower in the intervention group at 6 months ($p < 0.01$).

CONCLUSION: PIOMI promoted neuromotor coordination by improving neurodevelopment, thereby improving the oral feeding ability and prognosis of preterm infants.

OBJECTIVE: To explore the effect of breastfeeding promotion strategies on neonatal clinical outcomes of preterm infants during hospitalization in the neonatal intensive care unit (NICU).

METHODS: We developed breastfeeding promotion strategies, including the establishment of a multidisciplinary breastfeeding steering team, breastfeeding support of families and society, family-integrated care, kangaroo mother care, donor human milk bank, and so on. Preterm infants meeting the inclusion standard, less than 32 weeks gestational age, who were admitted to NICU from November 2015 to February 2017 were enrolled, and the eligible infants were divided into two groups (control group and intervention group) before and after policy implementation. The data of preterm infants including breastfeeding related outcomes (time to initiation of enteral feeding, time to initiation of breastfeeding, time to achieve full breastfeeding, time to achieve full enteral feeding and rate of breastfeeding), growth (extrauterine growth restriction) and complications were compared between the two groups.

RESULTS: One hundred and twenty-three preterm infants were enrolled, including 61 in the control group and 62 in the intervention group. There were no significant differences in gender, gestational age, birth weight, intrauterine growth retardation (IUGR) and admission disease status between the two groups (P>0.05). Compared with the control group, there were significantly earlier time to initiation of enteral feeding [15.37 (10.00, 22.13) h vs. 20.25 (12.88, 26.33) h, P<0.01], time to achieve full breastfeeding [91.00 (69.75, 103.00) h vs. 94.00 (80.37, 118.75) h, P=0.04], and time to achieve full enteral feeding [12 (11, 15) d vs. 14 (12, 18) d, P<0.01] in the intervention group. Otherwise, there were no significant differences in time to initiation of breastfeeding, hospital stay, extraterine growth restriction (EUGR) occurrence rate of weight, the rate of breastfeeding, mortality, and the incidence of complications including feeding intolerance, neonatal necrotizing enterocolitis (NEC), bronchopulmonary dysplasia (BPD) and retinopathy of prematurity (ROP) (P>0.05).

CONCLUSION: The breastfeeding promotion strategy was a quality improvement of ordinary breastfeeding protocol. It had significantly reduced time to initiation of enteral feeding, time to achieve full breastfeeding and time to achieve full enteral feeding for preterm infants in NICU. Further research is needed to confirm whether the strategies can improve the breastfeeding rate and reduce the occurrence of the complications, such as NEC, BPD, and ROP.


BACKGROUND AND OBJECTIVE: The emergence of the nonnutritive suck (NNS) pattern in preterm infants reflects the integrity of the brain and is used by clinicians in the neonatal intensive care unit (NICU) to assess feeding readiness and oromotor development. A critical need exists for an integrated software platform that provides NNS signal preprocessing, adaptive waveform discrimination, feature detection, and batch processing of big data sets across multiple NICU sites. Thus, the goal was to develop and describe a cross-platform graphical user interface (GUI) and terminal application known as NeoNNS for single and batch file time series and frequency-domain analyses of NNS compression pressure waveforms using analysis parameters derived from previous research on NNS dynamics.

METHODS. NeoNNS was implemented with Python and the Tkinter GUI package. The NNS signal-processing pipeline included a low-pass filter, asymmetric regression baseline correction, NNS peak detection, and NNS burst classification. Data visualizations and parametric analyses included time- and frequency-domain view, NNS spatiotemporal index view, and feature cluster analysis to model oral feeding readiness.

RESULTS. 568 suck assessment files sampled from 30 extremely preterm infants were processed in the batch mode (<50 minutes) to generate time- and frequency-domain analyses of infant NNS pressure waveform data. NNS cycle discrimination and NNS burst classification yield quantification of NNS waveform features as a function of postmenstrual age. Hierarchical cluster analysis (based on the Tsfresh python package and NeoNNS) revealed the capability to label NNS records for feeding readiness.

CONCLUSIONS. NeoNNS provides a versatile software platform to rapidly quantify the dynamics of NNS development in time and frequency domains at cribside over repeated sessions for an individual baby or among large numbers of preterm infants at multiple hospital sites to support big data analytics. The hierarchical cluster feature analysis facilitates modeling of feeding readiness based on quantitative features of the NNS compression pressure waveform.

Preterm infants whose mothers are unable to produce sufficient breast milk are increasingly being supplemented with pasteurised donor human milk (PDHM) instead of commercial preterm infant formula. Concerns have been raised that this practice can result in reduced growth. This retrospective clinical audit collected data from the medical records of a cohort of preterm infants (≤30 weeks gestational age) receiving either ≥28 d of PDHM (n = 53) or ≥28 d of their mother’s own milk (MOM, n = 43) with standard fortification supplied to both groups during admission. Weight growth velocity was assessed from regained birth weight to 34+1 weeks’ postmenstrual age (PMA); and weight, length and head circumference were compared at discharge and 12 months (corrected age). At 34+1 weeks’ PMA, the weight growth velocity (g/kg per d) was significantly lower in the PDHM group (15.4 g/kg per d, 95% CI 14.6, 16.1) compared with the MOM group (16.9 g/kg per d, 95% CI 16.1, 17.7, P = 0.007). However, the increase was still within clinically acceptable limits (>15 g/kg per d) and no significant difference was observed in the weight between the two groups. There was no significant difference in weight between the groups at discharge or at the 12-month corrected gestational age review. Although we demonstrated a significant reduction in the weight growth velocity of preterm infants receiving PDHM at 34 weeks’ PMA, this difference is not present at discharge, suggesting that the growth deficit is reduced by supplementation before discharge.


Feeding challenges are common for infants in the neonatal intensive care unit (NICU). While sufficient oral feeding is typically a goal during NICU admission, this can be a long and complicated process for both the infant and the family. Many of the stressors related to feeding persist long after hospital discharge, which results in the parents taking the primary role of navigating the infant’s course to ensure continued feeding success. This is in addition to dealing with the psychological impact of having a child requiring increased medical attention and the need to continue to fulfill the demands at home. In this clinical focus article, we examine 3 main areas that impact psychosocial stress among parents with infants in the NICU and following discharge: parenting, feeding, and supports. Implications for speech-language pathologists working with these infants and their families are discussed. A case example is also included to describe the treatment course of an infant and her parents in the NICU and after graduation to demonstrate these points further.


**AIMS:** To investigate timing of oral feeding (OF) introduction and full oral feeding (FOF) achievement in preterm infants and to explore factors associated with feeding progression.

**METHODS:** M Retrospective review of 100 medical records of preterms ≤32 weeks of gestation (GA) without major complications. Outcome measures were timing of OF introduction, transition time from nasogastric tube to FOF and FOF achievement. Variables such as sex, twins, GA, birthweight, respiratory supports used and duration of tube feeding, were also considered.

**RESULTS:** Post menstrual age (PMA) for OF introduction was 33.6 ± 1.1 weeks. FOF was achieved at 35.1 ± 1.5 weeks. PMA at OF introduction and PMA at FOF correlated with: birthweight (p = .0001, p = .001); duration of respiratory supports (p = 0.01, p = .0001); PMA at which respiratory supports were stopped (p = .0001, p = .0001); age of introduction of gavage (p = .0001, p = .003) and time of utilization of tube feeding (p = .02, p = .0001). Transition time was 1.5 ± 8.5 days. PMA at OF introduction significantly influenced PMA at FOF (p = .0001, r = .61). OF introduction, transition time and FOF were correlated with duration of hospitalization (p = .004, p = .0001, p = .008).

**CONCLUSIONS:** The achievement of feeding skills is confirmed to affect length of hospitalization, but the earlier you introduce OF, the earlier you reach FOF, so introduction should be anticipated. There is a clear trend to favor higher birthweight classes in FOF achievement. Feeding tube placement and need for respiratory supports may represent a nociceptive experience delaying feeding skills’ achievement. This highlights the importance of prospective studies investigating the role of preventative interventions.

BACKGROUND: Individualized feeding care plans and safe handling of milk (human or formula) are critical in promoting growth, immune function, and neurodevelopment in the preterm infant. Feeding errors and disruptions or limitations to feeding processes in the neonatal intensive care unit (NICU) are associated with negative safety events. Feeding errors include contamination of milk and delivery of incorrect or expired milk and may result in adverse gastrointestinal illnesses.

PURPOSE: The purpose of this review was to evaluate the effect(s) of centralized milk preparation, use of trained technicians, use of bar code-scanning software, and collaboration between registered dietitians and registered nurses on feeding safety in the NICU.

METHODS/SEARCH STRATEGY: A systematic review of the literature was completed, and 12 articles were selected as relevant to search criteria. Study quality was evaluated using the Downs and Black scoring tool.

FINDINGS/RESULTS: An evaluation of human studies indicated that the use of centralized milk preparation, trained technicians, bar code-scanning software, and possible registered dietitian involvement decreased feeding-associated error in the NICU.

IMPLICATIONS FOR PRACTICE: A state-of-the-art NICU includes a centralized milk preparation area staffed by trained technicians, care supported by bar code-scanning software, and utilization of a registered dietitian to improve patient safety. These resources will provide nurses more time to focus on nursing-specific neonatal care.

IMPLICATIONS FOR RESEARCH: Further research is needed to evaluate the impact of factors related to feeding safety in the NICU as well as potential financial benefits of these quality improvement opportunities.


BACKGROUND: Evidence supports the superiority of mother's own milk (MOM) in reducing the comorbidities common to prematurity and very low birth weight. In situations where an insufficient amount of MOM is available or maternal contraindications prevent its use, pasteurized donor human milk (DHM) is a viable substitution. When DHM is deemed best, a common practice in many neonatal intensive care units (NICUs) is for parents to provide their consent. However, no universal mandate for informed consent exists. Often, healthcare providers present and obtain the consent for DHM use prior to delivery or shortly after birth and this consent may be “bundled” along with other standardized NICU treatment consents. This approach is likely less than ideal since it provides insufficient time for decision making and often precedes the mother’s ability to initiate the expression of her own milk.

PURPOSE: To review the history of DHM use and the ethics surrounding the consenting process including the ethical principles involved in infant feeding decision making. We argue for the standardization and consistent use of informed consent for DHM in the NICU and offer clinical practice implications.

FINDINGS/RESULTS/IMPLICATIONS FOR PRACTICE AND RESEARCH: Providers face several challenges in the consenting process for the use of DHM in the NICU setting. These include limited time to support parents and educate them appropriately during the decision-making process. Standardized and consistent use of informed consent is essential to address the ethical concerns surrounding the use of DHM in the NICU setting.


DATA SOURCES: A systematic search of the literature on newborn feeding method in newborns with NAS was conducted with the use of the electronic databases PubMed, CINAHL, Nursing and Allied Health, PsycINFO, Evidence Based Medicine, Web of Science, and MEDLINE (Embase).

STUDY SELECTION: Studies were eligible for inclusion if the following criteria were met: the authors reported original data on outcomes related to newborn feeding and NAS, the research followed any type of quantitative design that included comparison of breastfed and formula-fed newborns with NAS, and the articles were published in English in peer-reviewed journals from 1990 to February 2018.

DATA EXTRACTION: Two authors independently extracted the data from the full-text articles and entered them into a data extraction template developed for the systematic review. The data were synthesized narratively because of the diversity in assessment of newborn feeding methods and outcome measures.

DATA SYNTHEIS: We identified eight studies in which newborn feeding method and outcomes related to NAS were evaluated in newborns exposed to opioids. The synthesis indicated that for newborns exposed
to methadone, breastfeeding was associated with decreased incidence and duration of pharmacologic treatment, shorter hospital length of stay, and decreased severity of NAS. The association between newborn feeding method and NAS among newborns exposed to buprenorphine was unclear. CONCLUSION: Breastfeeding may be effective to mitigate negative outcomes related to NAS among newborns exposed to methadone in utero. Women who are stable on opioid substitution treatment should be provided with appropriate education and support to breastfeed. However, to effectively promote breastfeeding among these mothers, evidence-based strategies are required, and barriers to breastfeeding need to be addressed.


BACKGROUND: Mothers’ own milk (MOM) has more than nutritional benefits for extremely preterm infants (<28 weeks). However, mothers encounter barriers that make it difficult to provide their own milk to their extremely preterm infants.
PURPOSE: The aim of this study was to describe and understand the experiences of mothers of extremely preterm infants regarding barriers to providing their own milk during infant hospital stay in the neonatal intensive care unit (NICU).
METHODS: This study followed a qualitative, interpretative design using Gadamer’s hermeneutic approach and included 15 in-depth semistructured interviews. The data were analyzed using a modified form of the steps described by Fleming.
RESULTS: Fifteen mothers of extremely preterm infants participated in the study. The following themes were extracted from the data analysis: (1) “unexpected and unusual lactation,” including the subthemes “the extremely preterm birth and the decision to provide MOM,” “the battle to produce milk,” and “my job was to make milk”; and (2) “providing MOM to a tiny infant in an unknown technological environment,” with the subthemes “the limitations of providing MOM in the NICU” and “the difficulties of having an extremely preterm infant.”
IMPLICATIONS FOR PRACTICE: To provide MOM to an extremely preterm infant, there is a need for informational and practical counseling by neonatal nurses educated in breastfeeding according to mothers’ requirements and emotional needs.
IMPLICATIONS FOR RESEARCH: Future research may analyze the parents’ and neonatal nurses’ experience about facilitators to improve MOM provision and the influence of women’s sociodemographic characteristics in providing MOM to the extremely preterm infants.


BACKGROUND: Kangaroo mother care is a comprehensive intervention given for all newborns especially for premature and low birthweight infants. It is the most feasible and preferred intervention for decreasing neonatal morbidity and mortality. Even though time to initiating breastfeeding has been examined by randomized controlled trials, varying findings have been reported. Therefore, the main objective of this meta-analysis was to estimate the pooled mean time to initiate breastfeeding among preterm and low birthweight infants.
METHODS: The authors searched for randomized controlled trial studies conducted on the effects of kangaroo mother care on the time to breastfeeding initiation among preterm and low birthweight infants. Published articles were identified through a computerized search of electronic databases that includes MEDLINE via PubMed, EMBASE, CINAHL and CENTRAL. The search terms were kangaroo mother care or (skin to skin), or conventional care, newborns, preterm infants, low birthweight infants and randomized controlled trial. A total of 467 eligible titles were identified and eight studies met the inclusion criteria. The extracted data were entered and analyzed using Cochrane Review Manager-5-3 software. Heterogeneity across studies was evaluated by Chi2 test and inconsistency index (I2). Publication bias was assessed using a funnel plot. The random effect model was applied to estimate the pooled mean time to initiate breastfeeding with 95% confidence interval.
RESULTS: In this meta-analysis, the overall pooled mean time to initiate breastfeeding was 2.6 days (95% CI 1.23, 3.96). Preterm and low birthweight infants receiving kangaroo mother care intervention initiated breastfeeding 2 days 14 h 24 min earlier than conventional care of radiant warmer/incubator method.
CONCLUSIONS: Kangaroo mother care promotes early initiation of breastfeeding as compared to conventional care method. Therefore, health facilities need to implement the kangaroo mother care for preterm and low birthweight infants.


BACKGROUND: Facilitating factors and barriers to breast milk feeding (BMF) very preterm (VP) infants have been widely studied at the individual level. We aimed to describe and analyse factors associated with BMF at discharge for VP infants, with a special focus on unit policies aiming to support BMF.

METHODS: We described BMF at discharge in 3108 VP infants enrolled in EPIPAGE-2, a French national cohort. Variables of interest were kangaroo care during the 1st week of life (KC); unit’s policies supporting BMF initiation (BMF information systematically given to mothers hospitalised for threatened preterm delivery and breast milk expression proposed within 6 hours after birth) and BMF maintenance (availability of protocols for BMF and a special room for mothers to pump milk); the presence in units of a professional trained in human lactation and regional BMF initiation rates in the general population. Associations were investigated by multilevel logistic regression analysis, with adjustment on individual factors.

RESULTS: In total, 47.2% of VP infants received BMF at discharge (range among units 21.1%-84.0%). Unit policies partly explained this variation, regardless of individual factors. BMF at discharge was associated with KC (adjusted odds ratio (aOR) 2.26 (95% confidence interval (CI) 1.40, 3.65)), with policies supporting BMF initiation (aOR 2.19 (95% CI 1.27, 3.77)) and maintenance (aOR 2.03 (95% CI 1.17, 3.55)), but not with BMF initiation rates in the general population.

CONCLUSION: Adopting policies of higher performing units could be an effective strategy for increasing BMF rates at discharge among VP infants.


Facilitating factors and barriers to breast milk feeding (BMF) for preterm infants have been mainly studied in very preterm populations, but little is known about moderate preterm infants. We aimed to analyze hospital unit characteristics and BMF policies associated with BMF at discharge for infants born at 32 to 34 weeks’ gestation (WG). EPIPAGE-2, a French national cohort of preterm births, included 883 infants born at 32 to 34 WG. We investigated kangaroo care (KC) in the first 24 hr, early involvement of parents in feeding support, volume of the unit, BMF information given to mothers hospitalized for threatened preterm delivery, protocols for BMF, presence of a professional trained in human lactation, unit training in neurodevelopmental care, and regional BMF initiation rates in the general population. Multilevel logistic regression analysis was used to investigate associations between unit policies and BMF at discharge, adjusted for individual characteristics and estimating odds ratios (ORs) and 95% confidence intervals (CIs). Overall, 59% (490/828) of infants received BMF at discharge (27% to 87% between units). Rates of BMF at discharge were higher with KC (adjusted OR [aOR] 2.03 [95% CI 1.01, 4.10], early involvement of parents in feeding support (1.94 [1.23, 3.04]), unit training in a neurodevelopmental care program (2.57 [1.18, 5.60]), and in regions with a high level of BMF initiation in the general population (1.85 [1.05, 3.28]). Creating synergies by interventions at the unit and population level may reduce the variability in BMF rates at discharge for moderate preterm infants.


BACKGROUND: Many very-preterm infants have difficulty in oral feeding during the first months of life after discharge. Since studies surveying the presence of feeding problems after the first year of life are limited and cultural/psychosocial differences can affect results, the aim of this study was to compare scores of a feeding problems test between very-preterm and full-term born children at the age of 2 and study the relationship between obtained scores and explanatory variables.

MATERIALS AND METHODS: This is a retrospective descriptive-analytic study conducted in 2014 in Semnan city of Iran. Thirty-eight 2-year-old children with the history of very-preterm birth were selected by census sampling method and 38 full-term babies born in the same hospital were selected randomly. The Iranian version of Lewinshon Feeding Disorders questionnaire was used and the relationship between explanatory
variables and the total score of the questionnaire was surveyed in each group by Mann-Whitney and linear regression tests.

**RESULTS:** Mean (SD) gestational age and weight of birth were 30.47 (1.63) weeks and 1630 (310) grams respectively in the very-preterm group. Feeding scores were not significantly higher in very-preterm babies, neither in total score ($p < 0.05$) nor in subtests. A relationship was just found between total feeding score and female gender both in the exposed group ($\beta = -0.36$, $p = 0.01$) and non-exposed group ($\beta = -0.49$, $p = 0.002$).

**Conclusions:** Two-year-old children born very preterm did not have higher feeding problems scores than full-term born peers. Male gender was related to more feeding problems at 2 years of age.


**OBJECTIVES:** Among very low birth weight infants born from January 2015 to December 2017, the Massachusetts statewide quality improvement collaborative aimed to increase provision of (1) any mother’s milk at discharge or transfer from a baseline of 63% to ≥75%, (2) exclusive mother’s milk at discharge or transfer from a baseline of 45% to ≥55%, and (3) to reduce racial and ethnic disparities in provision of mother’s milk.

**METHODS:** We used the Institute for Healthcare Improvement Breakthrough Series framework in which our main process measures were receipt of prenatal education regarding human milk education, first milk expression within 6 hours after birth, and any skin-to-skin care on 4 weekly audit days in the first month. We examined changes over time among all very low birth weight infants and for 3 racial and ethnic subgroups (non-Hispanic white, non-Hispanic black, and Hispanic) using control and run charts, respectively.

**RESULTS:** Of 1670 infants eligible to receive mother’s milk at 9 hospitals, 43% of their mothers were non-Hispanic white, 19% were non-Hispanic black, 19% were Hispanic, 11% were of other races or ethnicities, and 7% were unknown. Hospital teams conducted 69 interventions. We found improvement in all 3 process measures but not for our main outcomes. Improvements in process measures were similar among racial and ethnic subgroups. Hospitals varied substantially in the rate of any mother’s milk at discharge or transfer according to race and ethnicity.

**CONCLUSIONS:** Our collaborative achieved similar improvements in process measures focused within the first month of hospitalization among all racial and ethnic subgroups. Reduction in racial and ethnic disparities in mother’s milk at discharge was not reached. Future efforts will focus on factors that occur later in the hospitalization.


**OBJECTIVE:** To compare mothers’ own milk (MOM) consumption by infants born extremely preterm before and after implementation of a donor human milk (DHM) program and determine healthcare provider’s knowledge and practices regarding DHM.

**STUDY DESIGN:** One hundred fifty-seven infants born at <30 weeks of gestation were enrolled during 3 time-periods. Group 1: before DHM program implementation, Group 2: the year following implementation, and Group 3: the second year after implementation. The proportion of feeds consisting of MOM for 6 weeks following birth was analyzed using a generalized linear mixed model. The study’s second phase surveyed healthcare providers regarding knowledge and practices concerning DHM.

**RESULTS:** Group 1 consumed feeds with a greater proportion of MOM than Group 3 during weeks 1 ($P < .001$) and 3 ($P = .007$) and more than both Group 2 ($P = .033$) and 3 ($P = .021$) in week 4. During the first 14 days, Group 1 consumed feeds with 23.6% more MOM than Group 3 ($P = .002$) and had a greater odds of consuming feeds with >90% MOM ($P < .001$) than Group 3. During days 1-28, Group 1 consumed feeds with 22% more MOM than Group 3 ($P = .003$) and had greater odds of consuming feeds with >90% MOM than Group 2 ($P = .020$) and 3 ($P = .004$). Knowledge regarding DHM was inconsistent among providers and they were unlikely to communicate potential risks and benefits of DHM to mothers.

**CONCLUSIONS:** Following implementation of a DHM program, MOM consumption decreased over 2 years. Strategies focused on lactation success are necessary to increase MOM consumption.
OBJECTIVE: To examine the extent to which maternal race/ethnicity is associated with mother’s milk use among hospitalized very low birth weight (VLBW) infants and maternal receipt of hospital breastfeeding support practices (human milk prenatal education, first milk expression <6 hours after delivery, lactation consultation <24 hours, any skin-to-skin care <1 month).

STUDY DESIGN: We studied 1318 mother–VLBW infant pairs in 9 Massachusetts level 3 neonatal intensive care units (NICUs) between January 2015 and November 2017. We estimated associations of maternal race/ethnicity with any and exclusive mother’s milk on day 7, on day 28, and at discharge/transfer and hospital practices. We estimated HRs comparing the probability of continued milk use over the hospitalization by race/ethnicity and tested mediation by hospital practices, adjusting for birth weight and gestational age and including hospital and plurality as random effects.

RESULTS: Mothers were 48% non-Hispanic white, 21% non-Hispanic black, and 20% Hispanic. Initiation of mother’s milk was similar across groups, but infants of Hispanic mothers (hazard ratio [HR], 2.71; 95% CI, 2.05-3.59) and non-Hispanic black mothers (HR, 1.55; 95% CI, 1.17-2.07) stopped receiving milk earlier in the hospitalization compared with infants of non-Hispanic white mothers. Hispanic mothers had lower odds of providing skin-to-skin care at <1 month (OR, 0.61; 95% CI, 0.43-0.87) compared with non-Hispanic whites.

CONCLUSIONS: Hispanic and non-Hispanic black mothers were less likely than non-Hispanic white mothers to continue providing milk for their VLBW infants throughout the NICU stay.

OBJECTIVE: To estimate the time of first milk expression among mothers of very low-birth-weight (VLBW, 1,500 g or less) infants that predicts the maximal duration of mother’s milk provision during hospitalization in the neonatal intensive care unit (NICU).

METHODS: We performed a secondary analysis and studied 1,157 mother–VLBW infant pairs in nine Massachusetts hospitals born from January 2015 until December 2017. We determined the cut-point for timing of first milk expression after delivery that was associated with the highest probability of any and exclusive provision of mother’s milk for the infant at NICU discharge or transfer using recursive partitioning. We estimated hazard ratios (HRs) comparing the probability of continued provision of mother’s milk during the hospitalization between mothers who initiated milk expression before compared with after the cut-point (within 8 hours after delivery [referent] vs 9–24 hours), adjusting for gestational age, birth weight, maternal race and ethnicity, and clustering by hospital and plurality in Cox proportional hazards models.

RESULTS: Sixty-eight percent of mothers first expressed milk within 8 hours after delivery. First milk expression at 9–24 hours was associated with lower odds of any mother’s milk provided to the infant on day 7 (adjusted odds ratio [aOR] 0.39 [0.24–0.60]) and discharge or transfer (aOR 0.45 [0.33–0.62]), compared with expression within 8 hours. Findings were similar for exclusive mother’s milk. Mothers who first expressed 9–24 hours stopped providing milk earlier in the neonatal hospitalization (adjusted HR 1.64 [1.33–2.01]) compared with mothers who first expressed within 8 hours.

CONCLUSION: Using a data-driven approach, we identified that first milk expression within 8 hours was superior to 9–24 hours with respect to maximal duration of provision of mother’s milk for hospitalized VLBW infants. Randomized control trials are needed to further establish the causal relationship between timing of first milk expression and long-term lactation success among mothers of VLBW infants.

OBJECTIVE: To identify the progression of non-nutritive sucking (NNS) across postmenstrual age (PMA) and to investigate the relationship of NNS with medical and social factors and oral feeding.

STUDY DESIGN: Fifty preterm infants born at ≤32 weeks gestation had NNS assessed weekly starting at 32 weeks PMA with the NTrainer System. Oral feeding was assessed at 38 weeks PMA.

RESULTS: There were increases in NNS bursts per minute (p = 0.005), NNS per minute (p < 0.0001), NNS per burst (p < 0.001), and peak pressure (p = 0.0003) with advancing PMA. Level of immaturity and medical complications were related to NNS measures (p < 0.05). NNS measures were not related to Neonatal Oral
Motor Assessment Scale scores. Smaller weekly change in NNS peak pressure (p = 0.03; β = –1.4) was related to feeding success at 38 weeks PMA.

CONCLUSION: Infants demonstrated NNS early in gestation. Variability in NNS scores could reflect medical complications and immaturity. More stable sucking pressure across time was related to feeding success at 38 weeks PMA.


Multiple pregnancy increases the risk of a range of adverse perinatal outcomes, including breastfeeding failure. However, studies on predictive factors of breastfeeding duration in preterm twin infants have a conflicting result. The purpose of this observational study was to compare feeding practices, at hospital discharge, of twin and singleton very low birth weight infants. The study is part of a prospective survey of a national Spanish cohort of very low birth weight infants (SEN1500) that includes 62 neonatal units. The study population comprised all infants registered in the network from 2002 to 2013. They were grouped into singletons and multiples. The explanatory variables were first analyzed using univariate models; subsequently, significant variables were analyzed simultaneously in a multiple stepwise backward model. During the twelve-year period, 32,770 very low birth weight infants were included in the database, of which 26,957 were discharged alive and included in this analysis. Nine thousand seven hundred and fifty-eight neonates were multiples, and 17,199 were singletons. At discharge, 31% of singleton infants were being exclusively breastfed, 43% were bottle-fed, and 26% were fed a combination of both. In comparison, at discharge, only 24% of multiple infants were exclusively breastfed, 43% were bottle-fed, and 33% were fed a combination of both (p < 0.001). On multivariable analysis, twin pregnancy had a statistically significant, but small effect, on cessation of breastfeeding before discharge (OR 1.10; 95% CI: 1.02, 1.19). Risks of early in-hospital breastfeeding cessation were also independently associated with multiple mother-infant stress factors, such as sepsis, intraventricular hemorrhage, retinopathy, necrotizing enterocolitis, intubation, and use of inotropes. Instead, antibiotic treatment at delivery, in vitro fertilization and prenatal steroids were associated with a decreased risk for shorter in-hospital breastfeeding duration. Multiple pregnancy, even in the absence of pathological conditions associated to very low birth weight twin infants, may be an impeding factor for in-hospital breastfeeding.


INTRODUCTION: During nonnutritive suck, infants must intermittently swallow. When a swallow occurs, it must interact with respiration in 2 main ways. We have previously labeled HOW the interaction occurs as “swallow- breath interaction” (SwBr), and WHERE in the respiratory cycle the swallow occurs as “phase of respiration incident to swallow” (POR). We have described SwBr and POR in preterm infants with and without bronchopulmonary dysplasia and term infants with neonatal abstinence syndrome.

OBJECTIVE: The objective of this work is to describe SwBr and POR in term infants (TRM) and compare those findings to our previous study of low-risk preterm (LRP) infants.

METHOD: Suckle, swallow, nasal airflow and chest movement were recorded during nonnutritive suck in 12 TRM infants, collecting 94 swallows. SwBr and POR for each swallow were characterized by our previously described method. Generalized estimating equations were developed to relate the 3 types of SwBr and 5 types of POR to gender, birth weight, gestational age, postmenstrual age (PMA), and weeks post-first nipple feed. The percentages of SwBr and POR were compared to 16 LRP infants, with 176 swallows over 35 encounters.

RESULTS: TRM infants had more swallows with attenuated respiration (AR) with advancing weeks post-first nipple feed and fewer swallows occurring with obstructive apnea (OA) in males and with increasing birth weight. More swallows occurred at mid-expiration (ME) with increasing gestational age, PMA, and male gender and at mid-inspiration (MI) with increasing weeks post-first nipple feed. Fewer swallows occurred at MI in males. Infants in the LRP group studied before 35 weeks PMA were different from TRM infants but become indistinguishable from TRM infants as PMA approached 40 weeks. SwBr and POR in LRP infants progress towards improved feeding efficiency and safety. These results are similar to studies of nutritive feeding.

CONCLUSION: SwBr and POR during nonnutritive suck in LRP infants become more like TRM infants with advancing PMA. Because the same brainstem centers are activated in both nutritive and nonnutritive suck, investigation of swallow during nonnutritive suck may provide similar information as nutritive feeding with easier analysis.

**BACKGROUND:** Preterm infants often experience difficulty with the transition from tube to oral feeding. While many unimodal and multimodal sensorimotor interventions have been generated to optimize oral feeding skills, there has been little cohesion between interventions.

**PURPOSE:** The aims of this systematic review were to examine the effect of sensorimotor interventions on oral feeding outcomes and to determine whether multimodal interventions lead to better oral feeding performances than unimodal interventions.

**SEARCH STRATEGY:** A systematic search of CINAHL, Embase, MEDLINE, and PsycINFO databases was conducted. Studies were reviewed to assess the types of interventions used to improve transition to full oral feeding, volume intake, weight gain, and length of hospital stay.

**RESULTS:** The search identified 35 articles. Twenty-six studies examined a unimodal intervention, with the majority focusing on oral sensorimotor input and the others on tactile, auditory, and olfactory input. Nine studies assessed multimodal interventions, with the combination of tactile and kinesthetic stimulation being most common. Results varied across studies due to large differences in methodology, and caution is warranted when interpreting results across studies. The heterogeneity in the studies made it difficult to make any firm conclusions about the effects of sensorimotor interventions on feeding outcomes. Overall, evidence on whether multimodal approaches can lead to better oral feeding outcomes than a unimodal approach was insufficient.

**IMPLICATIONS FOR PRACTICE:** The use of sensorimotor interventions to optimize feeding outcomes in preterm infants varies based on methods used and modalities. These factors warrant caution by clinicians who use sensorimotor interventions in the neonatal intensive care unit.

**IMPLICATIONS FOR RESEARCH:** Large randomized clinical trials using a standardized approach for the administration of sensorimotor input are needed to further establish the effects on feeding outcomes in preterm infants.


**OBJECTIVE:** To verify the relationship of feeding practices of potential risk to dental caries in early childhood with sociodemographic variables, prematurity and Neonatal Intensive Care Unit admission (NICU).

**MATERIAL AND METHODS:** Data from medical records of infants and preschool children, including feeding practices (breastfeeding, bottle feeding, feeding during sleep, introduction and frequency of sugar use), sociodemographic variables, prematurity and NICU admission were collected. Chi-square, Fisher and Maximum Likelihood Ratio tests were used.

**RESULTS:** The number of medical records was 222 in the age group of 01-45 months. Breastfeeding was not present in 66.7% of preterm infants (p=0.003) and 66.1% of infants admitted at NICU (p=0.011). The use of feeding bottle occurred in 58.4% of infants whose mothers work / study; 58.4% of preterm infants and 60.9% of children admitted at NICU (p<0.001). Feeding during sleep occurred in 70.5% of infants aged 1-24 months (p<0.001); 51.4% were single children (p=0.010) and 76.7% did not attend daycare centers (p=0.003). The introduction of sugar occurred in 60.6% in the age group of 01-24 months. Feeding more than 3x / day occurred in 52.6% of infants aged 25-45 months (p=0.003) and; 51.8% with mothers whose schooling corresponded to elementary school (p=0.039).

**CONCLUSION:** Among caries-risk feeding practices, there was relationship between breastfeeding and prematurity and NICU admission; use of feeding bottle and mothers who worked and / or studied, prematurity and NICU admission; feeding during sleep and younger children, single child and those who did not attend daycare centers; and higher frequency of sugar use and older infants, and maternal schooling corresponding to elementary school.


**OBJECTIVES:** Benefits of mother’s only milk (MOM) for preterm infants are numerous. We realized that usage of MOM in our unit is less and often delayed for days. The proportion of MOM usage as the first feed after birth of total feed, was only 19%. In view of this existing evidence and identified problem, we decided to start
quality improvement (QI) initiative in our unit with the primary objective “To encourage the use of MOM as first feed in preterm (PT) and very low birth weight (VLBW) neonate from existing 19% to >50% over a period of 3 month.”

MATERIALS AND METHODS: This QI study involved the systematic implementation of evidence-based practices using Point of Care QI methodology developed by the WHO-SEARO.

RESULTS: After several Plan, Do, Study, Act, during the intervention phase, usage of MOM increases from baseline 19% to 91.3%. Postintervention, sustained usage of MOM after 6 months is at close to 80%.

CONCLUSIONS: Effective implementation of comprehensive communication bundles (CCB) is feasible in resource-constraint setting and resulted in sustained increase in the usage of MOM in PT and VLBW neonates.


INTRODUCTION: Hospitals are in a unique position to promote, protect, and support breastfeeding. However, the association between in-hospital events and breastfeeding success within population-based samples has not been well studied.

MATERIALS AND METHODS: A stratified (by education and birth weight) systematic sample of 5,770 mothers taking part in the Utah Pregnancy Risk Assessment Monitoring System, 2012–2015, were included. Mothers, 2–4 months postpartum, completed the 82-item questionnaire, including if they had ever breastfed their new baby, and if so, current breastfeeding status. Relationships between in-hospital experiences and breastfeeding termination and duration were evaluated via Poisson and Cox proportional hazard regression models, respectively, adjusting for other in-hospital experiences, maternal age, race/ethnicity, maternal education, marital status, smoking, physical activity, delivery method, pregnancy complications, and length of hospital stay.

RESULTS: Of all, 94.4% of mothers self-reported breastfeeding initiation, of whom 18.8% had breastfed <2 months, having breastfed on average 3.2 weeks (standard error: 0.07). In fully adjusted models, mothers who reported receiving a pacifier, receiving formula, or had staff help them learn how to breastfeed had a higher prevalence of terminating breastfeeding before 2 months (adjusted prevalence ratio [aPR] = 1.13, 95% confidence interval [CI]: 0.97–1.32; aPR = 1.20, 95% CI: 1.07–1.36; and aPR = 1.25, 95% CI: 1.08–1.34). Conversely, mothers who reported starting and feeding only breast milk in the hospital and receiving a phone number to call for help with breastfeeding had a lower prevalence of breastfeeding termination before 2 months (aPR = 0.72, 95% CI: 0.61–0.86; aPR = 0.57, 95% CI: 0.51–0.64; and aPR = 0.91, 95% CI: 0.80–1.03). Adjusted Cox models showed similar direction of associations.

CONCLUSIONS: Encouraging mothers to exclusively breastfeed in the hospital, and reducing gift packs containing pacifiers and formula, may be key areas United States hospitals can focus on to increase breastfeeding success. Prospective assessment in other geographical regions is needed to corroborate these findings.


BACKGROUND: Achievement of independent oral feeding is a major determinant of discharge and contributes to long lengths of stay. Accumulating evidence suggests that there is great variation between and within newborn intensive care units in the initiation and advancement of oral feeding. The Infant-Driven Feeding (IDF) method is composed of 3 behavioral assessments including feeding readiness, quality of feeding, and caregiver support. Each assessment includes 5 categories and is intended as a method of communication among caregivers regarding the infant’s readiness and progression toward independent oral feeding.

PURPOSE: To identify and summarize the available evidence on the use of the IDF method at initiation of oral feeds, time to independent oral feedings, and length of stay in the newborn intensive care unit or level II nursery for preterm infants.

METHODOLOGY/SEARCH STRATEGY: Four databases including CINAHL, Medline/PubMed, Ovid Nursing, and Embase were searched for “infant guided feedings,” “infant driven feeding,” “cue-based feeding,” and “co regulated feeding.” The full text of 32 articles was reviewed to identify experimental, quasiexperimental, or retrospective design to assess the evidence related to cue-based feeding.

FININGS: There were no randomized control, quasi-experimental, or retrospective studies utilizing the IDF method. There were 3 quality improvement projects utilizing the IDF method. The findings were conflicting: 1 project found the IDF method favorable in the achievement of full oral feedings, 2 projects found the IDF
method favorable for reducing length of stay, and 1 project did not find differences in initiation, achievement of oral feedings, or length of stay.

IMPLICATIONS FOR PRACTICE: There is scant evidence limited to quality improvement projects to support the use of the IDF method.

IMPLICATIONS FOR RESEARCH: Research is needed to empirically validate the IDF method and to inform practice related to the initiation and advancement of oral feeding for preterm infants.


OBJECTIVE: To evaluate the effect of patterned, frequency-modulated oro-somatosensory stimulation on time to full oral feeds in preterm infants born 26–30 weeks gestation.

STUDY DESIGN: This is a multicenter randomized controlled trial. The experimental group (n = 109) received patterned, frequency-modulated oral stimulation via the NTrainer system through a pulsatile pacifier and the control group (n = 101) received a non-pulsatile pacifier. Intent-to-treat analysis (n = 210) was performed to compare the experimental and control groups and the outcomes were analyzed using generalized estimating equations. Time-to-event analyses for time to reach full oral feeds and length of hospital stay were conducted using Cox proportional hazards models.

RESULTS: The experimental group had reduction in time to full oral feeds compared to the control group (-4.1 days, HR 1.37 (1.03, 1.82) p = 0.03). In the 29–30 weeks subgroup, infants in the experimental group had a significant reduction in time to discharge (-10 days, HR 1.87 (1.23, 2.84) p < 0.01). This difference was not observed in the 26–28 weeks subgroup. There was no difference in growth, mortality or morbidities between the two groups.

CONCLUSIONS: Patterned, frequency-modulated oro-somatosensory stimulation improves feeding development in premature infants and reduces their length of hospitalization.


BACKGROUND: The delayed transition from gavage-to-nipple feeding is one of the most significant factors that may prolong hospital length of stay (LOS). Osteopathic manipulative treatment (OMT) has been demonstrated to be effective regarding LOS reduction, but no investigations have documented its clinical validity for attaining oral feeding.

OBJECTIVES: To assess OMT utility regarding the timing of oral feeding in healthy preterm infants. DESIGN: Preliminary propensity score-matched retrospective cohort study. SETTING: Data were extrapolated from the neonatal intensive care unit (NICU) of Del Ponte Hospital in Varese, Italy, during the period between March 2012 and December 2013.

INTERVENTIONS: Two propensity score-matched groups of healthy preterm infants aged 28+0 to 33+6 were compared, observing those supported with OMT until hospital discharge and control subjects. MAIN OUTCOME MEASURES: Days from birth to the attainment of oral feeding was the primary endpoint. Body weight, body length, head circumference and LOS were considered as secondary endpoints.

RESULTS: Seventy premature infants were included in the study as the control group (n = 35; body weight (BW) = 1457.9 ± 316.2 g; gestational age (GA) = 31.5 ± 1.73 wk) and the osteopathic group (n = 35; BW = 1509.6 ± 250.8 g; GA = 31.8 ± 1.64 wk). The two groups had analogous characteristics at study entry. In this cohort, we observed a significant reduction in TOF (-5.00 days; p = 0.042) in the osteopathic group with a greater effect in very low birth weight infants.

CONCLUSIONS: These data demonstrate the utility and potential efficacy of OMT for the attainment of oral feeding. Further adequately powered clinical trials are recommended.


OBJECTIVE: To compare postdischarge growth, adiposity and metabolic outcomes of appropriate for gestational age (AGA) versus small for gestational age (SGA) premature infants fed an exclusive human milk (HM)-based diet in the neonatal intensive care unit.
**DESIGN:** Premature infants (birth weight ≤1250 g) fed an exclusive HM-based diet were examined at 12-15 months corrected gestational age (CGA) (visit 1) for anthropometrics, serum glucose and non-fasting insulin, and at 18-22 months CGA (visit 2) for body composition by dual-energy X-ray absorptiometry.

**RESULTS:** Of 51 children, 33 were AGA and 18 were SGA at birth. The SGA group had weight gain (g/day) equal to AGA group during the follow-up period. SGA had a significantly greater body mass index (BMI) z-score gain from visit 1 to visit 2 (0.25±1.10 vs -0.21±0.84, p=0.02) reflecting catch-up growth. There were no significant differences in total fat mass (FM) and trunk FM between groups. SGA had significantly lower insulin level (5.0±3.7 vs 17.3±15.1 µU/mL, p=0.02) and homeostatic model of assessment-insulin resistance (1.1±0.9 vs 4.3±4.1, p=0.02). Although regional trunk FM correlated with insulin levels in SGA (r=0.893, p=0.04), they had lower insulin level compared with AGA and no difference in adiposity.

**CONCLUSIONS:** SGA premature infants who received an exclusive HM-based diet exhibited greater catch-up growth without increased adiposity or elevated insulin resistance compared with AGA at 2 years of age. An exclusive HM-based diet may improve long-term body composition and metabolic outcomes of premature infants with ≤1250 g birth weight, specifically SGA.


**BACKGROUND:** Preterm mother-infant dyads often face many obstacles to breastfeeding. Preterm infants are at highest risk for low rates of exclusive breastfeeding.

**RESEARCH AIM:** To determine the prevalence of breastfeeding at 6 months among preterm infants and to identify factors that influenced mothers’ breastfeeding practices.

**METHODS:** A longitudinal observational study was conducted in a metropolitan hospital in Beijing, China. Mothers (N = 270) and their preterm infants (N = 280) were included in the study. Characteristics of preterm mothers and their perceptions of breastfeeding self-efficacy, knowledge, social support, and postpartum depression symptoms were measured at the discharge of neonatal intensive care. Breastfeeding data were collected by phone interview at 6 months corrected age.

**RESULTS:** At discharge, mothers of very preterm infants perceived a lower level of breastfeeding self-efficacy (measured with the Breastfeeding Self-Efficacy Scale–Short Form) and had a higher level of depression symptoms (measured with the Edinburgh Postnatal Depression Scale [EPDS]) than mothers of moderate and late preterm infants (p < .05-.01). Nearly half of all mothers had an elevated EPDS score, considered to be symptomatic of postpartum depression. At 6 months, only 22.5% of all infants were exclusively breastfeeding. Factors associated with exclusive breastfeeding, including younger maternal age, previous breastfeeding experience, shorter mother-infant separation time during intensive care, older infant gestational age, and a higher level of breastfeeding self-efficacy, significantly predicted exclusive breastfeeding practice (p < .05-.001).

**CONCLUSION:** The prevalence of breastfeeding at 6 months for preterm infants in this sample was low. Strategies to improve breastfeeding duration for preterm infants are needed, including support and education of mothers while in the hospital.


After a successful start providing pasteurized donor human milk (PDHM) in the well-newborn area, use and staff interest declined in the summer months. Nursing staff reported that because of the lengthy preparation time of PDHM, this option for feeding was not always offered to families. Defrosting PDHM is a 22-min process, and, in addition to consent, discussion, labeling, and so forth, the preparation time can be more than 30 min. The lack of expedient preparation was causing staff dissatisfaction, thus decreasing offers and use of PDHM.

**Wetzel, C. M., Davis, L., Grohler, N., Oprondek, D., Ruff, D., Lowery, K., ... & Wolff, J. (2019). A Quality Improvement Project to Improve the Use of Mother’s Own Milk (MOM) With Precision Oropharyngeal Therapy. *Advances in Neonatal Care*.**

**BACKGROUND:** Bioprotective properties of mother’s own milk (MOM) support the use of targeted MOM administration methods, including oropharyngeal therapy (OPT) with MOM, which may mimic the protective effects of swallowed amniotic fluid, thereby improving infant health outcomes.

**PURPOSE:** To increase the use of MOM-OPT in premature infants in the first week of life.

**METHODS:** Quality improvement methods were used to implement precision dosing of OPT.
RESULTS: After changing processes and replacing the colostrum immune therapy practice with longer-term precision OPT, the percentage of ordered doses administered to infants in the first week of life increased from 24% to 64%. There was also a 15% increase in very low birth-weight infants who received MOM (from 50% to 65%) at discharge. There were no reported adverse events related to OPT administration.

IMPLICATIONS FOR PRACTICE: Replacing the unit’s short-term colostrum immune therapy protocol with the longer-term precision OPT increased the number of doses given in the first week of life and increased the number of very low birth-weight infants discharged receiving MOM.

IMPLICATIONS FOR RESEARCH: Researchers should consider studying the reported positive effects of OPT related to infant response (positive oral stimulation, reduction in oral aversion, and improved oral feeding skills), parent participation in care, and maternal milk expression behaviors (longer milk expression duration).


BACKGROUND: Feeding dysfunction is a common consequence of prematurity and illness in neonates, often requiring supplemental nasogastric (NG) or gastrostomy (GT) feeding tubes. A standardized approach to the discharge of infants receiving home enteral nutrition (HEN) is currently lacking.

METHODS: The Home Enteral Feeding Transitions (HEFT) program was developed to identify patients eligible for HEN and create a standard discharge process. A structured tool helped determine discharge timing and route, and a dedicated outpatient clinic was created for infants discharged on HEN. Demographic, inpatient, and outpatient data were prospectively collected and compared with a historical cohort.

RESULTS: A total of 232 infants discharged from our neonatal intensive care unit (NICU) over 9 months met inclusion criteria. Ninety-eight (42%) were discharged with HEN, 68 NG and 30 GT, compared with 134 (58%) receiving full oral feeds. This represented a 10% increase in HEN utilization (P = 0.003) compared with our historical control group. Median HEN length of stay was 31.5 days compared with our historical average of 41 days (P = 0.23). Frequency of emergency department visits and admissions because of HEN was unchanged post intervention. Parents were satisfied (8.6/10), and 98% said they would choose HEN again. The median time to NG discontinuation after discharge was 13.5 days, with an estimated cost savings of $2163 per NICU day.

CONCLUSION: Our program is the first of which we know to use a standard care-process model to guide the decision-making and utilization of HEN at NICU discharge. HEFT shows that HEN at NICU discharge can be safe and effective, with high parental satisfaction.


BACKGROUND: NICU patients are commonly discharged home with nasogastric (NG) or gastrostomy (G-tube) feeding, but wide practice variation exists. The objective of this study was to evaluate feeding and growth outcomes and complications in NICU patients discharged home with NG or G-tube feeding.

STUDY DESIGN: Retrospective cohort study of infants discharged from a Level IV NICU with an NG or G-tube who had follow up to 1 year. Clinical characteristics and outcomes were compared between groups.

RESULTS: The study sample included 264 infants: 140 with NG and 124 with G-tube. More infants in the G-tube group (65%) still required tube feedings 12 months post-discharge than infants in the NG group (24%). Infants in the G-tube group had more tube-related ER visits than infants in the NG group. Growth outcomes did not differ.

CONCLUSION: Home NG feeding may be a safe alternative to a surgically placed G-tube in select NICU patients.


BACKGROUND: Few studies have examined the role of maternal emotions in breastfeeding outcomes.

RESEARCH AIM: We aimed to determine the extent to which positive maternal emotions during human milk feeding at 2 months were associated with time to any and exclusive human milk feeding cessation and overall breastfeeding experience.

METHODS: A sample of 192 women intending to breastfeed for at least 2 months was followed from the third trimester until 12 months postpartum. Positive emotions during infant feeding at 2 months were measured using the modified Differential Emotions Scale. Cox proportional hazards regression was used to estimate
adjusted hazard ratios (aHR) for time to any and exclusive human milk feeding cessation associated with a 1-point increase in positive emotions. Linear regression was used to estimate the association between positive emotions and maternal breastfeeding experience reported at 12 months.

**RESULTS:** Among those human milk feeding at 2 months, positive emotions during feeding were not associated with human milk feeding cessation by 12 months (aHR = 0.94, 95% CI [0.64, 1.31]). However, among women exclusively human milk feeding at 2 months, a 1-point increase in positive emotions was associated with a 35% lower hazard of introducing formula or solid foods by 6 months (aHR = 0.65, 95% CI [0.46, 0.92]). Positive emotions were associated with a significantly more favorable maternal report of breastfeeding experience at 12 months. Results were similar in sensitivity analyses using maternal feelings about breastfeeding in the first week as the exposure.

**CONCLUSIONS:** A positive maternal emotional experience of feeding is associated with breastfeeding outcomes.


**BACKGROUND:** Stress signals during sucking activity such as nasal flaring, head turning, and extraneous movements of the body have been attributed to incoordination of sucking, swallowing, and respiration (SSR) in premature infants. However, the association of uncoordinated sucking pattern with developmental outcomes has not yet been investigated. The aim of this study was to investigate whether uncoordinated sucking pattern during bottle-feeding in premature infants is associated with the developmental outcomes at 8–12 and 18–24 months of age (corrected for prematurity).

**METHODS:** We retrospectively reviewed the medical records and video recordings for the Neonatal Oral-Motor Assessment Scale (NOMAS) of premature infants and divided them into two groups based on the presence or absence of incoordination. The Bayley-III cognition composite scores of the incoordination-positive and incoordination-negative group were compared at 8–12 and 18–24 months of age.

**RESULTS:** Seventy premature infants exhibited a disorganized sucking pattern according to the NOMAS. The average Bayley-III cognition composite scores at 8–12 months of age were 92.5 ± 15.6 and 103.0 ± 11.3 for the incoordination-positive (n = 22) and incoordination-negative groups (n = 48), respectively (p = 0.002). The average Bayley-III cognition composite scores at 18–24 months were 90.0 ± 17.9 and 100.7 ± 11.5 for the incoordination-positive (n = 21) and incoordination-negative groups (n = 46), respectively (p = 0.005). A multiple linear regression analysis indicated that the presence of uncoordinated sucking pattern, grade 3 or 4 germinal matrix hemorrhage–intraventricular hemorrhage, and moderate to severe bronchopulmonary dysplasia were independently associated with cognitive development at 18–24 months of age.

**CONCLUSIONS:** Uncoordinated sucking pattern in premature infants was independently associated with a higher risk of abnormal developmental outcome in the cognitive domain of the Bayley-III at both 8–12 and 18–24 months. There may be a need for periodic follow-up and early intervention for developmental delay when incoordination of SSR that results in stress signals on the NOMAS is observed before 40 weeks postmenstrual age.
**OBJECTIVE**: To investigate the effect of music during routine nursing care on full-term newborns physiological measurements, hospital stay and stress symptoms.  
**METHODS**: The randomised controlled trial was conducted at the Level II neonatal intensive care unit of a state hospital in Turkey from November 2014 to August 2015, and comprised full-term newborns. Three groups were formed by simple randomisation according to babies’ Score for Neonatal Acute Physiology with Perinatal Extension-II: classical music, lullaby, and a control group. An audio system was installed in the incubators, and the sound level was set at 65dB for 30 minutes of classical music or lullabies during daily routine nursing care. Vital signs and stress indicators of the babies were measured before, during and after care. Their weight was measured daily, while length and head chest circumference were measured weekly.  
**RESULTS**: There were 45 newborns; 15(33.3%) in each of the three groups. Classical music had a positive effect on maintaining body temperature and oxygen saturation values of the babies (p<0.05). Classical music and lullabies reduced stress symptoms compared to the controls (p<0.05).  
**CONCLUSION**: Lullaby and classical music application during routine nursing care showed the potential to maintain physiological parameters and in reducing stress.  

**BACKGROUND**: Preterm infants are vulnerable humans requiring much care and attention. They may be exposed to irregular noise, light, and odor in the neonatal intensive care unit for a period of several weeks or months. This study was carried out to determine the effect of individualized developmental care on physiological parameters, growth, and transition to oral feeding in preterm infants.  
**METHODS**: The study was a randomized controlled trial. The sample comprised premature infants meeting the inclusion criteria. They were randomly assigned to four groups: the maternal voice group, the breast milk odor (BMO) group, the incubator cover (IC) group, and the control group.  
**RESULTS**: No statistically significant difference was found between the groups in terms of weight, height, and head circumference at time of discharge. Mean SO\textsubscript{2} values were statistically higher in the IC group than the other groups; however, the heart rate and respiratory rate were not statistically different in a significant sense between the groups. The briefest duration of transition to total oral feeding was seen in the BMO group.  
**CONCLUSION**: Individualized developmental care practices based on the results of these interventions are likely to support the care of preterm infants. Breast milk odor may ease the transition to breastfeeding.  

**PURPOSE**: The aim of this study was to analyze the efficacy of massage therapy and kinesitherapy on the anthropometric development of hospitalized preterm infants applied by parents.  
**DESIGN AND METHODS**: A prospective quasi-experimental study was designed. Hospitalized preterm infants received a daily 15-minute session of massage therapy and kinesitherapy. The control group received regular medical and nursing care.  
**RESULTS**: The massage therapy and kinesitherapy protocol significantly improved the anthropometric parameters studied: weight (895.7 ± 547.9 vs 541.8 ± 536.2; p < 0.001) size (5.5 ± 4.3 vs. 3.0 ± 3.1; p < 0.001) and head circumference (4.2 ± 3.2 vs 2.4 ± 2.6; p < 0.001).  
**CONCLUSIONS**: The implementation of a massage therapy and kinesitherapy protocol is beneficial for the anthropometric development of hospitalized preterm infants.  

**OBJECTIVE**: The aim of this study was to assess the effect of providing massage (tactile and kinesthetic stimulation) on behavioural responses for preterm infants.
Background: These infants have immature central nervous systems. Sleep–wake states during infancy have been shown to reflect severity of disease developments, and the nervous system and brain maturation.

METHODS: This study is a quasi-experimental study with before and after design conducted on 45 preterm infants who were admitted in neonatal intensive care unit (NICU). The subjects received massage 15 min per day for 5 days using field massage technique. Behavioural responses were measured by behavioural state, motor activity and behavioural distress. Data were obtained 10 min before and 10 min after the providing massage period.

RESULTS: An increase was observed in sleep state score after providing massage. And also, the awake, fidgeting and motor activity scores reduced after providing massage. No significant change was seen in the total behavioural distress.

CONCLUSION: The findings suggest that providing field massage had soothing and calming effect on preterm infants and could be beneficial in nursing intervention. Nurses working in neonatal intensive care unit need to be educated on how to performing the massage on preterm infants.


Vocalizations of full-term newborns occur in a short latency time during the neonatal period. Contingent response time of preterm babies is still unknown. An increase of preterm babies’ vocalizations following exposure to parental speech was also observed. Mothers and babies co-modulate their vocalizations in preterm dyads. Purpose: To observe temporal features of maternal and infants’ vocalizations in speaking and singing conditions in preterm dyads. Methods: In a NICU mothers (N = 36) were invited to speak and to sing to their preterm infants during Kangaroo Care. Microanalysis of temporal units were performed with ELAN Software. Results and conclusions: Preterm infants vocalize less often while their mothers speak and sing than during baseline and their vocalizations tend to be more alternating in the speaking condition and more overlapping in the singing condition. It is also concluded that preterm infants take more time to respond to maternal speaking than to maternal singing.


BACKGROUND: The neonatal intensive care unit is often a noisy, overstimulating environment that disrupts infants' regulation of physiological and behavioral states and interrupts caregiver bonding; however, infants benefit from early intervention, including the use of multimodal neurological enhancement (MMNE) intervention to provide appropriate neurodevelopmental stimulation. No one has investigated whether it assists infants in self-regulation.

PURPOSE: The purpose of this retrospective longitudinal analysis was to examine the effect of a music therapy intervention, MMNE, on self-regulation of premature infants as measured by changes in heart rate (HR).

METHODS: A convenience sample of 60 premature infants received 486 MMNE sessions provided by a board-certified music therapist (MT-BC). Documentation, taken during routine clinical services, involved recording infant’s HRs from the standard monitor for 3 minutes at baseline, during, and after a 20-minute MMNE intervention.

RESULTS: Infants’ mean HRs were decreased during and post-MMNE sessions compared with baseline (P< .004 and P< .001, respectively). Furthermore, infants with a baseline HR above 170 had significant decreases both during and after the MMNE session (P< .001 for both time periods).

IMPLICATIONS FOR PRACTICE: Results of this study support the existing body of evidence showing the benefits of MMNE with premature infants. Based on our results, MMNE may help infants develop and demonstrate self-regulation as indicated by maintained HRs during and after the intervention as well as a lowered HR for infants who had high HRs prior to MMNE.

IMPLICATIONS FOR RESEARCH: Further research needs to be done regarding how infants process MMNE and its potential to aid sensory processing.


Prematurity is associated with an increased risk of long-term health and neurodevelopmental problems. Key perinatal and neonatal factors that affect these outcomes have long been studied. However, more recently,
there has been an appreciation of the importance of environmental factors in long-term outcomes of preterm babies, particularly in light of the rapid maturation of the brain during these babies’ early days of life. Breastmilk and breastfeeding is the gold standard for infant feeding, including preterm babies. The benefits are well established in regard to protection from serious complications like necrotising enterocolitis. Although theoretically plausible, the benefits for neurodevelopment are less clear. Noise, pain and the environment of the neonatal intensive care can also affect infant neurodevelopment. It is established that noise and pain have deleterious effects. However, the benefits of single-room vs open-bay neonatal units remain under debate. Developmental care practices, of which there are many, are increasingly embraced worldwide. There are benefits both for the parents and the baby, however, the evidence is difficult to pool due to the heterogeneity of studies and study populations. Finally, it is important to remember the importance of the role of parents in shaping long-term neurodevelopment of the high-risk preterm newborn. Increasingly, positive parenting and parents’ mental health are shown to have long lasting advantages for preterm infants. A deeper understanding of early environmental factors is key to developing future interventions to optimise outcomes of preterm newborns.


Sensory development of the human brain begins prenatally, allowing cortical auditory responses to be recorded at an early age in preterm infants. Despite several studies focusing on the temporal characteristics of preterm infants’ cortical responses, few have been conducted on frequency analysis of these responses. In this study, we performed frequency and coherence analysis of preterm infants’ auditory responses to series of syllables and also investigated the functional brain asymmetry of preterm infants for the detection of the regularity of auditory stimuli. Cortical auditory evoked potentials (CAEPs) were recorded in 16 preterm infants with a mean recording age of 31.48 weeks gestational age (29.57–34.14 wGA) in response to a repetitive syllabic stimulus. Peak amplitudes of the frequency response at the target frequency and the first harmonic, as well as the phase coherence (PC) at the target frequency were extracted as age-dependent variables. A functional asymmetry coefficient was defined as a lateralization index for the amplitude of the target frequency at each electrode site. While the findings revealed a significant positive correlation between the mean amplitude at the target frequency vs. age (R² = 0.263, p = 0.042), no significant correlation was observed for age-related changes of the mean amplitude at the first harmonic. A significant correlation was also observed between the mean PC and age (R² = 0.318, p = 0.023). A right hemisphere lateralization over many channels was also generally observed. The results demonstrate that rightward lateralization for slow rate modulation, previously observed in adults, children and newborns, appears to be in place at a very young age, even in preterm infants.


BACKGROUND: Since introduction of neonatal Automated Auditory Brainstem Response (AABR) hearing screening in Neonatal Intensive Care Unit (NICU) graduates, Hearing Loss (HL) is established during the first few months of age. The diagnostic Auditory Brainstem Response (ABR) is used as the gold standard in establishing HL after birth. Aim of this study was to investigate the predictive value of better ear ABR findings at three months Post Term Age (PTA) in preterm infants with bilateral Sensori Neural (SNHL) or Conductive Hearing Loss (CHL). In Preterms with bilateral Auditory Neuropathy Spectrum Disorder (ANSD) the predictive value of Visual Reinforcement Audiometry (VRA) was investigated.

METHODS: Outcome data of graduates of a level III NICU, who didn’t pass AABR neonatal hearing screening between 2004-2016 were ana- lyzed retrospectively. At follow-up type and hearing level of gradu- ates with bilateral HL was established. Hearing level was investigat- ed at the age of two years using VRA and at four and eight years of age using play-audiometry. The Two One-Sided Tests equivalence procedure for paired means was applied with the magnitude of the region of similarity equal to 10dB.

RESULTS: In all 32 cases ABR at three months PTA correctly predicted the final type of HL. In 8 SNHL children initial ABR was equivalent with the four and eight year’s play-audiometry (p<0.05). In eight SNHL and 15 ANSD children, VRA levels didn’t reflect significantly play-au- diometry levels. Almost all cases (89%, N=8/9) with non- syndromic CHL recovered properly.

**AIM:** To compare the effectiveness of an intensive-intermittent vs. standard spaced protocolised music therapy intervention on supporting developmental milestone acquisition of infants >44 weeks postmenstrual age (PMA) hospitalised in a Neonatal Intensive Care Unit (NICU).

**METHOD:** This was a comparative effectiveness study of infants 44-66 weeks PMA with a projected NICU stay of at least one month from recruitment. Infants were randomised to one of two treatment groups: traditional therapy (2x/week) and intermittent-intensive (4x/week, off, 4x/week, off). Both groups received the same number of sessions over a 4-week period. Sessions at the start and end of the treatment period were video recorded. Two masked researchers reviewed and coded videos. Milestones used for video recording were adapted from the Developmental Assessment of Young Children.

**RESULTS:** Twenty-four infants participated, with groups matched for birth age, PMA at start of study, race, IVH severity, and respiratory support. Total and motor composite scores were higher post-intervention (Cohen’s d = 0.71 and 0.97, both p < 0.01), with the same degree of skill acquisition found for both intervention groups.

**CONCLUSION:** A developmental music therapy protocol supports developmental skills acquisition of post-term infants in a NICU. Similar outcomes for both groups provide therapists with varying treatment dosing options to best support their patients.


It is now clearly established that the environment and the sensory stimuli, particularly during the perinatal period, have an impact on infant’s development. During the last trimester of gestation, activity-dependent plasticity shapes the fetal brain, and prematurity has been shown to alter the typical developmental trajectories. In this delicate period, preventive interventions aiming at modulating these developmental trajectories through activity-inducing interventions are currently underway to be tested. The purpose of this review paper is to describe the potentialities of early vocal contact and music on the preterm infant’s brain development, and their potential beneficial effect on early development. Scientific evidence supports a behavioral orientation of the newborn to organized sounds, such as those of voice and music, and recent neuroimaging studies further confirm full cerebral processing of music as multisensory stimuli. However, the impact of long-term effects of music exposure and early vocal contact on preterm infants’ long-term neurodevelopment needs be further investigated. To conclude, it is necessary to establish the neuroscientific bases of the early perception and the long-term effects of music and early vocal contact on the premature newborns’ development. Scientific projects are currently on the way to fill this gap in knowledge.


**INTRODUCTION:** Rapid neural development occurs beginning in utero and extending throughout a child’s first years of life, shaped by environmental input, which is essential for language learning. If this development is disrupted by premature birth and/or related repeated hospitalizations, atypical language development may result even in the absence of severe neurologic damage.

**METHOD:** This narrative review describes typical neurodevelopment associated with language and the atypical neurodevelopment often experienced by children born prematurely that can adversely affect their language development.

**RESULTS:** We describe evidence-based intervention strategies applicable in the hospital setting that can support the language development of young children who are born prematurely.

**DISCUSSION:** To promote neurodevelopmental growth that will support language learning, children born prematurely need to engage in supportive interactions with others. Awareness of evidence-based strategies can equip health care staff to provide a supportive hospital environment to promote the language development of children born premature.

BACKGROUND: Premature babies are susceptible to a variety of health problems in early of their lives, thus, management of premature care should be designed to optimize the growth and development, with no more cost extension. The management of premature care by non-pharmacological treatments becomes popular nowadays, and applied in the hospital unit care, including the Tactile-Kinesthetic Stimulation (TKS) and Kangaroo Mother Care (KMC).

AIMS: This study is to present the effect of Tactile-Kinesthetic Stimulation (TKS) on weight gain and reduction length of stay care for premature babies, and to compare the results with the standard Kangaroo Mother Care (KMC) given at the hospital care unit.

METHODS: The study used a quasi-experimental design with pretest-posttest with a control group. A total of 32 premature babies was equally divided to a control group given a standard KMC procedure and an intervention group receiving the TKS. Sampling was done using a consecutive sampling method where the low birth weight infants were selected from two public hospitals in Semarang of Indonesia, with consent from the parents. Data was then analyzed by a repeated measure ANOVA, general linear model and Mann-Whitney test to find the significant mean difference at p value less than 0.05.

RESULTS: The data shows that the babies’ weight significantly increased day by day only if the premature neonates received Tactile-Kinesthetic Stimulation, gained 148.75 gram only 3 days after the initial measurement. However, from this study we noted that the premature babies’ weight at the control group provided only with Kangaroo Mother Care slightly decreased at 35.69 gram at the third day of observation. In average, premature babies receiving TKS need only 3 days before return home, while if receiving the standard KMC the preterm babies required 5 days in the hospital care.

CONCLUSION: Not only effective to gain the weight, giving Tactile-Kinesthetic Stimulation to the low birth weight baby shorter the length of stay in the hospital unit care. It suggests that the TKS intervention will provide good result in maintaining the weight of the low birth weight baby and will reduce the costs of staying in the hospital unit care.


AIM: This study compared whether preterm infants showed better tactile abilities during silence or when they heard a prerecorded female voice at different intensities.

METHODS: We studied 74 preterm infants of 28–35 weeks’ postconceptional age who were admitted to a French neonatal intensive care unit from 2014 to 2017. They were presented with wooden objects, one smooth and one angled, at various points during silence (n = 26) or while listening to a female voice at +5 (n = 24) or +15 decibels (n = 24) inside their incubator. We compared the conditions to see if there was any difference in how the infants handled the objects and also compared familiar and unfamiliar objects.

RESULTS: The preterm infants showed better handling skills and only displayed effective discrimination, during silence. We found that 27.1% of the infants exposed to female voices failed to get habituated to the object, compared to 7.7% in the silence condition (p < 0.05) and success during the voice conditions required more trials (6.1 vs. 5.3) than the silence condition (p = 0.05). The different voice intensities made no difference.

CONCLUSION: Being exposed to a female voice had a negative impact on preterm infants’ tactile sensory learning, regardless of its intensity.


BACKGROUND: To date, no study has compared preterm and full term auditory environments.

AIM: To define differences in auditory exposure for preterm infants at term equivalent age in the neonatal intensive care unit (NICU) compared to auditory exposure in hospital rooms on a labor and delivery ward after full term birth.

STUDY DESIGN: Ninety-eight infants (48 preterm infants born 28 weeks gestation in the NICU at term equivalent age and 50 full term infants in a hospital room on the labor and delivery ward within 4 days of birth) had auditory exposure measured over a single 16-hour period using the Language Environment Acquisition (LENA) device.

RESULTS: More language (p < 0.001) was observed on the labor and delivery ward than in the NICU, with an average of 3.3 h more language in a 16-hour period and an average of 14,110 more words spoken around infants in a 16-hour period on the labor and delivery ward (p < 0.001). More electronic sounds were observed in the NICU, with an average of 2.3 h more in the 16-hour period (p < 0.001). The average decibel level in the
NICU was lower than in the hospital rooms on the labor and delivery ward (57.16 ± 2.30 dB, compared to 63.31 ± 2.22 dB; p < 0.001).

CONCLUSION: The NICU auditory environment for preterm infants is different than the auditory environment for full term infants, with less language, more electronic sounds, and quieter stimuli. This understanding can aid in developing appropriate interventions that enhance positive forms of auditory exposures.

Lordier, L., Loukas, S., Grouiller, F., Vollenweider, A., Vasung, L., Meskaldij, D. E., ... & Grandjean, D. (2019). Music processing in preterm and full-term newborns: a psychophysiological interaction (PPI) approach in neonatal fMRI. NeuroImage, 185, 857-864. Neonatal Intensive Care Units (NICU) provide special equipment designed to give life support for the increasing number of prematurely born infants and assure their survival. More recently NICU's strive to include developmentally oriented care and modulate sensory input for preterm infants. Music, among other sensory stimuli, has been introduced into NICUs, but without knowledge on the basic music processing in the brain of preterm infants. In this study, we explored the cortico-subcortical music processing of different types of conditions (Original music, Tempo modification, Key transposition) in newborns shortly after birth to assess the effective connectivity of the primary auditory cortex with the entire newborn brain. Additionally, we investigated if early exposure during NICU stay modulates brain processing of music in preterm infants at term equivalent age. We approached these two questions using Psychophysiological Interaction (PPI) analyses. A group of preterm infants listened to music (Original music) starting from 33 weeks postconceptional age until term equivalent age and were compared to two additional groups without music intervention; preterm infants and full-term newborns. Auditory cortex functional connectivity with cerebral regions known to be implicated in tempo and familiarity processing were identified only for preterm infants with music training in the NICU. Increased connectivity between auditory cortices and thalamus and dorsal striatum may not only reflect their sensitivity to the known music and the processing of its tempo as familiar, but these results are also compatible with the hypothesis that the previously listened music induces a more arousing and pleasant state. Our results suggest that music exposure in NICU’s environment can induce brain functional connectivity changes that are associated with music processing.

Malawade, M., & Patil, N. (2019). IMMEDIATE EFFECT OF VARIOUS TYPES OF MUSIC ON VITAL SIGNS IN INFANTS. International Journal of Medical and Biomedical Studies, 3(1).

OVERVIEW: Infants experience stressors. Stress responses in infants include physiological responses (HR and oxygen saturation) and behavioral responses (behavioral state, motor activity, and signs of behavioral distress). Modulation of the stress response in infants may reduce energy demands and enhance recovery. The characteristics of auditory stimulation provided by music differ from those of other types of auditory stimulation. The infants respond differently to music than to other random noises. This study was carried out to examine the effects of different types of music on vital signs of infants.

METHODOLOGY: Thirty infants were included in the study. They were divided into two groups. Low and High pitched music was used with for two individual groups. The immediate effect was assessed through pre and post recordings for Heart rate, Reapiratory rate and O2 saturation level.

RESULTS: There was statistically significant change in Heart Rate, Respiratory Rate and O2 saturation individually. While comparing post data, except Heart Rate there was no significant difference found with both types of music.

CONCLUSION: Low pitched music has better immediate effect than high pitched music.


BACKGROUND: Light is one of the potential sources of harm to preterm infants admitted to the NICU. The physiological changes in response to sound such as an oscillation in heart rate, blood pressure, respiratory rate, and oxygen saturation are among the adverse effects of light on the infants. Thus, this research is developed with a purpose to determine the light reduction on heart rate, respiratory rate, and blood oxygen saturation in preterm infants.

MATERIALS AND METHODS: This clinical trial was performed on 60 preterm infants at 28-32 weeks of pregnancy who were hospitalized from 1/10/94 to 1/2/95 one week after stabilizing the clinical condition in the NICU at Tabriz Al-Zahra Medical Education Center. The samples were randomly divided into two groups. In the intervention group, in addition to the routine light reduction of the department (drawing the curtains,
turning off the extra light, and putting a thick cover on incubator), the faces of the infants were also covered by the light insulation covers, however, merely the routine light reduction of the department was applied in the control group. This research lasted for 6 days, and during the intervention days, the heart rate, respiratory rate, and oxygen saturation of infants were evaluated and recorded using checklist in two groups.

**RESULTS:** In the intervention group, the oxygen saturation was increased by 4%, while heart rate was reduced by 27 beats per min and respiratory rate was reduced by 19 breaths per min (p<0.0005). The noise variable was under control during the intervention days, and there was no significant statistical effect in accordance to the statistical results.

**CONCLUSION:** The results indicate the effect of light reduction on the increased oxygen saturation and reduced respiratory rate and heart rate in the preterm infants admitted at NICU, and this process can result in an increase in the preterm infant sleep.


**AIM:** Early-life atypical sensory functioning and behavioural profiles are often associated with long-term developmental problems, especially in former preterm infants. We tested whether parenting style is associated with atypical sensory threshold or behavioural outcomes in preterm and term infants assessed during early childhood.

**METHODS:** We prospectively evaluated parenting style for a cohort of term and preterm infants who had previous assessments of sensory development and behaviour. We used standardised tools to evaluate parenting style, sensory neurological threshold at one year, and internalising and externalising behavioural tendencies at two years. Covariates included gestational age, sex and maternal education.

**RESULTS:** For the entire cohort (n = 82), children of more permissive parents were 2.7 times more likely to demonstrate abnormal sensory neurological thresholds compared to children of parents with less permissive styles (CI: 1.4–4.9). More permissive parenting scores were also associated with 2.4 times increased internalising (CI: 1.3–4.2) and 3.0 times increased externalising (CI: 1.6–5.6) tendencies. In the preterm group only, higher authoritative parenting scores were associated with fewer behavioural problems.

**CONCLUSION:** Permissive parenting is associated with worse infant sensory and behavioural outcomes. Authoritative parenting is associated with fewer behavioural problems in preterm children. Modification of parenting style may improve sensory development and behavioural outcomes.


**BACKGROUND:** Premature infants are at risk for abnormal sensory development due to brain immaturity at birth and atypical early sensory experiences in the Neonatal Intensive Care Unit. This altered sensory development can have downstream effects on other more complex developmental processes. There are currently no interventions that address rehabilitation of sensory function in the neonatal period.

**METHODS:** This study is a randomized controlled trial of preterm infants enrolled at 32–36 weeks postmenstrual age to either standard care or standard care plus multisensory intervention in order to study the effect of multisensory intervention as compared to standard care alone. The study population will consist of 100 preterm infants in each group (total n = 200). Both groups will receive standard care, consisting of non-contingent recorded parent’s voice and skin-to-skin by parent. The multisensory group will also receive contemporaneous holding and light pressure containment for tactile stimulation, playing of the mother’s voice contingent on the infant’s pacifier sucking for auditory stimulation, exposure to a parent-scented cloth for olfactory stimulation, and exposure to carefully regulated therapist breathing that is mindful and responsive to the child’s condition for vestibular stimulation. The primary outcome is a brain-based measure of multisensory processing, measured using time locked-EEG. Secondary outcomes include sensory adaptation, tactile processing, speech sound differentiation, motor and language function, measured at one and two years corrected gestational age.

**DISCUSSION:** This is the first randomized controlled trial of a multisensory intervention using brain-based measurements in order to explain the causal effects of the multisensory intervention on neural processing changes to mediate neurodevelopmental outcomes in former preterm infants. In addition to contributing a critical link in our understanding of these processes, the protocolized multisensory intervention in this study is therapist administered, parent supported and leverages simple technology. Thus, this multisensory
intervention has the potential to be widely implemented in various NICU settings, with the opportunity to potentially improve neurodevelopment of premature infants.


**AIM:** Preterm birth poses concerns in daily functioning and behaviour in childhood, possibly connected to sensory processing disorder. This review aimed to systematically identify assessments, incidence and nature of sensory processing disorder in preterm-born infants and children.

**METHODS:** We searched literature through CINAHL-EBSCOhost, Cochrane, Ovid/PsychINFO, PubMed/Medline, Scopus and Google Scholar, published until November 2018. We included electronically available, peer-reviewed studies of preterm-born children that applied standardised sensory processing assessments. We excluded studies of preterm-born children with major neurodevelopmental impairments.

**RESULTS:** We identified 27 studies of premature children, aged from birth to nine years seven months. The assessments represented three versions of Sensory Profile questionnaires and three clinical tests, Test of Sensory Functions in Infants, the Miller Assessment for Preschoolers, and the Sensory Integration and Praxis Test. The studies revealed wide variation of atypical sensory processing: 28–87% in sensory modulation, 9–70% in somatosensory processing, and 20–70% in sensory-based motor processing.

**CONCLUSION:** Preterm-born children exhibited elevated risk for sensory processing disorder from infancy into school age. Routine screening of sensory processing, intervention intervals and parental consultations should be considered in ameliorating sensory processing and neurocognitive development. Moreover, a larger body of intervention studies is needed.


Evidence-based design (EBD) of hospitals could significantly improve patient safety and make patient, staff and family environments healthier. This systematic review aims to determine which neonatal intensive care unit design features lead to improved neonatal, parental and staff outcomes. Medline, CINAHL, Web of Science Citation Index and Cochrane Central Register of Controlled Trials Registry, were searched in January 2017. Using combinations of the relevant key words, review was performed following the recommended guidelines for reporting systematic reviews. English language limitation was applied and term limited to 2006–2016. Included studies were assigned a grade based upon their level of evidence and critically appraised using defined tools. Data were not synthesized for meta-analysis due to nature of literature reviewed and heterogeneity. Three thousand five hundred ninety-two titles were screened with 43 full-texts assessed for eligibility. Twenty nine studies were deemed eligible for inclusion. These included 19 cohort studies, two qualitative studies, seven cross-sectional studies, and one randomised control trial. Grey literature search from guidelines, and repositories yielded an additional 10 guidelines. ‘Single family room’ (SFR) design for neonatal units is recommended. An optimally designed neonatal unit has many possible health implications, including improved breastfeeding, infection and noise control, reduced length of stay, hospitalisation rates and potentially improved neonatal morbidity and mortality. High quality, family centred care (FCC) in neonatology could be assisted through well grounded, future proofed and technology enabled design concepts that have the potential to impact upon early life development.


**INTRODUCTION:** There is evidence to support the use of positive sensory exposures (music, touch, skin-to-skin) with preterm infants in the neonatal intensive care unit (NICU), but strategies to improve their consistent use are lacking. The Supporting and Enhancing NICU Sensory Experiences (SENSE) program was developed to promote consistent, age-appropriate, responsive, and evidence-based positive sensory exposures for the preterm infant every day of NICU hospitalization.

**METHODS:** A systematic and rigorous process of development of the SENSE program included an integrative review of evidence on sensory exposures in the NICU, stakeholder feedback, expert opinion, and focus groups.

**RESULTS:** SENSE implementation materials consist of parent education materials, tailored doses of sensory exposures for each postmenstrual age, an infant assessment of tolerance, bedside logs and implementation considerations for integrating the SENSE program into the NICU.
DISCUSSION: Research is needed to evaluate the SENSE program as an implementation strategy and to assess its impact on parent and infant outcomes.


BACKGROUND: Preterm birth is defined as babies born alive at less than 37 weeks of gestation. Due to the lack of the in-vitro environment and their exposure to harmful environment of the NICU has led to the preterm infants having a long term disability. The awareness of environmental factors on development gave rise to the formation of early intervention program. Multimodal interventional strategies which primarily use touch, vision, sound, and movement stimulation has shown to have an immediate physiological effect. However, the long term effect of multimodal stimulation with proper dosage in improving the motor outcomes is not well established.

AIM: The current study aimed to analyse the effectiveness of multimodal sensory stimulation in improving the motor outcomes of the preterm infant at one month of corrected age.

METHODOLOGY: A quasi-experimental study (pre and post test design) was conducted in Sri Ramachandra Medical centre and Hospital. Preterm infants with GA of 28–36 weeks, who were medically stable and referred for early stimulation, were recruited in the study by convenient sampling. Baseline parameters were assessed using Hammersmith neurological scale, after which the mothers were counselled about age appropriate milestone development. They were then taught to perform touch, kinaesthetic, vision, auditory, vestibular and proprioceptive therapy under the guidance of the therapist. On discharge, a pamphlet was given to the mothers and were educated to continue the therapy. At one month of corrected age, the preterm infants were reassessed using HNE.

RESULTS: The result shows that mean pre-therapy and post-therapy values of the preterm group had a significant improvement.

CONCLUSION: Multimodal stimulation is effective in improving the motor outcomes of the preterm infants, at one month of corrected age.


BACKGROUND: Two non-invasive ventilation strategies, Bubble Continuous Positive Airway Pressure (Bubble CPAP) and standard nasal Continuous Positive Airway Pressure (nasal-CPAP), are commonly used to treat preterm infants in the NICU, differentially impacting their auditory environment and contributing to noise exposure above recommended safe levels.

AIM: To compare differences in sound exposure for preterm infants receiving two types of non-invasive CPAP.

METHOD: Prospective observational study of 108 preterm infants, receiving either Bubble-CPAP or nasal-CPAP, using repeated measures of sound exposure in single-patient rooms and semi-private bays.

RESULTS: Analyses with repeated measures demonstrated that both types of CPAP increase noise levels above the background of the NICU, and that non-invasive nasal-CPAP produces higher noise pollution compared to Bubble CPAP, regardless of the room type.

CONCLUSION: While CPAP is a necessary treatment for many preterm infants, cumulative noise exposure in extremely preterm infants may also be a care consideration.


Environmental aspect including noise produced by medical devices as well as lighting levels in Neonatal Intensive Care Unit (NICU) are pain and stress stimuli for neonates in Neonatal Intensive Care Unit (NICU). Pain response and stress reaction of neonates can affect their neurologic development, negatively affecting many aspects of their future life. In Indonesia, there is no data on noise level (sound intensity) and lighting level in NICU in Indonesia. This study aimed to identify lighting and noise levels in NICU using descriptive observational study design. This study was done in the NICU of a referral hospital in Indonesia. The mean lighting level in the incubator, NICU, and phototherapy box were 6–20 lux; 108–148 lux (mean 120.33; median 116.95); and 2000–3500 lux respectively. Moreover, the noise level in incubator and NICU were 45.73–62.84 dB (mean 53.63, median 53.4) and 59.03–76.07 dB (mean 64.15, median 62.18) respectively. NICU lighting levels was optimal
for patient safety, however phototherapy produced high lighting level. Noise level was above the recommended 45dB standard. In conclusion, the stress potential of neonates in NICU was high.


**AIM:** The aim was to compare growth in very premature infants cared for in a single-family room (SFR) and an open-bay (OB) unit. We recorded duration of parental presence and skin-to-skin contact as proxies for parental involvement in care of their infants.

**METHODS:** We consecutively included infants with gestational ages 28 + 0 through 32 + 0 weeks at two hospitals in Norway, one SFR unit (n = 35) and one OB unit (n = 42). Weight, length, and head circumference were followed from birth to four months after term date. Both units adhered to the same nutritional protocol and methods of recording events.

**RESULTS:** The SFR mothers spent a mean (standard deviation) of 111 (38) hours and the OB mothers 33 (13) hours with their infants during the first week and 21 (5) versus 7 (3) hours per day later. The respective duration of skin-to-skin care was 21 (10) versus 12 (8) hours during the first week and 4.2 (2) versus 3.0 (2) hours per day later. The differences were similar, but less pronounced for the fathers. The growth trajectories did not differ between the groups.

**CONCLUSION:** SFR care was associated with more parental involvement, but not with better growth.


Tactile stimulation of the newborn is a long established, possibly innate practice. As of 2005, international guidelines recommend the stimulation and support of spontaneous breathing after birth.1 Interestingly, considerable variation in tactile stimulation, particularly in preterm infants, has been observed in practice.2 To increase knowledge on the clinical application of tactile stimulation, we conducted a prospective study including preterm infants (<37 weeks gestational age) to observe timing, duration, type and location of stimulation during the first 10 min of life. The relation between tactile stimulation and the timing of the first spontaneous breath was analysed.


**OBJECTIVE:** Studies of the impact of infant massage intervention on the growth of preterm infants have been conducted in neonatal intensive care units (NICUs) and have demonstrated positive effects; however, few data exist regarding the effects of massage interventions by mothers on the growth of infants in the NICU. The purpose of this randomized controlled trial was to examine the effects of a 2-week massage intervention conducted by mothers on their preterm infants.

**METHODS:** Of 112 stable preterm infants born at a gestational age (GA) between 32 and 34 weeks and enrolled from an affiliated hospital, 54 were randomly allocated to an intervention group, and 58 were allocated to a control group. Mothers were trained to conduct a massage intervention in the intervention group, while the control group received standard care. For the infants in both groups, height (Ht), weight (Wt), and head circumference (HC) were measured at the onset of massage intervention, after one week, and after two weeks. Fifteen mothers were interviewed about their preparation for and completion of the massage intervention.

**RESULTS:** Repeated-measures analysis of variance showed that weight, height and head circumference significantly increased in the intervention group. Preterm infants who underwent the two-week massage intervention had higher mean weight, height, and head circumference ($F = 41.151, 6.621, 24.158$, respectively; $p < .001$). This study developed modified massage intervention guidance to provide recommendations for optimal massage intervention by mothers in the NICU: (a) Adapt to the NICU atmosphere; (b) control the mother’s strength; (c) slowly perform each period of the massage, that is (i) place in a prone position ($5 + 5$ min); (ii) place in supine position ($5$ min); (d) stay relaxed and watch the preterm infant’s response.

**PRACTICE IMPLICATIONS:** Trained mothers conducted massage interventions, which can improve the growth of preterm infants. We developed massage intervention guidance to provide recommendations for optimal massage intervention by mothers in the NICU. We recommend that mothers apply massage intervention for preterm infants in the NICU.
**NEUROBEHAVIOR**


Neonatal neurocritical care is an evolving sub-specialty whose goal is to implement neuroprotective care strategies, continuous bedside monitoring of neurologic function, and therapies in order to reduce the risk of neurologic injury and improve long-term neurodevelopmental outcomes in neonates who require intensive care. The provision of neonatal neurocritical care requires a culture change across a Neonatal Intensive Care Unit (NICU) in which equal importance is placed on the neurologic care and the cardiorespiratory care of a given patient. It is a multi-disciplinary framework of care in which neonatologist and pediatric neurologist come together to address the unique needs of NICU patients whose brains are still developing and are vulnerable to injury. Advances in bedside brain monitoring techniques and the use of therapeutic hypothermia for Hypoxic-Ischemic Encephalopathy (HIE) have accelerated the development of NeuroICUs across the United States and abroad. Neonatologists, neurologists, neurophysiologists, nurses and other ancillary members of the team work together to develop guidelines for commonly encountered neurological conditions in the NICU. The use of these guidelines helps provide standardized care across a unit and can reduce morbidity and length of hospital stay.


**AIM:** Brain alterations in very preterm children at risk for developmental coordination disorder were investigated.

**METHODS:** Infants born very preterm with gestation age <30 weeks or birthweight <1250 g were recruited from Royal Women's Hospital Melbourne from 2001 to 2003. Volumetric imaging was performed at term equivalent age; at seven years, volumetric imaging and diffusion tensor imaging were performed. At seven years, 53 of 162 children without cerebral palsy had scores ≤16th percentile on the Movement Assessment Battery for Children-Second Edition and were considered at risk for developmental coordination disorder. **RESULTS:** At term equivalent age, smaller brain volumes were found for total brain tissue, cortical grey matter, cerebellum, caudate accumbens, pallidum and thalamus in children at risk for developmental coordination disorder ($p < 0.05$); similar patterns were present at seven years. There was no evidence for catch-up brain growth in at-risk children. At seven years, at-risk children displayed altered microstructural organisation in many white matter tracts ($p < 0.05$).

**CONCLUSION:** Infants born very preterm at risk for developmental coordination disorder displayed smaller brain volumes at term equivalent age and seven years, and altered white matter microstructure at seven years, particularly in motor areas. There was no catch-up growth from infancy to seven years.


**AIM:** Evaluate prospectively the neurobehavior of preterm infants (PT).

**STUDY DESIGN:** Cohort of PT (gestational age(GA) <32weeks), evaluated biweekly from 32 to 48 weeks post-menstrual age (PMA) by NICU Network Neurobehavioral Scale (NNNS). Scores were compared by repeated Measures ANOVA. Scores of PT were compared to those of full-term infants, matched for gender by ANOVA. **RESULTS:** 39 PT (mean ± SD: GA 29.2 ± 2.0 weeks; birthweight 1100 ± 331g) were studied. As PMA progressed, PT showed increasing scores in habituation, attention, arousal, regulation, maneuvers for orientation, quality of movements and hypertonicity, and decreasing scores in excitability, lethargy, non-optimal reflexes, asymmetry, hypotonicity, and signs of stress/withdrawal. At 40 weeks PMA, PT were similar to term neonates assessed in the first days of life, except for less habituation, regulation capacity and excitability, and more hypotonia.

**CONCLUSION:** At 40 weeks PMA, PT reached the performance of full-term neonates evaluated in the first days of life in most neurobehavior domains.

**AIM:** To investigate the effect of kangaroo care (KC) and its duration on neurobehavioral performance, stress response, breastfeeding success, and vital signs in premature infants.

**METHODS:** One hundred and twenty premature infants were randomized to receive either KC for 60 min daily, KC for 120 min daily or conventional care (controls) for at least 7 days. Salivary cortisol was measured before and after the first KC session and then after 7 days. Temperature, respiration rate, heart rate, and oxygen saturation were recorded, before and after KC. Neonates were evaluated by the Neonatal Intensive Care Unit Network Neurobehavioral Scale (NNNS).

**RESULTS:** Both KC groups demonstrated higher scores for attention, arousal, regulation, nonoptimal reflexes, and quality of movements and lower scores for handling, excitability, and lethargy, compared to controls (p < 0.05). Both KC groups had higher infant breastfeeding assessment tool score and reached full enteral feeds faster than controls (p < 0.05). After the first KC session, improvement in O2 saturation and temperature was observed in KC 120-min group compared with the KC 60-min group (p < 0.05). Salivary cortisol decreased in both KC groups compared with controls after 7 days (p < 0.05).

**CONCLUSION:** Preterm neonates who receive KC for long durations reach full enteral feeds faster, have better breastfeeding success, neurobehavioral performance, thermal control, and tissue oxygenation.


**PURPOSE:** Infants with brain injury are susceptible to developmental delays. Survivors of neonatal seizures are at risk for developmental delay, epilepsy, and further neurological comorbidities. Despite advances in neonatal critical care, the prevalence of adverse long-term outcomes and seizure recurrence remains unchanged. Our goal is to determine if early treatment of neonatal seizures with phenobarbital or levetiracetam is associated with worse neurodevelopmental outcomes in brain-injured infants.

**METHODS:** We conducted a retrospective cohort study of 119 infants admitted between 2013 and 2017 who were at risk for developmental delay and assessed in our clinic. We compared brain injury infants with neonatal seizures to brain injury infants without neonatal seizures using Bayley scores (BSID III) at 9–14 months gestational age. A comparison of Bayley scores between those exposed to phenobarbital and levetiracetam was conducted.

**RESULTS:** Twenty-two children with neonatal seizures scored lower than 53 children without seizures in all domains with significant values in composite scores for cognitive function (p = 0.003) and language (p = 0.031). We found no difference in scores at 9–14 months between infants exposed to phenobarbital versus levetiracetam.

**CONCLUSIONS:** Our results suggest that in infants with brain injury, the occurrence of neonatal seizures has an adverse effect on neurodevelopmental outcomes. The choice of antiseizure medication may not play a significant role in their outcomes.


**BACKGROUND:** Psychosocial adversity escalates medical risk for poor outcomes in infants born <30 weeks gestation. Neonatal neurobehavior and maternal psychological and socioenvironmental assessments may identify the earliest specific intervention needs. We hypothesized that maternal prenatal anxiety, depression, and adverse medical and socioenvironmental conditions would be associated with less optimal neonatal neurobehavior at neonatal intensive care unit (NICU) discharge.

**METHODS:** We studied 665 infants at 9 university NICUs. Risk indices of socioenvironmental, maternal, and neonatal medical factors were obtained from standardized, structured maternal interviews and medical record reviews. Brain injuries were classified by consensus ultrasonogram readings. NICU Network Neurobehavioral Scale (NNNS) exams were conducted at NICU discharge.

**RESULTS:** On the NNNS, generalized estimating equations indicated infants of mothers with prenatal anxiety had less optimal attention, and those born to mothers with prenatal depression had increased lethargy. Maternal medical complications predicted suboptimal reflexes. Socioenvironmental risk predicted lower self-regulation and movement quality. Infants with more severe neonatal medical complications had lower attention, increased lethargy, and suboptimal reflexes.
CONCLUSIONS: Combined information from the observed associations among adverse prenatal maternal medical and psychosocial conditions, and neonatal complications may assist in the early identification of infants at elevated neurobehavioral risk.


**BACKGROUND:** Emerging evidence indicates that infants who were born between 37 and 38 weeks of gestation are at higher risk of adverse long-term neurodevelopmental outcomes. Yet little is known about the auditory neural maturation during the first year of their life.

**AIM:** To compare the development of auditory brainstem response in early term (ET, 37–38 weeks gestational age, GA) and full term (FT, 39–41 weeks GA) infants.

**METHODS:** 126 infants received ABR testing at 6 weeks. 107 of them returned for the second assessment at 9 months, among which, 93 completed the ABR recordings. Comparison of the ABR variables were made depending on gestational age.

**RESULTS:** Analysis of covariance (ANCOVA) was used to identify the differences in ABR outcomes between two groups. After controlling for confounders, latencies for wave III, V and I-III, III-V and I-V intervals were prolonged in ET group compared with FT group at 6 weeks (all \( p < 0.03 \)). ABR parameters of both groups developed as the infants got older. At 9 months, ET infants remain showing the longer wave V latency and I-V interval (all \( p < 0.02 \)) than FT infants.

**CONCLUSION:** During early postnatal life, ET has a different pattern of functional auditory brainstem development comparing with FT infants. The prolonged auditory conduction time suggests less mature of the central auditory system in ET infants before 9 months.


**BACKGROUND:** Family-centered intervention for preterm infants has shown short- to medium-term developmental benefits; however, the neurological effects of intervention have rarely been explored.

**OBJECTIVE:** The objectives of this study were to examine the effect of a family-centered intervention program (FCIP) on neurophysiological functions in preterm infants with very low birth weight (VLBW; birth weight of <1500 g) in Taiwan, to compare the effect of the FCIP with that of a usual-care program (UCP), and to explore the FCIP-induced changes in neurobehavioral and neurophysiological functions.

**DESIGN:** This was a multicenter, single-blind randomized controlled trial.

**SETTING:** The study took place in 3 medical centers in northern and southern Taiwan.

**PARTICIPANTS:** Two hundred fifty-one preterm infants were included.

**INTERVENTION:** The FCIP group received a family-centered intervention and the UCP group received standard care during hospitalization.

**MEASUREMENTS:** Infants were assessed in terms of neurobehavioral performance using the Neonatal Neurobehavioral Examination–Chinese version, and their neurophysiological function was assessed using electroencephalography/event-related potentials during sleep and during an auditory oddball task during the neonatal period.

**RESULTS:** The FCIP promoted more mature neurophysiological function than the UCP, including greater negative mean amplitudes of mismatch negativities in the left frontal region in the oddball task in all infants, lower intrahemispheric prefrontal-central coherence during sleep in infants who were small for gestational age, and higher interhemispheric frontal coherence during sleep in those who were appropriate for gestational age. Furthermore, interhemispheric coherence was positively associated with the total neurobehavioral score in preterm infants who were appropriate for gestational age (\( r = 0.20 \)).

**LIMITATIONS:** The fact that more parental adherence strategies were used in the FCIP group than in the UCP group might have favored the intervention effect in this study.

**CONCLUSIONS:** Family-centered intervention facilitates short-term neurophysiological maturation in preterm infants with VLBW in Taiwan.

**BACKGROUND:** Kangaroo Mother Care (KMC) is an easy and emotional care that can reduce the mortality and morbidity in premature infants, but often the relationship between mother and her newborn is delayed due to some barriers. The aim of this study was to investigate perceived benefits and barriers of mothers in this regard.

**MATERIALS AND METHODS:** In this descriptive cross-sectional study, 121 mothers with premature infants admitted to the Neonatal Intensive Care Unit (NICU) of Yazd Shahid Sadoughi Hospital, Iran, studied using convenience sampling method in 2018. Data gathering accomplished by interviewing mothers using researcher-made questionnaire included baseline characteristics of parents and their infant and items measuring perceived benefits and barriers of mothers to KMC. The data were analyzed using SPSS software version 22.0.

**RESULTS:** Strengthening of the emotional relationship between mother and infant and a greater sense of confidence were the main perceived benefits of mothers. Not being in good physical and mental condition, lack of relevant knowledge and fear of performing KMC were the most important perceived barriers of mothers to KMC. The perceived benefits differed only in mother’s ethnicity and father’s occupation (P<0.05). The perceived barriers did not differ by any of demographic variables of parents and infants (P>0.05).

**CONCLUSION:** According to the results though the high perceived benefits of mothers in performing KMC, it seems that planning for improving mothers mental condition, providing mothers with necessary knowledge and reducing fear of caring can effectively promote doing KMC by mothers.


**AIM:** Individuals born at extremely low birthweight (ELBW; <1000 g) are exposed to early adversities that increase the risk of mental health problems in later life. Caring parenting has been shown to offset the negative effects of early adversity in general population samples. However, the long-term impact of caring parenting on the mental health of preterm survivors in adulthood is not known.

**METHODS:** Using data from the world’s oldest longitudinally followed cohort of ELBW survivors (n = 179) and matched normal birthweight (NBW) control participants (n = 145), we examined if caring parenting moderated the link between preterm birth and mental health at 30-35 years of age. Participants reported on the parenting they received from their mothers using the parental bonding instrument. Self-esteem and internalising problems (i.e. depression, anxiety) were self-reported at 30-35 years of age using the Coopersmith Self-Esteem Inventory and Young Adult Self-Report questionnaire, respectively.

**RESULTS:** A statistically significant interaction was found between birthweight status and caring maternal parenting on self-esteem and internalising psychopathology in adulthood. Stratified analyses demonstrated that caring parenting was associated with better self-esteem (P < 0.001) and lower levels of internalising symptoms (P = 0.001), but in NBW participants only.

**CONCLUSIONS:** While the receipt of caring maternal parenting promoted mental health in adults born at NBW, it did not have the same protective effect on ELBW survivors. More research is needed to elucidate the aspects of parenting and the family environment that promote the long-term mental health of preterm survivors.


Racism, segregation, and inequality contribute to health outcomes and drive health disparities across the life course, including for newborn infants and their families. In this review, we address their effects on the health and well-being of newborn infants and their families with a focus on preterm birth. We discuss three causal pathways: increased risk; lower-quality care; and socioeconomic disadvantages that persist into infancy, childhood, and beyond. For each pathway, we propose specific interventions and research priorities that may remedy the adverse effects of racism, segregation, and inequality. Infants and their families will not realize the full benefit of advances in perinatal and neonatal care until we, collectively, accept our responsibility for addressing the range of determinants that shape long-term outcomes.

Parents of preterm infants often experience high levels of stress resulting in feelings of trauma after discharge from the neonatal intensive care unit (NICU). However, post-traumatic growth can occur after a stressful incident resulting in more favorable individual outcomes. One predictor of post-traumatic growth that has not been studied in relation to the NICU is parents’ religiousness and spirituality. This study focused on filling this gap in the literature by conducting a pilot study comprised of 25 parents’ reports on their experiences of post-traumatic growth post-NICU discharge. Specifically, we explored associations between parents’ reports on religiousness and spirituality through measures of parent–child sanctification, religious coping, and spiritual disclosure in relation to parents’ distress and their post-traumatic growth. We found that parents who sanctified their parent–child relationship experienced higher levels of post-traumatic growth even in the presence of stress. Parents who reported increased use of positive forms of religious coping and open spiritual disclosure with their spouse/partner also reported higher levels of post-traumatic growth. Results support a continued focus on family-centered NICU care during and after discharge with the caveat of also considering parents’ spiritual and religious worldviews.


To evaluate discharge readiness perceptions among mother–father dyads, parents of infants in the neonatal intensive care unit completed a parenting readiness survey. Fathers had more favorable perceptions than their partners. Maternal perceptions and social risk, but not infant morbidities, predicted paternal perceptions. Discharge support should focus on the mother–father dyad.


PURPOSE: The primary purpose of this study was to investigate the effectiveness of 3 different methods for delivering instruction on infant handling to parents in the neonatal intensive care unit (NICU).

METHODS: Ninety-six parents in the NICU received instruction. Parents were taught the same 3 infant-handling techniques after random assignment to the (1) direct, (2) video, or (3) written-pictorial instructional groups. After baseline competency assessment, parents received instruction according to their group. A masked evaluator assessed parent performance, and parents rated instructional effectiveness.

RESULTS: All groups significantly improved handling performance. The direct and video groups performed 2 handling activities significantly better than the written-pictorial group. No significant differences were found between the direct and video groups. All groups perceived the instruction as effective.

CONCLUSIONS: Direct and video instructions are equally effective in teaching parents to perform simple whole motor tasks in the NICU, and parents welcome the instruction.


AIM AND OBJECTIVE: To describe factors associated with father involvement in the neonatal intensive care unit using the Heuristic model of the dynamic of parental behaviour and influence on children over time.

BACKGROUND: Research shows that infants with involved fathers have better cognitive development, fewer crying episodes after caesarean birth, improved breastfeeding exclusivity and duration, and more regular sleep patterns. Preterm infants with involved fathers have improved cognitive development.

DESIGN: This cross-sectional exploratory study used survey methodology to explore factors associated with father involvement in the neonatal intensive care unit.

METHODS: The STROBE checklist for cross-sectional studies was used (see Appendix S2). Biological fathers of infants in a 97-bed neonatal intensive care unit in the southern USA completed a survey which asked about their involvement with their hospitalised infants and factors which affected that involvement. Eighty fathers completed the survey.

RESULTS: Age ranged between 20-53 with 43% first-time fathers. Compared to less involved fathers, fathers who were more involved were younger, married or living with the mother, performed kangaroo care or fathers of multiple gestation. Fathers who had attended the delivery were more likely to bathe their infants than those who had not attended the delivery and fathers who performed kangaroo care felt more confident than...
those who did not. Compared to fathers who visited less often, fathers who visited more often were younger, had infants with a shorter hospitalisation time and lower acuity, and had fewer children in the family.

CONCLUSIONS: Fathers are involved with their neonatal intensive care unit infants in many ways. Factors were identified that affect involvement in the neonatal intensive care unit.

RELEVANCE TO CLINICAL PRACTICE: Results can help nurses in neonatal intensive care units worldwide facilitate father-infant interaction, identify fathers at risk for decreased involvement and advocate for institutional policy development for supporting neonatal intensive care unit father involvement.


OBJECTIVE: To identify enablers and barriers related to home Kangaroo Mother Care (KMC) adoption after hospital discharge.

STUDY DESIGN: An exploratory study, using a mixed methods evaluation, followed 60 mother–infant dyads from the hospital ward to 4 weeks post-hospital discharge.

RESULTS: Fifty-three of the mothers (88.3%) completed all study visits. The majority of mothers were breastfeeding and practicing skin-to-skin contact 4 weeks post-discharge. Seven mothers (13.2%) discontinued skin-to-skin contact at 4 weeks. KMC was practiced on average 3.3 h/day and 5.1 days/week. The top two enablers reported were significantly related to the amount of time skin-to-skin was practiced, with support for household responsibilities being most significant (U = 195, p = 0.008). Lack of privacy (p = 0.002) and lack of motivation (p = 0.034) were negatively correlated to duration of skin-to-skin contact.

CONCLUSION: Future programs may increase dissemination and adoption of home KMC by specifically addressing enablers and barriers correlated to duration of skin-to-skin contact.


There is growing evidence that the neurosensory and social environment of the Neonatal Intensive Care Unit (NICU) has lasting effects on the neurodevelopment of the high-risk hospitalized infant. Thus, many NICUs are transitioning from traditional, medical healing approaches to enhanced family-centered developmental care approaches with the aim of improving infant outcomes and parental mental health. This commentary describes a transdisciplinary neurodevelopmental program based on key principles and recommendations from current and evolving evidence-based care practice guidelines. This clinical initiative, known as the Growth and Development Unit (GDU), was developed within the context of a 66-bed level III NICU. The process of program inception, key elements of program development, as well as program strengths and challenges are discussed.


The purpose of this study was to evaluate the impact of access to communication technology on caregiver quality of life, neurodevelopmental, and medical outcomes (e.g., rehospitalization, emergency room visits, or surgeries) in preterm infants, and enrollment in public assistance programs. In this cross-sectional study, we surveyed families of preterm infants in a high-risk infant-follow-up clinic. We estimated associations of access to various modes of communication technology with outcomes, adjusting for sociodemographic and infant characteristics using linear and unconditional logistic regression. Access to email, text messaging, and smartphones was associated with higher quality of life scores on the Multicultural Quality of Life Index, and email and smartphone access was significantly associated with increased enrollment in early intervention. Evaluating smartphone and email access on neonatal intensive care unit discharge is important when considering enrollment in community programs and caregiver quality of life.


BACKGROUND: March of Dimes partners with hospitals across the country to implement NICU Family Support (NFS) Core Curriculum, a program providing education to parents in neonatal intensive care units (NICUs) across the country.
PURPOSE: This NFS project’s goal was to increase the efficiency and effectiveness of NICU parent education by establishing consistency, improving quality, and identifying best practices.

METHODS/SEARCH STRATEGY: A 5 topic curriculum was developed and implemented across NFS program sites. The project studied 4 main outcomes of interest related to efficiency and effectiveness: increase in parenting confidence, parent learning, knowledge change, and satisfaction. Data were collected from speakers and attendees immediately following educational sessions. Analytical approaches included descriptive statistics such as frequency, percentage, and response rate, and inferential approaches such as t test, χ, and analysis of variance.

FINDINGS/RESULTS: Findings suggest that the NFS Core Curriculum improved both program efficiency and effectiveness. Sessions fully implemented according to recommended strategies had better outcomes than sessions not fully implemented according to recommended strategies (P < .0001). Across the 3648 attendees at 41 sites, 77% of parents reported learning "a lot" at the session they attended and 85% of attendees reported increased confidence. Attendees also reported positive knowledge change and high satisfaction.

IMPLICATIONS FOR PRACTICE: Parent education best practices identified through this initiative can be utilized for future NFS Core Curriculum topics and potentially generalized to all NICU parent education and family education in other hospital intensive care units.

IMPLICATIONS FOR RESEARCH: Content and best practices identified through this project will require regular review to ensure medical accuracy and appropriateness of best practices as the physical design of NICUs evolves.


AIM: To describe parents of extremely preterm children experiences regarding feeding of their children during the first 3 years of the child’s life.

METHODS: This is a qualitative study involving interviews conducted with 12 parents of nine children who had been cared for at one neonatal intensive care unit in Sweden. The interviews were conducted between May and September 2018; the data were analysed using qualitative content analysis.

RESULTS: All parents experienced some difficulties with their child’s eating development and described feeding their child as sometimes both difficult and frustrating. Variation in when these difficulties arose made it hard for the parents to obtain the individual support they wanted and needed. Parents experienced a need for more support -- from both staff members and parents with similar experiences -- during and after their child’s stay at the NICU.

CONCLUSION: All parents participating in the study experienced difficulties during some phase of their child’s feeding development. They expressed the need for more specialized support both during and after their child’s time at the hospital.


BACKGROUND: Premature birth affects opportunities for interaction between infants and mothers. Skin-to-skin contact (SSC) is standard care in neonatal care but has not been sufficiently studied regarding the effects on interaction between preterm infant and mothers.

PURPOSE: The purpose of this study was to compare interaction between preterm infants and their mothers after continuous versus intermittent SSC from birth to discharge. A secondary aim was to study a potential dose–response effect between time in SSC and quality of interaction.

METHODS: Families were randomly assigned to either continuous (n = 17) or intermittent (n = 14) SSC before delivery. Interaction was measured from videotapes of a Still-Face Paradigm collected at 4 months’ corrected age. Face-to-face interaction was coded according to Ainsworth's Maternal Sensitivity Scales and the Maternal Sensitivity and Responsivity Scales-R. Dose–response correlations were calculated between mean time spent in SSC and each of the interaction scales.

RESULTS: There were no statistically significant differences between groups in maternal interactive behavior toward their infants regarding sensitivity, interference, availability, acceptance, withdrawal, or intrusivity. There was no correlation between mean time in SSC and quality of interaction.
IMPLICATIONS FOR PRACTICE: Continuous SSC from birth to discharge was not superior to intermittent SSC concerning mother–infant interaction between preterm infants and their mothers at 4 months' corrected age. However, compared with other studies, mean time in SSC was also high in the intermittent group.

IMPLICATIONS FOR RESEARCH: Further studies are needed to find out how interaction between parents and preterm infants can be improved, supported, and facilitated in the neonatal intensive care unit (NICU) and whether there is an optimal dose for SSC.


BACKGROUND: Parent participation based on collaboration with nurses is recognized as an important concept in neonatal care. However, there is a lack of research providing specific strategies to promote parent participation in clinical activities, and there are few studies including both mothers and fathers.

OBJECTIVES: The purpose of this study was to develop a Parent Participation Improvement Program for parents in neonatal intensive care units, and to evaluate its effects on parents' partnerships with nurses, attachment to infants, and infants' body weight.

DESIGN: The study consisted of two phases. The first phase involved development of the Parent Participation Improvement Program. The second phase, a parallel two-group randomized controlled trial to evaluate the effectiveness of this program, was conducted from February to August 2017 in the neonatal intensive care unit of a hospital in Seoul, South Korea. A total of 66 infants born at <37 weeks gestation, receiving high-flow nasal cannula or less respiratory support, and their 132 parents (66 mothers and 66 fathers) were approached for enrollment in the study. Sixty-six preterm infants were randomly assigned to the intervention group (n = 33 infants/66 parents) or the control group (n = 33 infants/66 parents).

METHODS: King's theory of goal attainment was used as the theoretical framework for this program. A literature review and in-depth interviews were conducted to organize and determine the contents of the program. To evaluate its effectiveness, in the second phase, the intervention group participated in a parent participation program comprised of an individualized interaction stage, a pre-participation stage, and an active-participation stage for two weeks. The control group was allowed routine visits. The Pediatric Nurse Parent Partnership Scale and the Maternal Attachment Inventory scale were employed, and infants were weighed on the same calibrated scale by a researcher.

RESULTS: In the final analysis, compared with the control group, both the mothers and fathers in the intervention group reported significantly higher scores in partnership (Mann-Whitney U = 99.50, p < .001) and attachment (t = 8.47, p < .001), as well as significantly higher scores within all partnership subscales except “communication.” There was no difference in infants' weight between the intervention and control groups.

CONCLUSIONS: The Parent Participation Improvement Program was proven effective in improving parents' partnerships with nurses and attachment to their infants. The results are expected to more effectively facilitate parent participation in neonatal care.

Holdren, S., Fair, C., & Lehtonen, L. (2019). A qualitative cross-cultural analysis of NICU care culture and infant feeding in Finland and the US. *BMC pregnancy and childbirth, 19*(1), 1-12.

BACKGROUND: The benefits of family-centered care for the health and well-being of preterm infants and their families include increased parent-infant closeness, improved lactation, and positive mental health outcomes; however, it is known that the extent to which family-centered care is adopted varies by unit. This study aimed to understand how differences in neonatal care culture in two units in Finland and the U.S. were translated to parents’ infant feeding experiences in the hope of improving relationally focused feeding practices in both locations.

METHODS: This qualitative, cross-sectional study utilized narrative methodologies to understand the lived experiences of 15 families hospitalized in a tertiary neonatal intensive care unit in Finland (n = 8) and the U.S. (n = 7).

RESULTS: A global theme of lactation as a means or an end showed that lactation and infant feeding were framed differently in each location. The three supporting themes that explain families’ perceptions of their transition to parenthood, support as a family unit, and experience with lactation include: universal early postnatal challenges; culture and space-dependent nursing support; and controlled or empowering breastfeeding experiences.

CONCLUSIONS: Care culture plays a large role in framing all infant caring activities, including lactation and infant feeding. This study found that in the unit in Finland, breastfeeding was one method to achieve closeness.
with an infant, while in the unit in the U.S., pumping was only an end to promote infant nutritional health. Therefore, breastfeeding coupled with closeness was found to be supportive of a salutogenic, or health-promoting, care approach for the whole family.


Racial and ethnic minorities receive lower-quality health care than white non-Hispanic individuals in the United States. Where minority infants receive care and the role that may play in the quality of care received is unclear.

**OBJECTIVE:** To determine the extent of segregation and inequality of care of very low-birth-weight and very preterm infants across neonatal intensive care units (NICUs) in the United States.

**DESIGN, SETTING, AND PARTICIPANTS:** This cohort study of 743 NICUs in the Vermont Oxford Network included 117,982 black, Hispanic, Asian, and white infants born at 401 g to 1500 g or 22 to 29 weeks’ gestation from January 2014 to December 2016. Analysis began January 2018.

**MAIN OUTCOMES AND MEASURES:** The NICU segregation index and NICU inequality index were calculated at the hospital level as the Gini coefficients associated with the Lorenz curves for black, Hispanic, and Asian infants compared with white infants, with NICUs ranked by proportion of white infants for the NICU segregation index and by composite Baby-MONITOR (Measure of Neonatal Intensive Care Outcomes Research) score for the NICU inequality index.

**RESULTS:** Infants (36,359 black [31%], 21,808 Hispanic [18%], 5,920 Asian [5%], and 53,895 white [46%]) were segregated among the 743 NICUs by race and ethnicity (NICU segregation index: black: 0.50 [95% CI, 0.46-0.53], Hispanic: 0.58 [95% CI, 0.54-0.61], and Asian: 0.45 [95% CI, 0.40-0.50]). Compared with white infants, black infants were concentrated at NICUs with lower-quality scores, and Hispanic and Asian infants were concentrated at NICUs with higher-quality scores (NICU inequality index: black: 0.07 [95% CI, 0.02-0.13], Hispanic: -0.10 [95% CI, -0.17 to -0.04], and Asian: -0.26 [95% CI, -0.32 to -0.19]). There was marked variation among the census regions in weighted mean NICU quality scores (range: -0.69 to 0.85). Region of residence explained the observed inequality for Hispanic infants but not for black or Asian infants.

**CONCLUSIONS AND RELEVANCE:** Black, Hispanic, and Asian infants were segregated across NICUs, reflecting the racial segregation of minority populations in the United States. There were large differences between geographic regions in NICU quality. After accounting for these differences, compared with white infants, Asian infants received care at higher-quality NICUs and black infants, at lower-quality NICUs. Explaining these patterns will require understanding the effects of sociodemographic factors and public policies on hospital quality, access, and choice for minority women and their infants.


The purpose of this review is to present a new framework, EI SMART (early intervention: sensorimotor development, attention and regulation, relationships, and therapist support) for identifying key components that could contribute to more effective interventions for infants at high risk of atypical neurodevelopmental outcome. We present a clinical consensus of current challenges and themes in early intervention, based on multidisciplinary group discussions, including parents of high-risk infants, supported by a literature review. Components to include in early intervention programmes are: (1) promotion of self-initiated, developmentally appropriate motor activity; (2) supporting infant self-regulation and the development of positive parent-infant relationships; and (3) promotion of early communication skills, parent coaching, responsive parenting, and supporting parental mental well-being. Such multimodal programmes may need to be evaluated as a package.

**WHAT THIS PAPER ADDS:** Early intervention programmes should address sensorimotor development, attention, self-regulation, and early communication skills. Therapist input to the programme should include parent coaching and support for parental mental well-being.

Moro reflex is present as early as 28 weeks of gestation with hand opening, extension and abduction by 32 weeks and anterior flexion by 37 weeks of gestation [1]. Absence, depressed or exaggeration of the reflex may indicate central nervous system disorders and asymmetria of the Moro reflex may be related to obstetrical damage of plexus or nerve [1]. Persistence of the primitive reflexes beyond 6 months interferes with developmental and neurological impairment [2]. Preterm infants born between 25 and 34 weeks' gestation showed several differences on neurological examination at term when compared to newborn term infants [3]. Preterm born infants who evaluated at term were more hyperexcitable, have less flexor tone in the limbs and have less extensor tone in the neck [3]. Romeo et al. [4] assessed the range and frequency distribution of neonatal neurological scores in late preterm infants at term and compared with full-term newborns. Preterm infants born at 34 gestational weeks showed some differences compared to preterm infants born at 35 and 36 gestational weeks in visual orientation, tone and Moro reflex. However late preterm infants who was born at 35 weeks or after have a neurological scores similar to term born infants.

There are different methods for eliciting Moro response in infants [5,6]. Vestibular and proprioceptive stimulation is necessary for Moro response. The stimulation of the semicircular canals of vestibular apparatus and the movement of the neck that cause proprioceptive stimulation are very important for a strong Moro response [7]. The extension and abduction of the arms are primarily triggered by vestibular receptors after the head and trunk are tilted backwards. The flexion and adduction of the arms are triggered by proprioceptive receptors [6]. Moro response diminishes at 3 months of age and usually disappears at the end of the fourth month [8]. An absence of Moro response may be predictive for adverse developmental outcome including cerebral palsy in early infancy [9,10]. The persistence of Moro response beyond 4 months also indicates higher risk for poor developmental outcome [9].

An objective evaluation of the Moro reflex may be guide for the identification of diagnostic disorders in clinical evaluation and in determining the relationship between early and late morbidities in long-term follow-up. To date there have only been a few methods available for assessing Moro response objectively. The aim of the study was to evaluate Moro response in late preterm and term infants with a video monitorization and with three-axis accelerometer.


**BACKGROUND:** More than 2.5 million newborns die each year, accounting for 47% of children dying worldwide before their age of five years. Complications of preterm birth are the leading cause of death among newborns. Pakistan is amongst the top ten countries with highest preterm birth rate per 1000 live births. Globally, Every Newborn Action Plan (ENAP) has emphasized on Kangaroo Mother Care (KMC) as an essential component of neonatal health initiatives.

**MATERIALS AND METHODS:** We conducted this qualitative study with 12 in-depth interviews (IDIs) and 14 focus group discussion (FGD) sessions, in two health facilities of Sindh, Pakistan during October-December 2016, to understand the key barriers and enablers to a mother's ability to practice KMC and the feasibility of implementing and improving these practices.

**RESULTS:** The findings revealed that community stakeholders were generally aware of health issues especially related to maternal and neonatal health. Both the health care providers and managers were supportive of implementing KMC in their respective health facilities as well as for continuous use of KMC at household level. In order to initiate KMC at facility level, study respondents emphasized on ensuring availability of equipment, supplies, water-sanitation facility, modified patient ward (e.g., curtain, separate room) and quality of services as well as training of health providers as critical prerequisites. Also in order to continue practicing KMC at household level, engaging the community and establishing functional referral linkage between community and facilities were focused issues in facility and community level FGDs and IDIs.

**CONCLUSION:** The study participants considered it feasible to initiate KMC practice at health facility and to continue practicing at home after returning from facility. Ensuring facility readiness to initiate KMC, improving capacity of health providers both at facility and community levels, coupled with focusing on community mobilization strategy, targeting specific audiences, may help policy makers and program planners to initiate KMC at health facility and keep KMC practice continued at household level.


**OBJECTIVE:** To determine the effect of family-based intervention on motor function in preterm infants.
**METHODS:** This study was designed as a randomized controlled trial between August 2015 and September 2016. Forty-two preterm infants were randomized and split equally between the family-based intervention group, composed of a physiotherapeutic and a familial component (8 males, 8 females; mean age 91+/−3.09 days), and the traditional early intervention group (8 females, 8 males, mean age: 91.06+/−2.4 days). Both groups received a treatment program based on a neurodevelopmental approach during 3- to 12-months-old. The groups were evaluated at corrected ages of the third, sixth, ninth, twelfth, and 24th months using the Bayley Scale of Infant and Toddler Development, Third Edition (Bayley-III).

**RESULTS:** Within-group changes over time were statistically significant using multivariate tests of fine motor (Multivariate analysis of variance (MANOVA); F=1515.27, p less than 0.001) and gross motor (MANOVA; F=1950.59, p=0.001) development. However, there was no interaction between groups in fine (MANOVA; F=0.027, p=0.872) and gross motor development (MANOVA; F=0.022, p=0.883).

**CONCLUSION:** The early intervention approaches might support fine and gross motor function development in preterm infants in the first year of life.


**BACKGROUND:** Skin-to-skin care (SSC) for infants improves physiologic stability, pain perception, brain development, parental bonding, and overall survival. Using quality improvement (QI) methodology, this project aimed to increase SSC for surgical infants in the neonatal intensive care unit (NICU).

**METHODS:** A multidisciplinary working group composed of key NICU stakeholders instituted a needs assessment querying perceptions and concerns about SSC. Based on survey results, multiple system level interventions were implemented. Data for surgical infants receiving SSC during hospitalization were tracked over time using the electronic health record.

**RESULTS:** Overall, 315 infants requiring a surgical consult were admitted to the NICU in the first 12 months of the project. After six months, SSC rates in this group increased from 51% to 60.5% (p < 0.01) and were sustained for 12 months. After one year, nursing staff reporting that they were somewhat to very comfortable providing SSC for surgical infants increased from 44% to 75% (p = 0.001) and the percent of nurses providing SSC for a surgical infant increased from 12% to 37% (p = 0.001). Inadvertent extubation did not significantly increase after implementation of the QI project.

**CONCLUSIONS:** Using QI methodology and multidisciplinary engagement, SSC was integrated safely into the routine care of surgical infants in the NICU.

**LEVEL OF EVIDENCE:** Level V.


The opioid crisis affects pregnant women and their infants. In the past two decades, the number of infants born with neonatal abstinence syndrome (NAS) has quadrupled causing the cost of healthcare expenditures to climb sharply. Pharmacological and non-pharmacological approaches are recommended for the management of NAS. Despite the attention NAS has recently received, treatment recommendations are limited to the hospital setting with much less focus on discharge planning. Additionally, the literature on NAS management does not consider research promoting mother-infant attachment. Recently, more emphasis has been placed on taking a holistic approach to NAS management. However, scholarly writings and research in this area are scarce. This article provides a review of current literature on NAS management and attachment-based interventions. Recommendations for practice and future research focused on holistic, non-pharmacological approaches to NAS management are provided.


**PURPOSE:** Several Danish neonatal intensive care units (NICUs) offer the possibility of an early discharge program (EDP) for families with premature infants, when the infant reaches the gestational age ≥ 34 weeks and a weight ≥ 1,500 g. The purpose of this study is to explore how the partnership with these families can be facilitated by the nurse based on the principles of the framework of family centered care (FCC).

**DESIGN AND METHODS:** The study was conducted as an ethnographic inquiry inspired by Spradley and based on participant observation of 12 contacts between nurse and family, one informal and three formal interviews with nurses in the EDP-unit of a Danish NICU.
RESULTS: This study illustrates how EDP-nurses facilitate a partnership with the families enrolled in EDP by using a range of complex strategies to adjust their care to the family's changing needs, while acknowledging the family's way of being. The partnership typically develops in three phases: "Settling in EDP," "Thriving in EDP," and "Leaving the EDP nest." The EDP-nurses have a clear understanding of whether a partnership is well functioning or challenging and they play a unique role by facilitating a partnership that supports the family on the journey towards a normal everyday life.

PRACTICE IMPLICATIONS: The knowledge unraveled in this study may prove helpful for training future EDP-nurses in the neonatal field of FCC, when improving the quality of an existing EDP or developing a new EDP based on the principles of FCC.


Hospitalization in the Neonatal Intensive Care Unit (NICU) is a stressful and potentially traumatic experience for infants as well as their parents. The highly specialized medical environment can threaten the development of a nurturing and secure caregiving relationship and potentially derail an infant’s development. Well-timed, dose-specific interventions that include an infant mental health approach can buffer the impact of medical traumatic stress and separations and support the attachment relationship. Many psychological interventions in the NICU setting focus on either the parent’s mental health or the infant’s neurodevelopmental functioning. An alternative approach is to implement a relationship-based, dyadic intervention model that focuses on the developing parent–infant relationship. Child–parent psychotherapy (CPP) is an evidence-based trauma-informed dyadic intervention model for infants and young children who have experienced a traumatic event. This article describes the adaptation of CPP for the NICU environment.


The Tromsø Intervention Study on Preterms (TISP) randomized 146 preterm-born children either to the Mother-Infant Transaction Program (MITP) or to a preterm control group. Previously, significant reductions of child behavior problems and maternal stress have been reported in the intervention group. This follow-up study examines whether the MITP may have affected the longitudinal adaptation between mothers and their children from two until nine years, expressed as associations between different behavioral problems and parenting stress reported by mothers. Associations between internalizing, attentional, and social problems and different dimensions of parenting stress were analyzed in separate models that included effects of time and group status. The MITP did not influence the development of longitudinal associations as no significant three-way interaction (stress*group*time) was found. Significant stress by group interactions was only found in reports on children’s attentional problems when analyzed with parent- or interaction-related stress. Mothers who had participated in the MITP reported weaker stress than control mothers. This effect was moderated by two independent variables, namely children’s birthweight and years of maternal education for the parent-child difficult interaction stress.


BACKGROUND: Parental sensitivity is the parent’s ability to recognize and interpret their infant’s cues, and identify and apply an appropriate response quickly. Sensitivity is central to the parent-infant relationship and predicts long-term attachment which also influences the child’s neurodevelopment. Parents of preterm infants are not less sensitive than parents of term infants but preterm infants may need more sensitive parenting. Moreover, increased parental stress in the NICU negatively influences parental sensitivity. Prior to NICU discharge, passive and active interventions, the former being interventions where parents receive information and the latter where parents participate in an aspect of their infant’s care, have been evaluated. Yet, no systematic review has examined the effect of both passive and active interventions as different types of interventions and their respective effects on sensitivity, nor have they examined their effects on neurodevelopment and parental stress.

OBJECTIVES: The primary objective of this systematic review is to examine the characteristics of passive and active interventions designed to enhance parental sensitivity. The secondary objective of this systematic
review and meta-analysis is to examine the effectiveness of early interventions for parents of preterm infants on parental sensitivity, parental stress and preterm infant neurodevelopment, compared to standard care.

**DESIGN/METHODS:** We adhere to the protocol which has previously been published and registered in the PROSPERO database (registration number: CRD42016047083). Eight databases have been searched. To be included, studies had to be randomized controlled trials (RCT) of early interventions for parents of preterm infants implemented in NICUs with parental sensitivity as a primary outcome and infant neurodevelopment as secondary outcome. Parental stress was added as a secondary outcome retrospectively because it was measured in many of the included RCTs. Intervention characteristics were qualitatively summarized. Because more than one study was available, a meta-analysis was conducted for the parental sensitivity outcome and for the parental stress outcome using a random effects model.

**RESULTS:** The literature search resulted in 7403 references. Following the study selection process, 24 papers accounting for eighteen studies published from 1988 to 2017 were included in the systematic review. These studies reported on fifteen different interventions. Interventions are often composed of an educational component where parents are taught their preterm infant’s cues. Parental participation in care using guided participation is also common and seems beneficial to promote sensitivity in the NICU. Only four interventions included fathers. Parents had a passive role in five interventions and had an active role in 14 interventions. Active parental participation included participation in kangaroo care, stimulation of their infant’s senses and participation in their infant’s care. The meta-analysis shows that passive interventions have an overall small but significant effect on parental sensitivity. Active interventions show no significant effect on this outcome. Both active and passive interventions also show no significant effect on parental stress. Infant neurodevelopment could not be considered in the meta-analysis because of insufficient data.

**CONCLUSION:** This is the first systematic review examining the effectiveness of interventions promoting sensitivity of parents of preterm infants in the NICU. Regardless of the meta-analysis results, this systematic review will guide clinical practice for the implementation of interventions in NICUs to enhance parental sensitivity, optimize neurodevelopment of preterm infants, and lower parental stress. Results also guide research and the development of interventions to further enhance sensitivity in the NICU.


**BACKGROUND:** Previous studies showed that parents of very preterm infants expressed feelings of incompetence and experienced high levels of stress upon the discharge of their infants. We conducted a systematic review of seven studies and observed potential benefits for parental outcomes when using discharge interventions that adopted guided participation (GP). More evidence is needed on the effective doses of discharge interventions underpinned by the principles of GP.

**AIM:** To investigate the feasibility and preliminarily estimate the effects on parental competence and stress outcomes of a newly developed, nurse-led, GP discharge program for mothers of very preterm infants.

**METHODS:** A two-arm randomized controlled trial was conducted in a neonatal intensive care unit (NICU). Mothers of infants with gestational ages of ≤32 weeks who had no congenital malformations and did not need to undergo major surgeries were recruited. All mothers were the primary caregivers to their infants. The intervention group received a nurse-led GP discharge intervention (three structured 30- to 60-min GP sessions and one follow-up phone call). The control group received usual care. The parental outcomes were measured using the Parenting Sense of Competence Scale (C-PSOC) and Perceived Stress Scale (C-PSS) at baseline (T0), on the day of discharge (T1), after the follow-up phone call (within 72 h after discharge) (T2), and 1 month after discharge (T3). The outcomes were analyzed using generalized estimating equations based on intention-to-treat principles.

**RESULTS:** Thirty infant–mother dyads were recruited. Greater improvements in the C-PSOC score were observed in the intervention group than in the control group at T1 and T2, although these differences were statistically insignificant. The intervention group exhibited greater improvements than the control group in the C-PSS scores at T1, T2, and T3, although these differences were also not statistically significant.

**CONCLUSIONS:** The findings suggest that a GP discharge intervention could improve parenting competence and stress among mothers with very preterm infants. The absence of adverse events suggests that the GP discharge intervention could be feasibly implemented in NICU settings. This feasibility study was not powered to determine the effectiveness of the intervention but is anticipated to lay the foundation for a future full-scale study.

**BACKGROUND:** Preterm birth is a leading cause of morbidity and mortality in children under five and often requires a newborn to have an extended stay in a neonatal intensive care unit (NICU). Maternal engagement, such as visiting the NICU to provide kangaroo mother care (KMC), can improve outcomes for preterm infants but requires significant investment of time and resources. This study sought to understand barriers and facilitators to provision of KMC in the NICU.

**METHODS:** We conducted semi-structured in-depth interviews with mothers of preterm infants (*N* = 20) at a large academic medical center in Massachusetts. A series of open-ended interview questions were designed to elicit all aspects of mothers’ experiences and to understand how these experiences influence provision of KMC. All interviews were recorded and transcribed verbatim. We conducted an inductive thematic analysis to identify themes in the data with a focus on the barriers and facilitators of KMC provision in the NICU.

**RESULTS:** Findings show that engaging in KMC is heavily influenced by the mental, emotional, and physical effects of preterm birth on the birth mother, such as stress around preterm birth and difficulty recovering from birth. These challenges are compounded by structural barriers such as costly accommodations, unreliable transportation, lack of child care, and inadequate maternity leave policies that limit the frequency and duration of KMC and parental ability to provide care.

**CONCLUSIONS:** A complex array of mental, emotional, physical, and structural factors determine a mother’s ability to visit the NICU and provide kangaroo mother care. Providing social supports, such as improved maternity leave policies and reliable hospital access through child care, accommodation, and transportation services, may address the structural barriers that inhibit KMC, reduce burdensome costs, and improve the health of mothers and their preterm infants.


**OBJECTIVE:** The purpose of this study was to determine the effect of preterm infant massage by the mother on the mood state of mothers of preterm infants.

**METHODS:** This experimental study assessed 52 mothers of preterm infants (born at 30-37 weeks of gestation) hospitalized in the neonatal intensive care unit of Afzalipour Hospital of Kerman University of Medical Sciences, Iran. Recruitment was done using the convenience sampling method, and participants were randomly assigned into intervention and control groups. In the intervention group, massage therapy was done once a day for 5 consecutive days. Infants in the control group received the usual care. Data were collected using a questionnaire of demographic information and the Profile of Mood State questionnaire and analyzed using SPSS version 19 (IBM Corp, Armonk, New York) and Kruskal-Wallis, Mann-Whitney U, Wilcoxon, and χ2 tests.

**RESULTS:** Comparison of the mothers’ mean mood scores between the intervention and control groups showed no significant difference before the intervention (P = .51), whereas mean scores differed significantly after the intervention between the groups (P = .005). Mothers’ mean mood scores improved significantly in the control group (P = .02) and the intervention group (P < .001), whereas the intervention group showed a greater improvement (-4.155 vs -2.238).

**CONCLUSION:** Those mothers performing massage on their preterm infants showed greater improvement in their mood compared with those in the control group. Teaching massage to the mothers of these infants could be considered as a possible intervention to enhance a mother’s mood and the quality of care she provides to her infant.


**BACKGROUND:** Survival of very-low-birth-weight infants is improving in neonatology and family-centered-care might contribute to premature infants’ clinical outcomes.

**AIM:** To evaluate a family-centered care intervention on clinical outcomes of very-low-birth-weight infants.

**METHODS:** A quasi-experimental study was conducted in a Chinese NICU between June 2016 and June 2017. The intervention included parental education of basic care knowledge and skills followed by active participation in care for at least 4 h a day. A total of 319 very-low-birth-weight infants were recruited by convenience sampling; intervention group *n* = 156 and control group *n* = 163. Primary outcome measures were
weight at discharge, length-of-stay, breastfeeding, nasal feeding, total parental nutrition, re-admission, hospital expenses. Secondary outcome measures were infant complications.

**RESULTS**: Infants’ weight at discharge was higher in the interventions group (2,654 g vs. 2,325 g, p < 0.001). Nutritional outcomes improved significantly: breastfeeding rate 139 vs. 91, p < 0.001; days of total parental nutrition 25 d vs. 32 d, p < 0.001; gastric feeding days 23 d vs. 35 d, p < 0.001. Length-of-stay and hospital expenses did not differ between both groups. Improved infants’ complications were bronchopulmonary dysplasia (32 vs. 51, p = 0.031), retinopathy of prematurity (between groups no/mild and moderate/severe, p = 0.003), necrotizing enterocolitis (6 vs. 18, p = 0.019), and re-admission rate (21 vs. 38, p = 0.023). No differences were observed in intraventricular hemorrhage and nosocomial infections.

**CONCLUSION**: Very-low-birth-weight premature infants might experience improved clinical health outcomes when parents are present and caring from them. Family-centered care is as a beneficial care model for premature infants and should be recognized and implemented by NICUs where parents have currently limited access.


**METHODS**: a single center randomized controlled trial conducted in a german level iii nicu. 88 preterm infants (25 to 32 weeks of gestational age) were randomized after initial stabilization to either 60 minutes DR-SSC or 5 minutes VC. 45 infants were allocated to DR-SSC, 43 to VC.

**RESULTS**: DR-SSC dyads showed a higher quantity of maternal motoric (18 vs 15, p=0.030), infant's vocal (7 vs 5, p=0.044) and motoric (20 vs 15, p=0.032) responses. Moreover, the combined score of maternal and infant responsive behavior was higher (86 vs 71, p=0.041) in DR-SSC dyads. DR-SSC mothers had lower risk of both, early postpartum depression (15% vs 45%, p=0.003) and impaired bonding (Score 3 vs 5, p=0.031).

**CONCLUSION**: In addition to regular intermittent kangaroo mother care, DR-SSC promotes MCI and decreases risk of maternal depression and bonding problems. Thus, DR-SSC may have positive effects on preterm development.


**CONTEXT**: In addition to various barriers studied for kangaroo mother care (KMC), time opportunities for better implementation of KMC need to be studied.

**AIM**: Time–motion analysis of the mother’s daily activities was carried out to identify scope to improve KMC.

**SETTINGS AND DESIGN**: This is a 24-h recall-based questionnaire study. Mothers were interviewed whose newborns were admitted at a tertiary and secondary care neonatal care unit of western India over a period of 9 months from November 2015 to July 2016.

**MATERIALS AND METHODS**: Mothers were approached when the preterm neonate and mother dyad was eligible for KMC, that is, when mothers were physically healthy and newborns were physiologically stable. A total of 60 mothers were enrolled in the study. Mothers’ daily activities were noted, and time spent in each activity was charted for 3 consecutive days. Missed time opportunities which could be used to increase daily KMC hours were studied.

**STATISTICAL ANALYSIS USED**: To compare quantitative variables, two-sample unpaired t-test and one-way analysis of variance were used.

**RESULTS**: The average time of activities which consumed most was 8.24 h for sleep/rest, 3.46 h for meals/snacks, 4.89 h for breastfeeding, and a daily average of only 1.4 h was used for KMC. A quite a significant proportion, that is, 3.89 h, was spent for meeting relatives which could be used for KMC as well without affecting social meetings.

**CONCLUSION**: Time–motion analysis was helpful to find out weak links in KMC implementation. Providing family-centered environment in terms of implementing KMC during meeting hours with family may augment KMC hours.


**BACKGROUND**: Family-centered care (FCC) in neonatal intensive care units (NICUs) was initiated in 1992 to promote a respectful response to individual family needs and support parental participation in care and
decision-making for their infants. Although benefits of FCC have been reported, changes in the maternal experience in the NICU are unknown.

PURPOSE: The purpose of this study was to compare mothers’ experiences in NICUs where FCC is the standard of care and to compare these with the experiences of mothers 2 decades ago.

METHODS: In this qualitative descriptive design, mothers of infants born under 32 weeks postconceptional age were asked to describe their experiences with their infant’s birth and hospitalization. Open-ended probing questions clarified maternal responses. Saturation was reached after 14 interviews. Iterative coding and thematic grouping was used for analysis.

RESULTS: Common themes that emerged were: (1) visiting; (2) general caregiving; (3) holding; (4) feeding; and (5) maternal ideas for improvement. Findings indicated important improvements in privacy, mother–nurse relationship, ease of visiting, and maternal knowledge and participation in infant caregiving.

IMPLICATIONS FOR PRACTICE: Mothers suggested improvements such as additional comforts in private rooms, areas in the NICU where they can meet other mothers, and early information on back-transport. Better recognition and response for mothers without adequate social support would provide much needed emotional assistance.

IMPLICATIONS FOR RESEARCH: Future research addressing benefits of webcams, wireless monitors, back-transport, maternity leave, and accommodations for extended visiting for siblings would address other needs mentioned by mothers.


BACKGROUND: Parents of neonates are integral components of patient safety in the neonatal intensive care unit (NICU), yet their views are often not considered. By understanding how parents perceive patient safety in the NICU, clinicians can identify appropriate parent-centered strategies to involve them in promoting safe care for their infants.

PURPOSE: To determine how parents of neonates conceptualize patient safety in the NICU.

Methods: We conducted qualitative interviews with 22 English-speaking parents of neonates from the NICU and observations of various parent interactions within the NICU over several months. Data were analyzed using thematic content analysis. Findings were critically reviewed through peer debriefing.

FINDINGS: Parents perceived safe care through their observations of clinicians being present, intentional, and respectful when adhering to safety practices, interacting with their infant, and communicating with parents in the NICU. They described partnering with clinicians to promote safe care for their infants and factors impacting that partnership. We cultivated a conceptual model highlighting how parent-clinician partnerships can be a core element to promoting NICU patient safety.

IMPLICATIONS FOR PRACTICE: Parents’ observations of clinician behavior affect their perceptions of safe care for their infants. Assessing what parents observe can be essential to building a partnership of trust between clinicians and parents and promoting safer care in the NICU.

IMPLICATIONS FOR RESEARCH: Uncertainty remains about how to measure parent perceptions of safe care, the level at which the clinician-parent partnership affects patient safety, and whether parents’ presence and involvement with their infants in the NICU improve patient safety.


This study aimed to compare the effect of education through smart phone SMS and face-to-face method for mothers on the awareness and care for premature newborns hospitalized in Valiasr hospital in Birjand, Iran. In this quasi-experimental study, 15 mothers of premature neonates hospitalized in NICU ward of Valiasr hospital in Birjand were chosen and then assigned into RESEARCH 23(98), Page541 ARTICLE RESEARCH intervention and control groups randomly. The required information was collected through mother and neonate demographics questionnaire as well as the questionnaire for measuring mothers’ awareness about breast-feeding and premature neonatal care. The intervention group received education in a face-to-face session and then for four weeks through SMS. On the other hand, the control group received only one face-to-face educational session. After three months, we investigated the indices of neonatal development (height, weight, head circumference) and the premature neonate care measurement questionnaire. In order to compare the developmental indices regarding investigation of awareness and manner of care in both groups, independent t-test was used, with P<0.05 considered significant. The neonatal development indices at the beginning of
birth and three months later were measured which showed a significant difference in the intervention group. Furthermore, a significant difference was observed in the two groups in terms of awareness and manner of care provided by their mothers \((p<0.05)\). Education through SMS to mothers with hospitalized neonates is effective in persistence of care and controlling the natural course of growth of premature neonates. Thus, as cell phone is economical and usable by the most individuals in the society, it can be employed to improve health and for education in follow-up and helping in improvement of health status of premature neonates.


**PURPOSE:** To evaluate the effect of a NICU parent education program on parents' early language and literacy practices, and on their confidence interpreting and responding to infant signals.

**DESIGN:** Single group, pre- and post-test, mixed-methods evaluation design.

**SAMPLE:** One hundred and four parents and other caregivers completed questionnaires before and after the one-hour program. Ten parents participated in follow-up interviews.

**MAIN OUTCOME VARIABLES:** Before and after sessions, participants reported on frequency of their current and intended early language and literacy practices, and their confidence interpreting and responding to infant signals. Participants also reported program satisfaction. Interview participants reported their behavior change one to two weeks later.

**RESULTS:** The program significantly increased intention to engage in more early language and literacy practices, and increased parent-reported knowledge of how and when to interact with their infants. The majority of interviewed parents reported engaging in these practices one to two weeks later.


**OBJECTIVE:** To evaluate the role of kangaroo mother care (KMC) on growth and breast feeding rates in very low birth weight (VLBW) neonates.

**MATERIALS AND METHODS:** A literature search was done to identify eligible studies using various electronic database searches including PubMed and EMBASE, various Web of Science including Scopus, Index Copernicus, African Index Medicus (AIM), Thomson Reuters (ESCI), Chemical Abstracts Service (CAS), SCIWISE (Scientific World Index), Google Scholar, Latin American and Caribbean Health Sciences Information System (LILACS), Index Medicus for the Eastern Mediterranean Region (IMEMR), Index Medicus for the South-East Asian Region (IMSEAR), and Western Pacific Region Index Medicus (WPRIM) and various clinical trial registries.

**RESULTS:** Thirteen studies that evaluated the role of KMC in VLBW infants in improvement of growth outcome (weight/length/head circumference) or breast feeding rates as their primary or secondary outcome, were included in this systematic review. Seven studies evaluated both growth and breast feeding rates, four studies evaluated breast feeding rates and two studies evaluated growth outcome. All included studies except one either showed positive effect or no effect on growth and breast feeding rates.

**CONCLUSIONS:** KMC has a positive effect on growth of the VLBW infants and also leads to increase in the breast-feeding rates. KMC should be an integral part of neonatal care and should be promoted as an essential newborn care component.


**BACKGROUND:** Biological signaling and communication between mothers and infants during breastfeeding may shape infant behavior and feeding. This signaling is complex and little explored in humans, although it is potentially relevant for initiatives to improve breastfeeding rates.

**OBJECTIVES:** The aim of this study was to investigate physiological and psychological aspects of mother-infant signaling during breastfeeding experimentally, testing the effects of a relaxation intervention on maternal psychological state, breast milk intake, milk cortisol levels, and infant behavior and growth.

**METHODS:** Primiparous breastfeeding mothers and full-term infants were randomly assigned to receive relaxation therapy \([\text{intervention relaxation group; } n = 33 (RG)]\) or to the control group \([\text{control group; } n = 31 (CG); \text{no relaxation therapy}]\) at 2 wk postpartum. Both groups received standard breastfeeding support. Home visits were conducted at 2 (HV1), 6 (HV2), 12 (HV3) and 14 (HV4) wk to measure maternal stress and anxiety, breast milk intake and milk cortisol, and infant behavior and growth.
RESULTS: RG mothers had lower stress scores postintervention than the CG (HV3 Δ = -3.13; 95% CI: -5.9, -0.3) and lower hindmilk cortisol at HV1 (Δ = -44.5%; 95% CI: -76.1%, -12.9%) but not at HV2. RG infants had longer sleep duration (Δ = 82 min/d; 95% CI: 16, 149 min/d) at HV2 and higher gains in weight and body mass index standardized deviation score than the CG infants (Δ = 0.76; 95% CI: 0.3, 1.22; and Δ = 0.59; 95% CI: 0.09, 1.1, respectively). RG infants had a mean milk intake at HV3 that was 227 g/d higher than that of the CG infants (P = 0.031) after controlling for gender and milk intake at HV1.

CONCLUSIONS: The trial shows the effectiveness of a simple relaxation intervention for improving maternal and infant outcomes and identifies some potential signaling mechanisms for investigation in future and larger studies, especially in settings where mothers are more stressed, such as those with preterm or low birth weight infants. This trial was registered at clinicaltrials.gov as NCT01971216.


OBJECTIVE: To conduct a systematic review of the literature documenting racial/ethnic disparities in quality of care for infants in the NICU setting.

DATA SOURCES: Medline/PubMed, Scopus, Cumulative Index of Nursing and Allied Health, and Web of Science were searched until March 6, 2018, by using search queries organized around the following key concepts: “neonatal intensive care units,” “racial or ethnic disparities,” and “quality of care.”

STUDY SELECTION: English language articles up to March 6, 2018, that were focused on racial and/or ethnic differences in the quality of NICU care were selected.

DATA EXTRACTION: Two authors independently assessed eligibility, extracted data, and cross-checked results, with disagreements resolved by consensus. Information extracted focused on racial and/or ethnic disparities in quality of care and potential mechanism(s) for disparities.

RESULTS: Initial search yielded 566 records, 470 of which were unique citations. Title and abstract review resulted in 382 records. Appraisal of the full text of the remaining 88 records, along with the addition of 5 citations from expert consult or review of bibliographies, resulted in 41 articles being included.

LIMITATIONS: Quantitative meta-analysis was not possible because of study heterogeneity.

CONCLUSIONS: Overall, this systematic review revealed complex racial and/or ethnic disparities in structure, process, and outcome measures, most often disadvantaging infants of color, especially African American infants. There are some exceptions to this pattern and each area merits its own analysis and discussion.


In this article, we describe the results of the second phase of a randomized controlled trial of Minding the Baby (MTB), an interdisciplinary reflective parenting intervention for infants and their families. Young first-time mothers living in underserved, poor, urban communities received intensive home visiting services from a nurse and social worker team for 27 months, from pregnancy to the child’s second birthday. Results indicate that MTB mothers’ levels of reflective functioning was more likely to increase over the course of the intervention than were those of control group mothers. Likewise, infants in the MTB group were significantly more likely to be securely attached, and significantly less likely to be disorganized, than infants in the control group. We discuss our findings in terms of their contribution to understanding the impacts and import of intensive intervention with vulnerable families during the earliest stages of parenthood in preventing the intergenerational transmission of disrupted relationships and insecure attachment.


OBJECTIVE: To understand the perception of the multiprofessional health care team regarding the inclusion of fathers in the care of preterm infants who are in Intensive Care Units (ICUs).

METHODS: This is a descriptive study with a qualitative approach, using a semi-structured interview with 12 health care professionals of a neonatal ICU, from February to July 2017. The data were analyzed according to the Discourse of the Collective Subject.

RESULTS: Seven main ideas (MI) emerged from the text analysis, which were grouped into two themes: 1) the role of the father according to the multiprofessional health care team views (MI1: parent provider, MI2: shared care, MI3: supportive father); 2) perception of the father caring for the hospitalized preterm infant
(MI4: father does not change diapers; MI5: father conquering new spaces; MI6: strengthening the bonding; MI7: father providing maternal security.

CONCLUSIONS: The results of this study point out to the importance of including the father figure in the humanized care of preterm infants. Professional health care team should be more aware of fathers’ importance in the care of hospitalized preterm infants.

The presently reported patient was a 37-year-old married primipara with peripartum depression comorbid with bonding disorder. Care anxiety and a lack of affection towards her baby first appeared at around the time of delivery, and the patient developed major depression at one month after the birth of her healthy baby. At first, standard treatment for major depression including the use of antidepressants, electroconvulsive therapy, and supportive psychotherapy were provided. However, bonding problems appeared to impede and obstruct the amelioration of depression. Although treatment methods for bonding disorder have not yet been established, Kangaroo Care was introduced to facilitate skin-to-skin contact. We also educated her in better parenting behavior and provided repeated motivational interviews with her family because a lack of partner and social support and personal temperament (low self-directedness and cooperativeness) were thought to be related to her bonding disorder. This case suggests the effectiveness of Kangaroo Care, which promotes a humanizing maturation of both baby and parent alike, for mothers with postpartum depression and comorbid severe bonding disorder.

BACKGROUND: Preterm infants remain increasingly neurodevelopmentally disadvantaged. Parental touch, especially during skin-to-skin contact (SSC), has potential to reduce adverse consequences.
PURPOSE: To examine relationships between parental engagement and salivary oxytocin and cortisol levels for parents participating in SSC intervention.
METHODS: A randomized crossover design study was conducted in a neonatal intensive care unit; 28 stable preterm infants, mothers, and fathers participated. Parental engagement was measured using the Parental Risk Evaluation Engagement Model Instrument (PREEMI) prior to hospital discharge. Saliva samples for oxytocin and cortisol levels were collected 15-minute pre-SSC, 60-minute during-SSC, and 45-minute post-SSC.
RESULTS: Data were analyzed using Pearson’s correlation to measure relationships between parental engagement composite scores and salivary oxytocin and cortisol levels for parents participating in SSC intervention. Adjusted linear regression models demonstrated that as infant oxytocin levels increased during SSC, maternal engagement scores significantly decreased at discharge (β = -.04; P = .01). Linear regression, adjusting for infant oxytocin and cortisol levels, showed that as paternal oxytocin levels increased, there was a significant decrease in paternal engagement (β = -.16; P = .03) and as paternal cortisol levels increased, there was a significant decrease in paternal engagement (β = -68.97; P =.05).
IMPLICATIONS FOR PRACTICE: Significant relationships exist between parental engagement and salivary oxytocin and cortisol levels. Defining parent engagement facilitates identification of parent risks and needs for intervention to optimize preterm outcomes.
IMPLICATIONS FOR RESEARCH: The PREEMI can serve as a standardized instrument to examine parent engagement.

AIMS AND OBJECTIVES: To explore how parents of preterm infants express the constructive aspects of their experiences. Using the notion of post-traumatic growth as a back-drop, this study supplements the research on parents’ difficulties by providing a more nuanced understanding of what it is like to have a preterm child.
BACKGROUND: Researchers have reported that parents feel afraid, worried, helpless, powerless, guilty and stressed, as well as that preterm birth can be associated with physical and psychological ill health among parents; however, a few researchers have found indications of post-traumatic growth among parents.
DESIGN: This study includes qualitative interviews and relates to COREQ guidelines for reporting qualitative research.

METHODS: A total of 13 mothers and 10 fathers of extremely preterm children, as well as 11 mothers and 7 fathers of moderately preterm children, were interviewed. The data analysis was based on thematic analysis.

RESULTS: The analysis resulted in six themes that describe various constructive aspects of having a preterm child: acceptance of the fact that events do not always occur as planned; gratitude and reconsideration of the situation; reappraisal of close relationships; reliance on one’s own ability to deal with events; thankfulness for what one has; and openness to being exposed to various kinds of people and their experiences.

CONCLUSIONS: The parents recounted constructive aspects of their experiences such as an altered understanding of themselves, others and life itself. These themes provide a more nuanced way of understanding how parents can relate to having preterm children.

RELEVANCE TO CLINICAL PRACTICE: This knowledge can help professionals to enable parents to activate their social network and to acknowledge their care for each other, as well as to help parents see beyond cultural ideals regarding childbirth and family life and to find their own solutions to everyday life.


BACKGROUND/SIGNIFICANCE: Premature infants often experience extended stays in the neonatal intensive care unit (NICU) as opposed to home with parents. This prolonged separation creates a strain for both parents and infants, decreasing attachment and parental caregiving. One strategy to combat this shared stress is increasing parental participation, particularly through the use of their voices whether parents are present or not.

PURPOSE: This Evidence-Based Practice Brief column explores the connection between mother and child, specifically the effects of maternal voice on infant autonomic stability, weight gain, and behavioral states.

METHODS: A systematic search of CINAHL, PubMed, and PsycInfo was used to identify studies involving the use of maternal voice intervention with preterm infants in the NICU.

RESULTS: Fifteen studies were identified. Three intervention categories emerged: (1) live maternal speech, (2) recorded maternal speech (subcategories included whether intervention content was prescribed or not), and (3) recorded maternal speech that was combined with biological maternal sounds (heart rate). Within each category, studies were organized chronologically to reflect how knowledge has changed overtime.

IMPLICATIONS FOR PRACTICE: Maternal voice has physiological as well as behavioral and emotional effect on preterm infants. Several studies found that maternal voice increased autonomic stability improving (heart rate and respirations) as well as weight gain. No negative effects were identified. Given these findings, incorporating different types of maternal voice into routine care by the bedside nurse can assist the mother in feeling more involved in her infant’s care without seemingly being a distraction or obstacle to providers.

IMPLICATIONS FOR RESEARCH: A major limitation for generalizability was sample size; more research is needed with larger sample sizes replicating interventions types to discern best outcomes.


BACKGROUND: Women with opioid use disorder (OUD) are encouraged to breastfeed, but have lower breastfeeding rates than the general population.

OBJECTIVE: We examined self-reported barriers and motivators for breastfeeding in women with OUD and the relationship between maternal/postnatal factors and breastfeeding noninitiation/discontinuation.

MATERIALS AND METHODS: A cross-sectional design was used; 40 women with OUD who were eligible to breastfeed were included. Information about breastfeeding initiation, duration, barriers/motivators, demographic characteristics, and self-efficacy was obtained through semi-structured interviews at 4–8 weeks postpartum. Wilcoxon rank sum or Fisher’s exact test was used to examine the relationship between maternal/postnatal factors and never-initiated/discontinued breastfeeding.

RESULTS: Respondents were 29.3 ± 5.3 years old; most were prescribed buprenorphine (77.5%); and 36.8% of infants were treated for neonatal opioid withdrawal syndrome with methadone or morphine. Most (75.0%) participants initiated breastfeeding; 50.0% continued breastfeeding at 4–8 weeks. The most common motivators included infant health (100%) and bonding (45.0%). On average, women reported discontinuing breastfeeding at 3.3 ± 1.1 weeks postpartum. The most common barriers were concerns regarding transfer of medications or other substances to the infant (50.0%) and concerns about breast milk supply (35.0%). Mean
self-efficacy scores were similar among those who continued versus never-initiated/discontinued breastfeeding (33.5 versus 33.0; p = 0.388). Neonatal intensive care unit admission was associated with never-initiated/discontinued breastfeeding (p = 0.047).

CONCLUSION: Women with OUD share many similar motivators and barriers to breastfeeding with the general population. Unique concerns include infant exposure to medications or substances, even in those who are eligible to breastfeed, which should be addressed by targeted education for patients and providers.

**BACKGROUND:** Mothers of preterm infants are at increased risk for postpartum depression, which may disturb parenting and child development. Strategies for prevention are needed. Therefore, we evaluated how an educational intervention for neonatal staff affected depression symptoms among mothers of preterm infants.

**METHODS:** The Close Collaboration with Parents intervention was implemented in the NICU at Turku University Hospital in Finland. Maternal depression was compared between the pre-intervention and post-intervention cohorts using the Edinburgh Postnatal Depression Scale. The eligible infants were born ≤1500 g without major anomalies and survived. Data were available from 145 and 93 mothers in the pre-intervention and post-intervention cohorts, respectively, at 4 and/or 6 months of corrected age.

**RESULTS:** The depression scores were significantly lower in the post-intervention cohort than in the pre-intervention cohort; the estimated difference was 2.54 points (95% CI, 1.24–3.83), $p < 0.001$. A total of 10.3% of the mothers in the pre-intervention cohort and 2.1% in the post-intervention cohort exceeded the threshold for depression, $p = 0.066$.

**CONCLUSION:** The Close Collaboration with Parents intervention decreased depression symptoms among the mothers of very preterm infants. Systematic educational intervention targeted to the whole NICU staff can potentially prevent postnatal depression among mothers of preterm infants.


**OBJECTIVE:** This study was conducted to examine the effect of narrative writing on fathers' stress in the Neonatal Intensive Care Units (NICUs) during infants’ hospitalization.

**METHODS:** A quasi-experimental study was conducted among two groups of fathers with preterm infants in the NICUs of two teaching hospitals of Gorgan University of Medical Sciences. Pre- and post-tests were administered to a sample size of 70 during 6 months. The Parental Stressor Scale (PSS) was used. The data were analyzed using descriptive and analytical statistical methods.

**RESULTS:** The mean total stress score was 74.05 ± 17.39 in the control and 80.11 ± 15.82 in the intervention group on the 3rd day, suggesting no significant difference. In other words, both groups had a similar stress level before the intervention (p-value = .13, $t = 1.52$). However, the mean total stress score was 85.45 ± 16.91 in the control group and 48.00 ± 10.49 in the intervention group on the 10th day, suggesting a significant reduction in the stress level in the intervention group following the intervention (p-value = .001, $t = -11.01$).

**CONCLUSION:** According to the findings, the narrative writing may be considered as an efficient supportive intervention to reduce the fathers’ stress in the NICUs. However, more research is needed to justify its implementation.


**OBJECTIVES:** To explore needs of parents of very preterm infants hospitalised in Neonatal Intensive Care Units according to their socioeconomic position, obstetric history and infant's characteristics. METHODOLOGY: Sequential explanatory mixed methods study. Individual quantitative questionnaires (n = 118 mothers; 89 fathers) during infants’ hospitalisation; couples-based semi-structured interviews (n = 26) four months after childbirth (July 2013-June 2014).

**SETTING:** All level III public neonatal intensive care units in North Portugal.

**RESULTS:** Mothers valued more information needs than fathers and their overall scores were mainly influenced by age and educational level, while fathers’ needs perceptions were influenced by previous children. Despite gender differences, the assurance and proximity needs of parents apply across sociotechnical environments. Qualitative findings added the following needs: instrumental support from the government; regular emotional support from psychologists and social workers; enhancement of privacy to assure family-centred information and comfort; and availability of peers and health professionals as mediators in the provision of coherent information.

**CONCLUSIONS:** The promotion of family-friendly and gender-equality policies is crucial to support family integrated healthcare services. This study raises awareness for developing sensitive conceptual frameworks...
and instruments to assess parents’ needs considering their socioeconomic position and reproductive trajectories, as well as privacy and regular emotional support in the neonatal intensive care unit.


The following presents the findings of a small-scale pilot study to investigate fathers’ experiences of attending a support group on the Neonatal Intensive Care Unit at Addenbrooke’s Hospital, Cambridge. The group was set-up in January 2018 to enable a safe and supportive space for fathers with a baby on the neonatal unit. Emerging themes are discussed, including the value of the shared group experience, enjoyment and feelings of validation and inclusion of being an active family member. Implications for future clinical practice are addressed, with recommendations for other neonatal units that may be considering running such groups.


**BACKGROUND:** Parents’ experiences transitioning their children from neonatal to developmental/rehabilitation services (DRS) are unknown.

**METHODS:** A qualitative descriptive approach was used, including interviews with 18 parents (13 mothers and 5 fathers) of children born preterm and diagnosed with cerebral palsy (CP), located in a large urban center in Canada. Interview data underwent thematic analysis.

**RESULTS:** Parents’ experiences with transition to DRS were a whole new world with three key themes: Wanting to know what to expect, feeling supported in their transition, and getting there emotionally and physically. Transition broke an emotional bond with neonatal services while parents were simultaneously entering DRS, experiencing their child’s CP diagnosis, and reliving prior emotional trauma.

**CONCLUSIONS:** The findings reveal a cumulative emotional burden for parents in the first 3 years of life; a known critical period for parenting and early childhood development. Early transition interventions should consider including enhanced supports and services for parents.


**AIM:** To assess the impact of relaxation technique on stress, anxiety and milk output among the postpartum mothers of hospitalized neonates in NICU.

**MATERIALS AND METHODS:** In a non-blinded randomized controlled trial with total enumeration sampling technique, screening of NICU admission was done daily based on inclusion criteria. From total 160 admissions over a period of 6 month, 74 postpartum mothers meet the inclusion criteria whose neonates were born preterm (26–33 weeks gestation) and admitted consecutively to the level-III NICU at AIIMS Hospital in New Delhi, India. Total 57 mothers agree to participate, they were enrolled and randomly assigned to experimental (n1 = 29) and control (n2 = 28) groups using a computer generated random allocation sequence. There were total seven dropouts with the final sample size of 25 in each group. Baseline data including socio-demographic profile, maternal stress and anxiety were collected using subject data sheet, standardized Parental Stress Scale (PSS): NICU and Perinatal Anxiety Screening Scale (PASS) on 4 ± 2 postpartum day. An audio assisted relaxation technique of 30 min duration, was developed under the guidance of yoga therapist, which included deep breathing (5 min), Suksham Vyayam (8 min), Anulom-Vilom (5 min), Brahmari (5 min), Progressive Muscle Relaxation (PMR) (5 min), and deep breathing (2 min). The experimental group was administered audio assisted relaxation technique followed by every day practice for 10 days, while the control group continued to receive the routine care. The impact of the relaxation technique on stress, and anxiety of mothers along with milk output was assessed after 10 days of enrolment.

**RESULTS:** Baseline characteristics and pre-intervention mean maternal stress (3.9 ± 0.5 vs. 3.8 ± 0.5, p = 0.34) and anxiety scores (31.12 ± 11.4 vs. 31.08 ± 12.0, p = 0.99) were comparable in both the groups. There was significant reduction observed in maternal stress (2.9 ± 0.5 vs. 3.6 ± 0.6) and anxiety scores (19.8 ± 6.7 vs. 28.18 ± 11.7, p ≤ 0.05) and improvement in milk output (69.2 ± 19.3 vs. 54.1 ± 22.5, p ≤ 0.05) in experimental group as compared to control group.

**CONCLUSION:** Use of relaxation technique may have significant role in reducing maternal stress and anxiety and improving the milk output.

BACKGROUND: A history of depression in post-partum women who have infants admitted to the neonatal intensive care unit (NICU), is associated with higher risk for anxiety and stress. These conditions, which can be harmful to neonates, may be missed if maternal mental health screening is confined to depression.

OBJECTIVE: To determine if the history of a previously diagnosed depression would be associated with an increased risk of both postpartum depression and other stress-related disorders (i.e. anxiety and stress) among mothers with infants in the NICU.

DESIGN: Prospective survey questionnaire-based study conducted over a period of 9 months.

SETTING: Urban inpatient hospital-based setting, serving mainly low-income population.

PARTICIPANTS: A total of 118 mothers of newborns who had been in the NICU for 7–29 days were approached for enrollment. Out of 118, 96 mothers consented to be screened and were asked to fill out the 21-item Depression Anxiety and Stress Scale-21 (DASS-21) questionnaire.

OUTCOME: Primary outcome was to determine whether the history of a previously diagnosed depression is associated with an increased risk of both postpartum depression and other stress-related disorders (i.e. anxiety and stress).

RESULTS: Out of the 96 subjects, 36 (37.5%) had a previous history of depression before delivery (Group A) while 60/96 (62.5%) did not (Group B) and 46/96 (48%) of the mothers were positive for either depression, anxiety, or stress. This included 22/96 (22.9%) mothers who screened positive for depression; 37/96 (38.5%) who screened positive for anxiety; and 32/96 (33.3%) who screened positive for stress. After adjusting for maternal drug abuse, birth weight and maternal gravidity, the association between a previous history of depression and current depression scores were statistically significant (p = .04), as were the associations between previous depression and current anxiety and stress scores (p = .02 and p = .003, respectively).

CONCLUSIONS AND RELEVANCE: A history of depression, documented in the antepartum medical record, identifies post-partum women who are at higher risk for anxiety and stress. Screening for depression alone may lead to missing these mental health issues.


AIMS: In the present study, it was aimed to investigate the relationships between breastfeeding attitude and perceived stress levels of Turkish mothers.

METHODS: In this descriptive study, the Personal Information Form prepared by the researchers, Perceived Stress Scale (PSS) and Iowa Infant Feeding Attitude Scale (IIFAS) were used to collect the study data. The present study included 788 mothers having 0-6 month-old infants. The data obtained were with the independent t-test, one-way ANOVA and Pearson correlation analyses.

FINDINGS: The mean scores of the participants obtained from the PSS and IIFAS were 25.60 ± 7.3 and 61 ± 6.6, respectively. At the end of the correlation analysis, it was observed that breastfeeding attitude decreased as the perceived stress level increased in mothers.

CONCLUSIONS: The results of the research indicated that as the perceived stress levels of mothers in the postpartum period increased, their breastfeeding attitudes decreased. It is suggested that nurses should support women by providing education and counselling during pregnancy and postpartum period.


OBJECTIVE: To evaluate the stress level of mothers of preterm infants with gestational age ≤34 weeks, hospitalized in neonatal intensive care.

METHOD: A cross-sectional study with 74 mothers of premature infants in neonatal intensive care, who answered the ”Parental Stress Scale: Neonatal Intensive Care Unit” instrument, validated in Brazil.

RESULTS: The mean stress level was 4.41 (± 0.77) and the general stress level was 4.36 (± 0.76), with a significant difference (p <0.001) between the subscale ”Alteration in parental roles” and other subscales, meaning that mothers were in a very stressful situation.

CONCLUSION: All items in the subscale ”Alteration in parental roles” of the ”Parental Stress Scale: Neonatal Intensive Care Unit” were identified as the main source of stress experienced by mothers. This study suggests carrying out further studies with other methodologies to increase the knowledge of maternal stress in the national context, applying care interventions involving the parents.

**OBJECTIVE:** Previous studies suggest that maternal postpartum mental health issues may have an impact on parenting and child development in preterm infants, but have often not measured symptomatology in the neonatal intensive care unit (NICU) or followed families through early childhood. This study examines how maternal depressive symptoms and stress in the NICU are related to parenting behaviors at age 5 years, in mothers of children born very preterm (at ≤30 weeks' gestation).

**METHOD:** This longitudinal study followed a diverse sample of 74 very preterm children and their mothers. Maternal depression and stress were assessed in the NICU. At age 5, mother-child dyads were observed and coded for maternal intrusiveness, negativity, sensitivity, and positivity. Other covariates, including maternal and child intelligence, maternal education, income-to-needs ratio, maternal depression at age 5 years, and child sex were included in multivariate analyses.

**RESULTS:** The interaction between maternal NICU stress and NICU depression for intrusiveness and negativity indicates that greater NICU depression was associated with more intrusiveness under medium or high levels of NICU stress, and more negativity under high levels of NICU stress. Furthermore, greater NICU depression was associated with less sensitivity, over and above other covariates.

**CONCLUSION:** Findings suggest that early maternal peripartum depression and stress in the NICU can have lasting impacts on multiple parenting behaviors, highlighting the need for screening and targeted interventions in the NICU.


Infants who require admission to a neonatal unit and who ultimately present with complex neurodevelopmental difficulties often require more sustained engagement with early intervention services during admission and beyond. However, there is little research exploring families’ experiences of early intervention (EI) therapy received throughout a neonatal unit admission and continuing through transition into the community setting. This study was designed to explore parents’ perceptions of EI therapy for infants with complex emerging neurodevelopmental difficulties. Using a descriptive qualitative approach, interviews were conducted with 6 mothers whose infants had been admitted to a neonatal unit and were receiving EI therapy services for their child. Interviews were audio-recorded and transcribed and then thematically analyzed. Four key themes emerged articulating the parent experiences during their evolving relationship with therapy providers in the neonatal unit and following discharge: (a) a vulnerable start—adjusting to the unexpected; (b) becoming a mother—becoming a family; (c) the therapy journey; and (d) a new reality. Attributes that enhanced the developing parent–provider relationship were identified including the importance of developing collaborative communication styles, supporting families in developing their expectations of the parent– provider relationship, and ensuring clarity in the nature, scope, and contribution of EI therapy to their child and overall family development. Early introduction of EI therapists during an infant’s admission to a neonatal unit can serve to strengthen the parent–provider relationship by offering a support continuum during a vulnerable time.


**BACKGROUND:** Mothers of preterm infants, early or late, report more distress than mothers of full-term infants. Malawi has the highest preterm birth rate in the world, but nothing is known about the relation of preterm birth to maternal mental health.

**PURPOSE:** Compare emotional distress among mothers of early-preterm, late-preterm, and full-term infants.

**METHOD:** We recruited 28 mothers of early-preterm, 29 mothers of late-preterm, and 28 mothers of full-term infants. Emotional distress was assessed 24-72 hours following birth. One-way ANOVA and regression analysis were used to compare the three groups.

**FINDINGS:** Mothers of early-preterm infants reported more distress symptoms than mothers of full-term infants, and mothers of late-preterm infants were intermediate between the other two groups. Having a support person present was associated with lower symptoms and caesarean birth was associated with more symptoms.
DISCUSSION: Promoting maternal mental health is important following preterm birth and healthcare providers need to support mothers.


Having a sick infant in the NICU can be quite stressful and overwhelming to parents. They require support and may have varied needs. A systematic review of qualitative and quantitative studies from 5 electronic databases (Ovid Medline, EMBASE, PsycINFO, CINAHL and Sociological Abstracts), covering January 2001 – March 2016 identified the needs and stressors of parents of term or near-term Infants in the NICU. Six articles addressed the needs and 14 identified the stressors of parents.

Parents’ most important need was for accurate and honest information. Needs focused around sensitive infant care and involvement in decision-making. The greatest stressor for parents was alteration to the parental role, followed by infant appearance. Fathers and parents of infants undergoing surgery are an under-researched population.

Based on the evidence, enhancing staff-parent communication would better meet parental needs and reduce stressors. Our key recommendations highlight the need for family-centred and individualised care practices in the NICU.


OBJECTIVE: To use a social-ecological conceptualization to analyze change of maternal distress, defined as depression, anxiety, and perinatal-specific post-traumatic stress (PPTS), across very low birth weight (VLBW) infants’ first year of life and to identify infant, maternal, and neighborhood predictors of these changes over time.

METHODS: Mothers of VLBW infants (n = 69) completed psychological distress questionnaires 2 to 4 weeks after infant birth, 2 weeks before infant discharge from neonatal intensive care unit, and at infants’ 4- and 8-month corrected age (age adjusted for prematurity). Infant and maternal sociodemographic data were collected from medical chart review. Neighborhood data were obtained through US census data. Multilevel linear growth modeling was used to (1) predict unstandardized estimates of mothers’ initial levels of depression, anxiety, and PPTS at the time of infant’s birth and the rate of change of these markers of distress over time and (2) model unstandardized estimates of infant, maternal, and neighborhood as predictors of distress at infants’ birth and change over time.

RESULTS: Unstandardized estimates from multilevel linear growth modeling revealed depression (-2.8), anxiety (-1.4), and PPTS (-0.7) declined over infants’ first year of life (<0.001). Mothers residing in lower-income homes and neighborhoods, respectively, reported lower anxiety (-11.2, p = 0.03) and PPTS (-31.1, p = 0.01) at infant birth. Greater infant birth weight predicted both lower anxiety (-0.02, p = 0.02) and lower PPTS (-0.02, p = 0.005).

CONCLUSION: Mothers psychologically recover over VLBW infants’ first year of life. Results add to a building literature about socioeconomically disadvantaged mothers of preterm infants, reporting lower distress; this warrants additional research.


INTRODUCTION: This study was conducted to examine whether the parental report of objective infant medical indices (e.g., birth weight, length of stay) can be used to identify parents at risk for psychosocial sequelae.

METHODS: Parents (N = 199) cohabitating with their partner and child who was discharged from a neonatal intensive care unit (NICU) 6 months to 3 years prior to the administration of the study completed an online survey, which included parent-reported infant health, parenting stress, family burden, and family resources.

RESULTS: A hierarchical cluster analysis identified the following three clusters of parents at risk for stress and family burden as determined by infant medical severity and access to resources: lowest risk (n = 77), moderate risk (n = 68), and highest risk (n = 8).

DISCUSSION: This work highlights how a measure using parent-reported infant health severity, which was developed for this study, can be used to better understand family outcomes following NICU hospitalization.

**BACKGROUND:** Sleep disruption during the first postpartum year is associated with several negative health outcomes including postpartum depression. Such disruption may be a greater issue for parents of preterm neonates, yet literature on this subject has not been critically reviewed.

**OBJECTIVE:** To synthesize literature on sleep quantity, sleep quality, and factors influencing sleep among parents of preterm infants during infant hospitalization and following discharge.

**DESIGN:** A systematic review.

**DATA SOURCES:** Medline, EMBASE, CINAHL, PsycINFO, Scopus, and Cochrane Database of Systematic Reviews were searched from their inception to February 2017.

**METHODS:** Potentially eligible citations were reviewed by two independent reviewers. Both quantitative and qualitative studies were eligible for inclusion. Data on eligible studies and review outcomes were extracted using a customized form.

**FINDINGS:** Eighteen reports from 16 studies met inclusion criteria. Four studies included a control group of parents of full-term infants. Three studies reported sleep quantity means, of which only one provided values for an exclusive sample of mothers of preterm infants and found on average, mothers obtained 6.3 h of sleep/day in the first 5–10 days. Twelve studies reported on sleep quality; most (n = 10) relied on self-reported measures and identified poor subjective sleep quality whereas two studies objectively measured sleep of poor quality. Parental stress was the most consistent factor associated with sleep quality.

**CONCLUSION AND IMPLICATIONS:** Quality and quantity of sleep among parents of preterm infants is inadequate and may negatively influence family health outcomes. Further research on correlates and changes in sleep is required to identify at-risk parents and inform targeted clinical recommendations and interventions aimed at maximizing sleep for parents of preterm infants.


**BACKGROUND:** Provider–parent communication is a critical determinant of how neonatal intensive care unit (NICU) parents cope, yet staff feel inadequately trained in communication techniques; many parents are not satisfied with the support they receive from hospital providers.

**PURPOSE:** This study evaluated whether NICU staff would demonstrate improved knowledge and attitudes about providing psychosocial support to parents after taking an online course.

**METHODS:** After providing demographic information, staff at 2 NICUs took a 33-item survey both before and after taking a 7-module online course “Caring for Babies and Their Families,” and again at 6-month follow-up. Scores (means ± standard deviation) from all time periods were compared and effect sizes calculated for each of the course modules.

**RESULTS:** NICU staff participants (n = 114) included nurses (88%), social workers (7%), physicians (4%), and occupational therapists (1%). NICU staff showed significant improvement in both knowledge and attitudes in all modules after taking the course, and improvements in all module subscores remained significant at the 6-month follow-up mark. Night staff and staff with less experience had lower pretest scores on several items, which improved on posttest.

**IMPLICATIONS FOR PRACTICE:** This course, developed by an interprofessional group that included graduate NICU parents, was highly effective in improving staff knowledge and attitudes regarding the provision of psychosocial support to NICU parents, and in eliminating differences related to shift worked and duration of work experience in the NICU.

**IMPLICATIONS FOR RESEARCH:** Future research should evaluate course efficacy across NICU disciplines beyond nursing, impact on staff performance, and whether parent satisfaction with care is improved.


In the United States, ethnic minority status and low socioeconomic status both confer greater risk of premature birth. These sociodemographic factors also contribute to a greater risk of postpartum depression, as does giving birth prematurely. Considering the known adverse effects of postpartum depression on children’s development, NICU-based mental health services for these high-risk mothers is an important public health intervention. Although counseling and educational interventions in the NICU have been shown to decrease maternal depressive symptoms, these interventions require parental presence on the unit. Mothers
of both low socioeconomic and ethnic minority status face systemic barriers that may prevent them from visiting their infants, such as lack of paid leave, transportation, and childcare. We propose directions for future research with the aim of increasing access to services. Directions include brief individual therapy, telehealth, and increasing the psychosocial support skills of other health professionals. Potential barriers to implementation are discussed.


**BACKGROUND:** Fathers are important to infant outcomes. Infants of involved fathers have improved weight gain, sleep, and psychosocial behaviors. Father involvement with neonatal intensive care unit (NICU) infants reduces the length of stay.

**PURPOSE:** The purpose of this study was to explore and describe involvement, confidence, and beliefs of fathers of infants who were hospitalized in the NICU and discharged home in order to begin to investigate NICU father involvement from a longitudinal perspective.

**METHODS:** This exploratory qualitative study was conducted 4 to 5 years after the initial NICU stay using telephone interviews. Fathers who participated in this study were selected from participants of a previous NICU study. Qualitative analysis was conducted using standard procedures for grounded theory.

**RESULTS:** Nineteen fathers participated in the study. The major themes were “It was scary,” “Just be there,” “It was rough,” “It’s not about yourself,” “A special bond,” and “Almost a treat.” The fathers reported that the NICU providers, nurses, and staff helped them to overcome uncertainty and lack of knowledge, which helped them improve their confidence and involvement during the NICU stay.

**IMPLICATIONS FOR PRACTICE:** Fathers see nurses as a source of support. Nurses can encourage fathers to visit regularly and participate in infant care activities. NICU presence aids fathers in developing confidence and knowledge in parenting during their child’s infancy, which can set the stage for ongoing involvement.

**IMPLICATIONS FOR RESEARCH:** Future work should continue to focus on longitudinal studies of fathering and the role of the NICU in encouraging involvement and parenting readiness.


**AIMS:** The aims of this study were to explore parents’ stress levels and negative feelings after premature births and to identify the risk factors related to parents’ stress and negative feelings during their children’s neonatal intensive care unit (NICU) stay.

**BACKGROUND:** Preterm birth is a multi-problematic event that may put the babies in danger for both their medical and neurophysiological conditions and could have a negative impact on both the mother–father relationship and the parent–child interactions.

**METHODS:** The study involved 43 mothers and 38 fathers of preterm infants. All participants filled out the Parental Stressor Scale: Neonatal Intensive Care Unit and the Profile of Mood States.

**FINDINGS:** The results revealed significant differences between mothers’ and fathers’ responses to preterm births in terms of both stress and negative feelings. We found that, for mothers, their own young age and the baby’s need for respiratory support were significant predictors of stress; for fathers, their own young age and the baby’s lower gestational age and worse condition at birth were significant predictors of stress and negative feelings. The NICU may be a stressful place both for mothers and fathers. Identifying which mothers and fathers are at risk immediately after their children are born could help to direct specific interventions that can reduce these parents’ stress and prevent them from negative feelings.


Stress in parents who have an infant in the NICU is well documented in literature. Prematurity and related comorbid conditions, high-tech NICU environments, presence of multidisciplinary health care professionals, altered parenting roles, and concerns of health outcomes in the infant are common stress factors. Further, inadequate management of stress can result in poor parent–infant bonding, poor infant outcome, and postpartum depression in parents. Effective stress management strategies may help parents adapt to their parental role thereby improving infant outcomes. Research has shown mindfulness-based strategies help reduce stress in the general population. Can this strategy be applied in the context of parents of infants in the NICU? Literature is scant on the impact of mindfulness-based strategies on parents of infants in the NICU and
on the infant's health outcomes. This article explores the application of mindfulness-based strategies to reduce stress in parents of infants in the NICU.


**INTRODUCTION:** Congenital heart disease (CHD) is one of the most common causes of infant admission to pediatric intensive care and is associated with profound psychological stress for mothers, fathers and their infants. Intensive care unit admission represents an opportunity to offer evidence-based strategies to prevent or minimize severe psychological distress and promote secure bonding and attachment, alongside high-quality infant medical care.

**OBJECTIVES:** We aimed to identify, synthesize and critically appraise published evidence on the efficacy and cost-effectiveness of mental health interventions delivered in neonatal, pediatric or cardiac intensive care units for parents of infants with CHD. A secondary goal was to develop recommendations for advancing health policy, practice and research in the field.

**METHODS:** In accordance with a prospectively registered protocol (CRD42019114507), six electronic databases were systematically searched for studies reporting results of a controlled trial of a mental health intervention for parents of infants aged 0–12 months with a congenital anomaly requiring intensive care unit admission. To maximize generalizability of results, trials involving infants with any type of structural congenital anomaly requiring surgery were included. Outcomes included intervention type, process, efficacy, and cost-effectiveness.

**RESULTS:** Across all forms of congenital anomaly, only five trials met inclusion criteria (four in CHD, one in gastrointestinal malformation). All interventions engaged parents face-to-face, but each had a distinct therapeutic approach (parent-infant interaction and bonding, early pediatric palliative care, psycho-education, parenting skills training, and family-centered nursing). Four of the five trials demonstrated efficacy in reducing maternal anxiety, although the quality of evidence was low. Positive results were also found for maternal coping, mother-infant attachment, parenting confidence and satisfaction with clinical care, as well as infant mental (but not psychomotor) development at 6 months. Mixed results were found for maternal depression and infant feeding. No evidence of efficacy was found for improving parent, infant or family quality of life, physical health or length of infant hospital stay, and there were no data on cost-effectiveness.

**CONCLUSIONS:** Stronger evidence for the efficacy of mental health interventions to buffer the effects of intensive care unit admission for parents of infants with CHD is urgently needed. Robust, high-quality trials are lacking, despite the established need and demand, and health policies prioritizing parent mental health care in the context of early childhood adversity are needed.


**PURPOSE:** This study was done to develop a program to promote maternal role confidence and maternal attachment for mothers of premature infants and to evaluate the effects in a neonatal intensive care unit (NICU).

**METHODS:** This program was developed through a literature review and validation of an expert group, and tested with 60 preterm infants (experimental group 30, control group 30) in a NICU in South Korea. Data were collected from December 2017 to March 2018 and analyzed using descriptive statistics, t-test, χ²-test and Fisher’s exact test with the SPSS/Win statistical program.

**RESULTS:** Maternal role confidence for the experimental group increased significantly compared to the control group (t=3.22, p=.002). Maternal attachment in the experimental group increased significantly compared to the control group (t=2.30, p=.025).

**CONCLUSION:** The program developed in this study should be effective in promoting maternal role confidence and maternal attachment in mothers of premature infants.


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BACKGROUND: We have limited information on families’ experiences during transition and after discharge from the neonatal intensive care unit.

METHODS: Open-ended semi-structured interviews were conducted with English or Spanish-speaking families enrolled in Medicaid in an urban high-risk infant follow up clinic at a safety-net center, which serves preterm and high-risk term infants. We generated salient themes using inductive-deductive thematic analysis.

RESULTS: Twenty-one participants completed the study. The infant’s median (IQR) birth weight was 1750 (1305, 2641) grams; 71% were Hispanic and 10% were Black non-Hispanic; 62% reported living in a neighborhood with 3-4th quartile economic hardship. All were classified as having chronic disease per the Pediatric Medical Complexity Algorithm and 67% had medical complexity. A conceptual model was constructed and the analysis revealed major themes describing families’ challenges and ideas to support transition centered on the parent-child role and parent self-efficacy. The challenges were: (1) comparison to normal babies, (2) caregiver mental health, (3) need for information. Ideas to support transition included, (1) support systems, (2) interventions using mobile health technology (3) improved communication to the primary care provider and (4) information regarding financial assistance programs. Specific subthemes differed in frequency counts between infants with and without medical complexity.

CONCLUSIONS: Families often compare their preterm or high-risk infant to their peers and mothers feel great anxiety and stress. However, families often found hope and resilience in peer support and cited that in addition to information needs, interventions using mobile health technology and transition and financial systems could better support families after discharge.


Evidence suggests that mothers of infants hospitalized in the Neonatal Intensive Care Unit (NICU) experience elevated rates of psychological symptoms. However, previous studies of this population have been mainly cross-sectional and have focused on very preterm infants. Although moderate- to late-preterm infants generally thrive, the possible psychological toll on their mothers has not yet been sufficiently examined. In the current study, we used a longitudinal design to investigate whether mothers of moderate- to late-preterm infants experience elevated rates of psychological symptoms during the infant’s hospitalization in the NICU and 6 months later. Results indicated that these mothers did show elevated depression, anxiety, and PTSD symptoms, and that symptom levels were similar in mothers of moderate- versus late-preterm infants. Mothers of moderate- to late-preterm infants hospitalized in the NICU appeared to experience these symptoms steadily over a 6-month period after giving birth. These findings suggest a need for greater support for these mothers while in the NICU.

hospitalisation. The Swedish version of the Parental Stressor Scale: Neonatal Intensive Care Unit was used to assess parental stress.

**RESULT:** The total stress scores did not vary significantly between the control and intervention groups either for mothers or for fathers. However, on item-level, some items were significantly more distressed for mothers in the control group compared to the intervention group; other sick babies being cared for in the room (p = 0.016); my baby's unusual or abnormal breathing patterns (p = 0.025); not being able to hold my baby (p = 0.014); sometimes forgetting what my baby looks like (p = 0.042); being afraid of touching or holding my baby (p = 0.030); feeling the staff is closer to my baby than I am (p = 0.006). Comparing stress between mothers and fathers in the control group demonstrated a significant higher overall stress level for mothers compared to fathers (p < 0.005). The same result was found in the subscales Infant's behaviour and appearance (p = 0.016) as well as Parental role alteration (p = 0.001). No significant differences revealed between parents in the intervention group except for one item not being able to feed the babies themselves. It was significantly more distressed for mothers (p < 0.001).

**CONCLUSION:** In this study, there was a decreased stress experience on item level in different subscales amongst mothers, but the study did not demonstrate any impact of the intervention on total stress experience either for mothers or for fathers.


**OBJECTIVE:** To evaluate the feasibility of a mindfulness-based training session (MBTS) for parents of neonates born at ≤32 weeks’ gestation in a level 3 neonatal intensive care unit (NICU).

**STUDY DESIGN:** Within 14 days of admission, parents completed the Parental Stressor Scale: Neonatal Intensive Care Unit Questionnaire (PSS:NICU), Cognitive and Affective Mindfulness Scale (CAMS-R), and a survey on stress management techniques. Parents then participated in a MBTS with instruction in mindfulness-based practices and were asked to practice the techniques during the NICU stay. At discharge, parents repeated the surveys to evaluate their mindfulness-based practice experience.

**RESULTS:** Of the 98 parents approached, 51 consented to participate (52%). Of these, 28 completed MBTS, initial, and discharge surveys. One parent had previously practiced mindfulness. The majority of parents (79%) reported that mindfulness practice was helpful, and 71% stated that they would continue their practice after NICU discharge. There was no difference in PSS:NICU or CAMS-R at discharge.

**CONCLUSION:** An MBTS was feasible to provide to parents in our NICU. Parents practiced the mindfulness-based techniques and reported benefit from their mindfulness-based practice. Future studies are needed to evaluate if an MBTS is a valuable resource for NICU parents' coping.


**BACKGROUND:** Premature delivery and a potential Neonatal Intensive Care Unit admission may be associated with the risk of poor maternal health. We aimed to examine the mothers’ health-related quality of life (HRQoL) at the time of infant discharge.

**STUDY DESIGN:** Fifty mothers completed the Medical Outcomes Study-Short Form 12. It has a Physical Component Score (PCS) and Mental Component Score (MCS), both with a mean of 50 and standard deviation of 10. Analysis included infant, maternal, and pregnancy-related characteristics.

**RESULTS:** In multivariable analyses, a household income of <150K lowered the PCS by 10 points (p = 0.003) compared to those with higher incomes. Marginal significance was noted in GA, for every week gained the PCS score was lower by 1.5 points.

**CONCLUSION:** Several risk factors are associated with lower physical health ratings in mothers of preterm infants at discharge. This information can be used to inform providers in their anticipatory guidance to the family and follow-up plans.


Parenting preterm infants is a unique experience distinct from parenting full-term infants, characterized by a delayed transition to parenthood and limited caregiving opportunities. This study explored mothers’ and fathers’ lived experiences of parenting during infancy in the context of preterm birth. Semistructured qualitative interviews were conducted with 13 parents (6 fathers, 7 mothers) of preterm infants. Data were analyzed using interpretative phenomenological analysis. Four superordinate themes emerged: (a) An
unnatural disaster: The traumatic nature of preterm birth, (b) The immediate aftermath: Disconnected and displaced, (c) Breaking the ice: Moving from frozen to melted, and (d) Aftershocks: Transitioning home. Both parents experienced preterm birth as traumatic. Similarities and differences in mothers' and fathers' experiences were identified. Preterm birth posed challenges for nurturant and social caregiving and resulted in anxiety, hypervigilance, and overprotective parenting behavior. The results highlight the need for trauma-informed care and further research developing and testing empirically based interventions.


AIMS AND OBJECTIVES: To investigate the effectiveness of a structured nursing intervention program on maternal stress and NICU-related maternal ability after the admission of premature infants to a neonatal intensive care unit (NICU).

BACKGROUND: Mothers of premature infants may face stress having premature infants, and their infants may be admitted to the NICU for a few weeks or months. The mothers’ experience of stress would be worse if they have low knowledge and poor NICU-related maternal ability. Mothers of infants admitted to the NICU require well-planned interventions to cope with psychological matters arising after an infant hospitalisation.

DESIGN: Quasi-experimental design.

METHODS: A total of 216 mothers were consecutively assigned to control and intervention groups. Each group consisted of 108 mothers. The mothers in both groups received questionnaire concerning maternal stress and NICU-related ability during their first visit to NICU (within 48 hr of admission). A structured nursing intervention was implemented for 10 days on mothers in the intervention group. The control group continued to receive existing practice nursing care. Mothers of both groups were again given the questionnaire on maternal stress and NICU-related ability after 14 days of admission.

RESULTS: In the intervention group, the difference between the mean total score of maternal stress and parental role and relationship subscale decreased significantly, compared to the control group ($p = 0.04; p = 0.01$) respectively. Maternal ability improved significantly in mothers in the intervention group 2 weeks post intervention, $p < 0.001$.

CONCLUSION: A structured nursing intervention for mothers could significantly reduce maternal stress and promote maternal NICU-related abilities.

RELEVANCE TO CLINICAL PRACTICE: The results of the study could help neonatal nurses to develop an appropriate nursing intervention for parents with premature infants in the NICU.


The prevalence of infants born before 37 weeks of gestation continues to rise in the United States. Advances in neonatology have led to improved survival rates among preterm infants, including those born at a very-low-birth-weight (VLBW). Exclusive human milk feeding is a therapeutic intervention for VLBW preterm infants, and mothers are encouraged to provide their own milk. Yet, it is well-established that mothers and infants may face extraordinarily complicated lactation and infant feeding challenges in NICU settings, many of which emanate from birth trauma. The purpose of this study is to gain a deeper understanding of the ways in which the hyper-medicalized management of preterm birth and infant feeding in NICU environments affect mothers' postpartum health and well-being. Seventeen mothers of VLBW preterm infants were interviewed August 2016–June 2017 within three years of their infant’s NICU discharge about their feeding decisions and experiences. Narrative analysis yielded five themes: (1) the physical and emotional trauma of giving birth prematurely impacted mothers’ lactation experiences; (2) separation from their infants intensified mothers’ suffering and disrupted lactation; (3) mothers experienced being marginalized in their infant’s NICU care; (4) mothers practiced embodied forms of resistance to cope with both trauma and marginalization; and (5) skilled support was central to mothers’ positive lactation experiences in the NICU. We draw upon feminist theory in the anthropology of reproduction to examine the fundamental hierarchies of power in U.S. neonatal critical care systems that fracture mothers’ interembodied relationships to their newborns, exacerbate lactation failure, and engender traumatic postpartum neglect. Moreover, we theorize mothers’ expressions of suffering in the context of preterm birth and lactation insufficiency as idioms of distress engendered by the violence of neglectful care. Narrative inquiry is instrumental to designing structural transformations in the systems of care available to mothers of preterm infants who are admitted to a NICU.

Premature babies and their families often require on-going community-based care after discharge from the neonatal unit. Parents themselves have identified the need for health professionals to understand the specific needs of parents of premature babies in order to provide the optimal support they require. This study aimed to explore the existing knowledge base and learning needs of community health professionals, to further understand how they can adequately support parents in the community with premature babies. A mixed-methods approach was used comprising a questionnaire, semi-structured interviews and secondary data analysis. Participants included thirteen Health Visitor [HV] students, eight educators and seven parents from a previous study. Thematic analysis revealed important insights into the knowledge and learning needs necessary to support parents of premature babies in the community. Three main themes emerged: development of prior knowledge; the importance of practice-based learning; learning and training needs. Knowledge, confidence and skills in relation to caring for parents with premature babies varied between individuals depending on their placement during training and subsequent experiences. While transferable skills in supporting parents in the community were present, more education and training in the specific needs of premature babies and parents would be welcomed. Tailored resources for community-based health professionals on the specific needs of the premature baby would enhance provision of optimal support for parents.


**BACKGROUND:** Preterm birth is associated with increased stress of parents that might influence the parental-child interaction, thus potentially having influence on the neurobehavioral development of the preterm infants. However, little is known concerning the age dependency of parental stress after preterm birth. **OBJECTIVE:** The aim of the present study was to examine the age dependency of stress in mothers and fathers after preterm birth and neonatal intensive care unit (NICU) admission of their infant. **METHODS:** In a prospective observational pilot study 47 mothers and 47 fathers completed the parental stress scale; NICU (PSS-NICU) questionnaire within 72 hours after delivery. This questionnaire measures parental stress after preterm birth with three subscales “Looks and Behave” of the child, “Parental Role Alteration” and “Sights and Sounds”. Stress levels of mothers and fathers were compared and correlated to the age of mothers and fathers, respectively. **RESULTS:** Parental stress experience after preterm birth tended to be higher in mothers compared to fathers. Mothers showed a significant positive correlation of the “Sights and Sounds” Scale and age, whereas fathers did not show any significant age dependency of stress. **CONCLUSION:** In mothers stress level increases with increasing age after preterm birth and admission of their infant to NICU, whereas fathers did not show any significant age dependency of stress.


**BACKGROUND:** Preterm birth does not only affect infants but also represents an unexpected and traumatic event for parents. There are few reports on parenting stress during early infancy comparing preterm and term mothers, with the results being somewhat inconsistent. **METHODS:** As part of a longitudinal study, preterm mother-infant and term mother-infant dyads were enrolled. Dyads were assessed twice: during hospitalisation in the neonatal intensive care unit (NICU) and at 3 months of infant age (corrected age for preterm). Each mother completed a self-report set of psychological questionnaire in both time points. All the children underwent a neurological examination at 40 weeks post conceptional age and at 3 months (corrected age for preterm). **RESULTS:** 20 preterm and 20 term dyads were included. NICU mothers reported elevated postnatal depressive symptoms and high stress level, even if the preterm infants were with low perinatal risk and normal neurological examination. Comparing preterm infant with low perinatal risk and normal neurological examination with term-born children at 3 months, we found higher parental stress in term mothers than in preterm mothers.
LIMITATIONS: This study was limited by a relatively small sample size; findings are preliminary and warrant further investigation in larger-scale study.

CONCLUSIONS: Findings confirm that becoming a mother of a preterm infant is an event associated with emotional distress. These symptoms may resolve with time, and sometimes are independent of the infant’s clinical severity. Assessing parental sources of stress and subsequent follow-up is essential to promote parental support, both for preterm and term mothers.


BACKGROUND: Preterm labor is the most stressful experience for mothers. Consultation by interpersonal psychotherapy (IPT) approach is a method to support mothers with preterm labor.

OBJECTIVES: This study aimed to assess the effect of interpersonal psychotherapy oriented child birth education on adaptation role and stress in mothers of infants admitted to the intensive care unit.

METHODS: This randomized interventional study investigated 92 primiparous women with a newborn admitted to the newborn intensive care unit of Kamali Hospital. The sampling method was convenient and samples were randomly assigned to two groups of control and intervention by four blocks randomization method. In addition to routine care, the intervention group received three IPT counseling sessions. The data collection tool in this study was parental stress questionnaire and maternal role adaptation questionnaire.

RESULTS: The results of repeated measure test indicated that the maternal stress score had a significant change over time (P < 0.001) with significant differences between the two groups (P < 0.001), and maternal role adaptation changed significantly over time (P < 0.001) with a significant difference between the two groups (P < 0.001).

CONCLUSIONS: Considering the impact of interpersonal psychotherapy-oriented child birth education on maternal stress and maternal role adaptation, as well as the limited duration and cost of this program and the possibility of training it by nurses and midwives, it is suggested to include this training program in routine interventions for mothers with a premature baby.


The initial bonding experience between a mother and her infant has been shown to have a positive effect on neurobehavioural responses. Many women often wait several hours before seeing their baby for the first time either due to caesarean section delivery or peripartum complications. A technology solution utilizing FaceTime can improve mothers’ experience by allowing them to see their babies earlier. The technology allows the mother to see her baby in real time and the opportunity for the neonatal nurse to answer questions about her baby’s care and well-being. The results showed that the use of iPads led to a significant reduction in the time mothers were able to see their babies for the first time.


This study was conducted to investigate the effects of expressive writing on postpartum depression and stress of mothers with a preterm infant in NICU. This clinical trial was carried out on 91 mothers whose infants were in NICU. Subjects were assigned to intervention and control groups. In the intervention group, subjects were asked to start expressive writing from the third day of hospitalization in NICU and continue it until the tenth day. EPDS, PSS: NICU, and PSS-14 COHEN were completed by all the mothers on days 3 and 10, and 1–3 months after the admittance. Mean EPDS score was obtained as 9.65 ± 5.28, 9.23 ± 5.41, 8.19 ± 4.45, and 7.60 ± 4.65, respectively, for control group at days 3 and 10, and 1–3 months after hospitalization, and it was also obtained as 9.62 ± 5.89, 6.04 ± 3.39, 2.95 ± 2.41, and 2.44 ± 2.01, respectively, for the intervention group at days 3 and 10, and 1–3 months after hospitalization (p < 0.001). Mean PSS-14 COHEN score was lower for intervention group similar to the control group (p < 0.005). Results of the independent samples T-test showed higher stress scores for the control group before and after the intervention, but the difference was not statistically significant (p = 0.08). Mothers with an infant in NICU experienced a high level of postpartum depression and stress. Thus, according to findings of this study, expressive writing is proposed as a convenient and inexpensive means to reduce levels of postpartum depression and stress.

OBJECTIVE: To classify NICU interventions for parental distress and quantify their effectiveness.

STUDY DESIGN: We systematically reviewed controlled studies published before 2017 measuring NICU parental distress, defined broad intervention categories, and used random-effects meta-analysis to quantify treatment effectiveness.

RESULTS: Among 1643 unique records, 58 eligible trials predominantly studied mothers of preterm infants. Interventions tested in 22 randomized trials decreased parental distress (p < 0.001) and demonstrated improvement beyond 6 months (p < 0.005). In subgroup analyses, complementary/alternative medicine and family-centered instruction interventions each decreased distress symptoms (p < 0.01), with fathers and mothers improving to similar extents. Most psychotherapy studies decreased distress individually but did not qualify for meta-analysis as a group.

CONCLUSION: NICU interventions modestly reduced parental distress. We identified family-centered instruction as a target for implementation and complementary/alternative medicine as a target for further study. Investigators must develop psychosocial interventions that serve NICU parents at large, including fathers and parents of full-term infants.


OBJECTIVE: This study aims to investigate whether posttraumatic stress disorder (PTSD) symptoms exist >1 year after neonatal intensive care unit (NICU) experience and whether PTSD symptomatology differs across parents of infants of different gestational age categories.

METHODS: A survey was given to parents at routine NICU follow-up visits. Parents completed the PTSD CheckList–Civilian (PCL-C), a standardized scale comprising 17 key symptoms of PTSD. Parents also rated how traumatic their birth experience, first day in the NICU, and first week in the NICU were from “Not Traumatic at All” to “Most Traumatic.” Fisher’s exact test was used to compare PCL-C responses across gestational age categories (Extremely Preterm, Very Preterm, Moderate to Late preterm, and Full Term).

RESULTS: Eighty parents participated. In total, 15% of parents had “Moderate to High Severity” PTSD symptoms. There were no statistical differences in PTSD prevalence between parents of children <1 year old and parents of children >1 year old (P = .51). There was also no statistical difference in prevalence of “Moderate to High Severity” level of PTSD symptoms across gestational age (P = .16). Overall, 38% of parents rated at least one experience as “Most traumatic.”

CONCLUSION: A high percentage of parents who had a recent NICU experience and parents who had a NICU experience more than a year ago demonstrated PTSD symptoms. In light of these results, many parents of NICU graduates—both mothers and fathers—would benefit from access to long-term counseling services.


INTRODUCTION: Preterm birth may generate significant distress among the parents, who often present with difficulties in appropriating their parental role. Parental stress and low perceived parental self-efficacy may interfere with the infant’s socioemotional and cognitive development, particularly through disrupted parent–infant interactions. Perceived parental self-efficacy represents the belief of efficacy in caring for one’s own infant and successful incarnation of the parental role, as well as the perception of one’s own abilities to complete a specified task. Interventions to support parental role, as well as infant development, are needed, and parental self-efficacy represents a useful indicator to measure the effects of such early interventions.

METHODS AND ANALYSIS: This study protocol describes a randomised controlled trial that will test an early intervention in the neonatal intensive care unit (NICU) (JOIN: Joint Observation In Neonatology) carried out by an interdisciplinary staff team. Mothers of preterm neonates born between 28 and 32 6/7 weeks of gestational age are eligible for the study. The intervention consists of a videotaped observation by a clinical child psychologist or child psychiatrist and a study nurse of a period of care delivered to the neonate by the mother and a NICU nurse. The care procedure is followed by an interactive video guidance intended to demonstrate the-neonate’s abilities and resources to his parents. The primary outcome will be the difference in the perceived maternal self-efficacy between the intervention and control groups assessed by self-report
questionnaires. Secondary outcomes will be maternal mental health, the perception of the parent–infant relationship, maternal responsiveness and the neurodevelopment of the infant at 6 months corrected age.

ETHICS AND DISSEMINATION: Ethical approval was granted by the Human Research Ethics Committee of the Canton de Vaud (study number 496/12). Results from this study will be disseminated at national and international conferences, and in peer-reviewed journals.


A neonatal early discharge (NED) program is a supported process where preterm infants leave hospital before they have established full sucking feeds and are gavage fed by their parents while they transition to breast- and/or bottle-feeds. While there is some evidence in the literature describing the outcomes of this process for preterm infants, there is even more limited evidence of the effects and outcomes of these NED programs on parents. The objective of this study was to summarize and critically appraise the literature regarding the effects of NED on parents. A literature search was conducted for English language publications since 2007 using MEDLINE, Cumulative Index of Nursing and Allied Health Literature (CINAHL), PsycINFO, and Google Scholar. A total of 20 primary articles met the inclusion criteria for the review. An integrative thematic synthesis identified 4 themes: establishing parenting skills/confidence; bonding with the newborn; psychological distress; and the need for support and resources. Findings suggest that parents have various concerns regarding discharge from the neonatal unit and therefore support from healthcare professionals and family plays a crucial role during the experience. There were also various external factors such as socioeconomic status and cultural differences that impact on parents differently, and it is therefore challenging to draw definite conclusions. This warrants further research in the area.


Parenting a preterm infant is more challenging than a full-term one. Parent involvement in early intervention programs seems to have positive psychosocial effects on both the child and parent. CareToy is an innovative smart system that provides an intensive individualized home-based family-centred EI in preterm infants between 3 and 9 age-corrected months. A RCT study, preceded by a pilot study, has been recently carried out to evaluate the effects of CareToy intervention on neurodevelopmental outcomes with respect to Standard Care. This study aims at evaluating the effects of CareToy early intervention on parenting stress in preterm infants. Parents (mother and father) of a subgroup of infants enrolled in the RCT filled out a self-report questionnaire on parenting stress (Parenting Stress Index-Short Form (PSI-SF)) before (T0) and after (T1) the CareToy or Standard Care period (4 weeks), according to the allocation of their preterm infant. For twins, an individual questionnaire for each one was filled out. Results obtained from mothers and fathers were separately analysed with nonparametric tests. 44 mothers and 44 fathers of 44 infants (24 CareToy/20 Standard Care) filled out the PSI-SF at T0 and at T1. CareToy intervention was mainly managed by mothers. A significant reduction in Parental Distress subscale in the CareToy group versus Standard Care was found in the mothers. No differences were found among the fathers. CareToy training seems to be effective in reducing parental distress in mothers, who spent more time on CareToy intervention. These findings confirm the importance of parental involvement in early intervention programs.


BACKGROUND: The neonatal intensive care unit (NICU) can cause significant psychological distress in a mother. There is no common definition of maternal distress in the NICU currently in use.

PURPOSE: To develop a clear conceptual understanding of maternal distress in the NICU using conceptual definitions and empirical findings.

METHODS/SEARCH STRATEGY: A literature search was conducted using EBSCOhost, MEDLINE, CINAHL, PsycINFO, and Google Scholar. The concept analysis was guided by Walker and Avant’s (2011) guide.

FINDINGS/RESULTS: Maternal distress in the NICU consists of a combination of depressive, anxiety, trauma, and posttraumatic stress symptoms. The symptoms occur together on a spectrum and present differently in each mother. The antecedents to maternal distress are a NICU hospitalization and a perceived interruption to the transition to motherhood. Consequences of maternal distress in the NICU are issues with developing a healthy maternal-infant bond, adverse infant development, and decreased maternal quality of life.
IMPLICATIONS FOR PRACTICE: A complete understanding of maternal distress in the NICU will lead to increased awareness of adverse mental health states in this population.

IMPLICATIONS FOR RESEARCH: Identification of mothers at risk for maternal distress in the NICU, as well as the identification of antecedents and consequences related to the mother and the infant from maternal distress in the NICU. Using a single, clear definition of maternal distress in the NICU population will lead to a more cohesive body of literature.


OBJECTIVES: Maternal depression in the postpartum period is prevalent and associated with negative child outcomes, including behavior problems and cognitive delays. Mothers of children admitted directly after birth to the neonatal intensive care unit (NICU) are at even higher risk for depressive symptoms and infants born premature and/or at low birth weight may be more vulnerable to the adverse effects of maternal depression. Understanding mechanisms, particularly modifiable mechanisms, involved in the development or persistence of depressive symptoms is critically important for developing effective treatments.

METHODS: The longitudinal, secondary analysis investigated the role of psychological inflexibility (rigidly avoiding or attempting to control distressing internal experiences, precluding present moment awareness of contingencies and engagement with important values) as a mediator of the relationship between early (1–2 weeks postpartum) and later (3 and 6 months postpartum) depressive symptoms among mothers with an infant in the NICU.

RESULTS: Psychological inflexibility measured 2 weeks after infant discharge from the hospital fully mediated the relationship between early and later depressive symptoms at 3 months postpartum, with partial mediation at 6 months, while controlling for factors previously found predictive of postpartum depression.

Conclusions: for Practice: Psychological inflexibility may be a mechanism by which postpartum depressive symptoms persist after hospital discharge among new mothers with a NICU infant. Acceptance and Mindfulness therapies which specifically target psychological inflexibility may be promising interventions to reduce depressive symptoms postpartum.


Mothers of infants in the neonatal intensive care unit (NICU) face stressors including turbulent emotions from their pregnancy/unexpected preterm delivery and their infant’s unpredictable health status. The study purpose was to examine the psychological state of mothers prior to the discharge of their technology-dependent infants (eg, feeding tubes, supplemental oxygen) from the NICU to home. The study sample consisted of mothers (N = 19) of infants dependent on medical technology being discharged from a large Midwest NICU. A descriptive, correlational design using convenience sampling was employed to recruit mothers to examine associations of infant and maternal factors, resourcefulness, and stress with psychological state (depressive symptoms, posttraumatic stress symptoms). Forty-two percent of mothers were at high risk for clinical depression, with 37% in the clinical range for posttraumatic stress disorder. Increased depressive symptoms were significantly associated with the increased frequency and perceived difficulty of their stress and posttraumatic stress symptoms. Increased posttraumatic stress symptoms were significantly associated solely with elevated depressive symptoms. This study identified factors associated with the mothers’ increased psychological distress, providing beginning evidence for future interventions to employ prior to their technology-dependent infant’s NICU discharge.


This study examined the relationship of mothers’ psychological well-being (depressive symptoms, posttraumatic stress symptoms) and resourcefulness with their technology-dependent infants’ healthcare utilization (rehospitalization, emergency department [ED] visits) following discharge from the neonatal intensive care unit (NICU). This descriptive, correlational study was conducted at a large Midwest level 4 NICU in the United States. Mothers (n = 19) with a technology-dependent infant (eg, supplemental oxygen, feeding tubes) to be discharged home from the NICU within 2 to 3 weeks were interviewed face-to-face using...
standardized instruments. Infant rehospitalization and ED visit data were collected from the electronic medical record (EMR) for the first 3 months following the infant’s discharge. Analyses included descriptive statistics and negative binomial regression. A majority of infants (72.2%) required at least 1 hospitalization; 33% required at least one ED visit. Mothers’ age and resourcefulness were significant predictors of ED visits while only resourcefulness predicted rehospitalizations. Neither depressive symptoms nor posttraumatic stress symptoms significantly predicted healthcare utilization. Maternal resourcefulness was the only main variable that significantly predicted both ED visits and hospitalizations and one of the few modifiable factors that could assist mothers with successfully coping with the complexity of caring for a technology-dependent infant. Future research should focus on interventions to enhance mothers’ resourcefulness prior to their technology-dependent infant’s NICU discharge.


postpartum depression. Taken together, these studies provide a strong basis for interventions that support parents in the parenting role and guide parents in developmentally appropriate interactions with their preterm babies. These interventions have the potential to lessen the adverse impact of preterm birth on babies and mothers. In addition, the positive benefits of reduced stress can improve parent mental health outcomes and ultimately may further improve parents’ relationships with their babies.


**OBJECTIVE:** To examine trajectories of psychological distress in mothers of children born very preterm (VPT, <30 weeks gestation) and full term from 2 to 13 years after the birth, and examine predictors of maternal psychological distress over time within the VPT group.

**METHODS:** Mothers of children born VPT (n = 159) and full term (n = 71) completed questionnaires assessing their psychological distress when their child was 2, 7, and 13 years of age. Mixed models were used to examine differences between groups in maternal psychological distress over time. Family social risk, child neonatal medical risk, child sex, multiple pregnancy, and child’s neurodevelopmental impairment in early childhood were examined as potential predictors of maternal psychological distress within the VPT group.

**RESULTS:** Mothers of children born VPT displayed elevated psychological distress compared with mothers of full-term children, and this difference was consistent over time. Higher family social risk was associated with elevated maternal psychological distress throughout childhood across all time-points. There was evidence that mothers of children at higher neonatal medical risk displayed increasing psychological distress over time.

**CONCLUSIONS:** Mothers of children born VPT show prolonged psychological distress. Mothers from socially disadvantaged background and those whose child has neonatal medical complications may require extensive support to prevent prolonged psychological distress and promote optimal outcomes for children and families.
PAIN AND STRESS MANAGEMENT


**OBJECTIVE:** To compare the analgesic effects of sucrose, music, and their combination on venipuncture’s pain in preterm neonates.

**METHODOLOGY:** A double-blinded randomized control trial conducted at a Neonatal Intensive Care Unit (NICU) affiliated to Tehran University of Medical Sciences (TUMS) in Tehran, Iran. One hundred and twenty preterm neonates were randomly allocated into three experimental (sucrose, music and combination of sucrose and music) and one control groups (n = 30 for each group). Two minutes before the venipuncture, 0.5 ml of oral %24 sucrose was provided for the sucrose and combination groups. The combination group additionally received lullaby music as same as the music group. The control group had headphones without playing music and received sterile water. Blinded assessment of the Premature Infant Pain Profile (PIPP) was performed before and during venipuncture, as well as 30 seconds and 10 minutes after its completion.

**RESULTS:** The pain scores during venipuncture in the sucrose and combination groups were significantly lower than the control group (p = .003, p < .001, respectively) but not in the music group. Thirty seconds after the end of the venipuncture, the pain score in the three intervention groups was significantly lower than the control group (sucrose, music and, combination group, p < .001, p = .009, p < .001, respectively). Ten minutes after the venipuncture, there was no significant difference in pain scores among the four groups.

**CONCLUSION:** Music could relief pain 30 seconds after the venipuncture completion but not during the venipuncture. A more prolonged period of playing music is recommended to evaluate the analgesic effects of music in preterm neonates in future studies.


**BACKGROUND:** Pain is a common paediatric problem, and procedural pain, in particular, can be difficult to manage. Complementary therapies are often sought for pain management, including massage therapy (MT). We assessed the evidence for use of MT for acute procedural pain management in children.

**METHODS:** We searched five main databases for (i) primary studies in English, (ii) included children 0 to 18 years of age, (iii) compared MT for procedural pain management to standard care alone or placebo, and (iv) measured pain as the primary or secondary outcome. The data were extracted by one author and verified by a second author. Randomized controlled trials were evaluated using the Cochrane Risk of Bias tool.

**RESULTS:** Eleven paediatric trials of procedural pain in neonatal, burn, and oncology populations, a total of 771 participants, were identified. Eight reported statistically significant reductions in pain after MT compared to standard care. Pain was measured using validated pain scales, or physiologic indicators. The studies were heterogeneous in population, techniques, and outcome measures used. No adverse events associated with MT were identified.

**CONCLUSION:** MT may be an effective nonpharmacologic adjunct for management of procedural pain in children.


Premature infants hospitalized after birth are exposed to repeated painful procedures as part of their routine medical care. Early neonatal exposure to unmanaged pain has been linked to numerous negative long-term outcomes, such as the development of pain hypersensitivity, detrimental psychological symptomology, and altered neurodevelopment. These findings emphasize the crucial role of pain management in neonatal care. The aim of this article is to give an overview of evidence-based non-pharmacological pain management techniques for hospitalized neonates. Research supporting the effectiveness of various proximal, distal, and procedural pain management methods in neonates will be presented. Additionally, understanding the larger biopsychosocial context of the infant that underpins the mechanisms of these pain management methods is essential. Therefore, two important models that inform non-pharmacological approaches to infant pain management (DIAPR-R [The Development of Infant Acute Pain Responding-Revised], Attachment Theory) will be discussed.

**OBJECTIVE:** To test our hypothesis that an innovative method of early palliative care called “Baby, Attachment, Comfort Interventions” reduces psychological distress in parents of neonates with congenital heart disease.

**STUDY DESIGN:** Prospective cohort study of parents of neonates with congenital heart disease. Distress was evaluated at admission and discharge using Neonatal Unit Parental Stressor Scale and Depression Anxiety Stress Index-21. Control parents received standard of care. Intervention parents received interdisciplinary interventions aimed at improving neonatal comfort and parenting experience.

**RESULTS:** Seventy-seven parents participated. Stress decreased in the intervention group (26 parents) but not in the control group (51 parents). There was no decrease in anxiety or depression in either group.

**CONCLUSION:** Early palliative care reduces stress in parents of neonates with congenital heart disease. Further work is needed to address depression/anxiety in this group of high-risk parents.


Preterm neonates hospitalized in the neonatal intensive care unit undergo frequent painful procedures daily, often without pain treatment, with associated long-term adverse effects. Maternal-infant skin-to-skin contact, or kangaroo care (KC), and sweet-tasting solutions such as sucrose are effective strategies to reduce pain during a single procedure; however, evidence of sustained efficacy over repeated procedures is limited. We aimed to determine the relative sustained efficacy of maternal KC, administered alone or in combination with 24% sucrose, to reduce behavioral pain intensity associated with routine neonatal procedures, compared with 24% sucrose alone. Stable preterm infants (n = 242) were randomized to receive KC and water, KC and 24% sucrose, or 24% sucrose before all routine painful procedures throughout their neonatal intensive care unit stay. Pain intensity, determined using the Premature Infant Pain Profile, was measured during 3 medically indicated heel lances distributed across hospitalization. Maternal and neonatal baseline characteristics, Premature Infant Pain Profile scores at 30, 60, or 90 seconds after heel lance, the distribution of infants with pain scores suggesting mild, moderate, or severe pain, Neurobehavioral Assessment of the Preterm Infant scores, and incidence of adverse outcomes were not statistically significantly different between groups. Maternal KC, as a pain-relieving intervention, remained efficacious over time and repeated painful procedures without evidence of any harm or neurological impact. It seemed to be equally effective as 24% oral sucrose, and the combination of maternal KC and sucrose did not seem to provide additional benefit, challenging the existing recommendation of using sucrose as the primary standard of care.


**BACKGROUND:** Every year, an estimated 15 million babies are born preterm (<37 weeks’ gestational age) globally. These preterm infants are exposed to repeated stressful and often painful procedures as part of routine life-saving care within the neonatal intensive care unit (NICU). Low thresholds for tactile and nociceptive input make it more difficult for neonates to discriminate between noxious and nonnoxious stimuli, which can result in continuous activation of stress responses in an attempt to achieve stability through adaptation, or allostatic. Rapidly reoccurring stressors can render stress-response systems over- or underactive, creating wear and tear, or allostatic load. A better understanding of biomarkers related to allostatic load might aid in early detection and prevention/alleviation of allostatic load in this population.

**PURPOSE:** To identify stress biomarkers that have been studied in preterm infants at different time points in the NICU and as long-term outcome measures.

**METHOD/SEARCH STRATEGY:** Systematic searches were conducted of PubMed, CINAHL, SCOPUS, and PsychInfo databases.

**FINDINGS/RESULTS:** Twenty-one studies met inclusion criteria for this review. Several putative biomarkers were identified, including cortisol levels, epigenetic markers, brain microstructure, markers of oxidative stress, and the brain–gut–microbiome axis.
CONCLUSION: The interaction of disease with therapeutic interventions may inadvertently increase infant allostatic load. In addition to human studies, future research should leverage newly available large data sets to conduct additional analyses.


**AIMS AND OBJECTIVES:** To determine the comparative efficacy of developmental care versus standard care for reducing pain and stress in preterm infants during examinations for retinopathy of prematurity (ROP).

**BACKGROUND:** ROP examinations are routinely performed in neonatal intensive care units to detect these lesions. Pain scores recorded during and after eye examinations have revealed physiological and behavioural manifestations of pain and stress.

**DESIGN:** A randomised crossover trial was conducted.

**METHODS:** Fourteen preterm infants were evaluated. The modified developmental care bundle included environmental modifications, positioning and containment, oxygen supplementation, interaction and approach and cue-based individual care, which were applied before, during and after the ROP examination. The primary outcomes were obtained from pain and stress scores using the premature infant pain profile-revised (PIPP-R) and a behavioural evaluation. The secondary outcomes were recovery time to the baseline of the vital signs and oxygen saturation.

**RESULTS:** Statistical significances were found in the care type comparison (p = 0.013), time comparison (p < 0.001) and type-by-time interaction (p = 0.005) in the PIPP-R, and also in the care type comparison (p < 0.001), time comparison (p < 0.001) and type-by-time interaction (p = 0.001) in the behavioural evaluation scores using a generalised estimating equation (GEE) analysis. Recovery time for the developmental care (N = 13, mean = 8.6 ± 11.5 min, 95% CI = 1.68-15.57) was significantly shorter than for the standard care (N = 11, mean = 25.5 ± 20.8 min, 95% CI = 11.45-39.46), which was found to be statistically significant according to the Wilcoxon signed-rank test (N = 11, p = 0.003).

**CONCLUSIONS:** A bundled developmental care intervention significantly reduced pain and stress responses and the time needed for infants to recover their physiological status following the procedure.

RELEVANCE TO CLINICAL PRACTICE: Since the results show the benefits of developmental care in an ROP examination, it can be the practical evidence basis by which to develop a standard of procedure or guideline for clinical practice.


**INTRODUCTION:** The Neonatal Intensive Care Unit (NICU) is the place for at-risk newborns who need ongoing care. Massage therapy is a systematic touch by human hands that contributes to weight gain, decreases pain responses and decreases hospital stay.

**OBJECTIVE:** To review the systemic effects of massage therapy on premature infants in the Neonatal Intensive Care Unit.

**METHODOLOGY:** This is a systematic review. A search was performed in the Pubmed, Scielo and Lilacs database, with no restrictions related to the year of publication. Only randomized clinical trials were included in this study, with a sample of individuals of both sexes, under 28 days of age and addressing massage therapy related to systemic responses in premature infants in the neonatal intensive care unit. Studies that were related to physical exercise, medication use, oral stimulation and gastrointestinal effects related to massage were excluded. The following descriptors were used: “massage” AND “premature newborn” OR “premature” OR “preterm” AND “neonatal intensive care units”.

**RESULTS:** Of the six articles included in this literature review, five showed satisfactory results on the systemic effects of massage therapy on premature newborns, such as weight gain, decreased length of stay in the NICU, improvement in parasympathetic nervous system function and increased cell cytotoxicity of natural killer cells. Only one study reports that massage therapy does not induce sleep.

**CONCLUSION:** Massage therapy produces systemic beneficial effects in preterm infants admitted to the Neonatal Intensive Care Unit.

**BACKGROUND:** Infants are exposed to different painful procedures during hospitalization in the neonatal intensive care unit (NICU). Due to the harmful effects of pain on infants, NICUs require methods by the aid of which the pain in infants can be controlled. Yakson touch and oral glucose are among non-pharmacological methods for pain relief in infants. In this regard, the present study was conducted to compare the effect of Yakson touch and oral glucose on the severity of phlebotomy pain in preterm infants.

**METHODS:** In this randomized clinical trial, 99 preterm infants hospitalized in NICU were randomly allocated to three groups, including Yakson touch (n=33), oral glucose (n=33), and control (n=33). In the oral glucose group, 1 cc of 50% glucose was orally given to the infants 1 min before phlebotomy. In the Yakson touch group, touching was performed for 5 min, and then the phlebotomy was performed. The infants in the control group did not receive a specific treatment. Infant pain level was determined before and after the phlebotomy using video recording based on Neonatal Infant Pain Scale. The data were analyzed using the analytical statistical tests, including the analysis of variance, Chi-square, Wilcoxon, and Kruskal-Wallis, in SPSS software (version 20).

**RESULTS:** The mean scores of pain in the two experimental groups were significantly lower than that of the control group (P=0.001), but there was no significant difference between the two experimental groups (P>0.05).

**CONCLUSION:** According to our findings, both two methods (i.e., Yakson touch and oral glucose) can reduce phlebotomy pain in preterm infants hospitalized in intensive care unit. It is recommended to use Yakson touch in case of lack of access to glucose.


The purpose of this study was to assess the association between maternal interactive behavior and infant cortisol stress reactivity in response to the Still Face paradigm (SF) in a cohort of four-month old infants (adjusted age) born preterm (<32 weeks gestation, N = 22) compared with infants born full term (>37 weeks gestation, N = 28). Infant cortisol reactivity was calculated as area under the curve (AUC) from baseline to the third cortisol sample (30 min post-SF) using the trapezoidal rule, while the percent of time mothers spent using a contingent interaction style was measured (0–100%) during episodes 1 (Play; baseline), 3 (Reunion#1), and 5 (Reunion#2) while mother-infant dyads participated in the SF paradigm. We hypothesized that because infants born preterm are at increased risk for dysregulation, they would show, compared to full-term infants, a blunted stress response, involving under-responsiveness. We found blunted cortisol stress reactivity among the preterm infants. We also found that mothers of preterm infants demonstrated less contingent maternal interaction during Reunion#1 of the SF; and that contingent maternal interaction at Reunion#2 of the SF was protective against cortisol stress reactivity in response to the SF. However, we did not find that the influence of maternal interaction on cortisol reactivity was moderated by gestational age group (full term vs preterm): the association between contingent maternal interaction and stress reactivity was similar for both gestational groups across episodes. In order to improve self-regulation and longer term social and cognitive developmental outcomes in medically at-risk infants, future research is warranted to determine how these findings relate to infants’ stress reactions in naturalistic settings, and the directionality and temporal relationship between cortisol stress responses and maternal interactive behavior.


Hospitalized newborn infants experience pain that can have negative short- and long-term consequences and thus should be prevented and treated. National and international guidelines state that adequate pain management requires valid pain assessment. Nociceptive signals cause a cascade of physical and behavioral reactions that alone or in combination can be observed and used to assess the presence and intensity of pain. Units that are caring for newborn infants must adopt sufficient pain assessment tools to cover the gestational ages and pain types that occurs in their setting. Pain assessment should be performed on a regular basis and any detection of pain should be acted on. Future research should focus on developing and validating pain assessment tools for specific situations.

Preterm infants (PTI) typically experience many painful and stressful procedures or events during their first weeks of life in a neonatal intensive care unit, and these can profoundly impact subsequent brain development and function. Several protective interventions during this sensitive period stimulate the oxytocin system, reduce pain and stress, and improve brain development. This review provides an overview of the environmental risk factors experienced by PTI during hospitalization, with a focus on the effects of pain, and early maternal separation. We also describe the long-term adverse effects of the simultaneous experiences of pain and maternal separation, and the potential beneficial effects of maternal vocalizations, parental contact, and several related processes, which appear to be mediated by the oxytocin system.


Changes in facial expression are an essential form of social communication and in nonverbal infants are often used to alert care providers to pain-related distress. However, studies of early human brain development suggest that premature infants aged less than 34 weeks' gestation do not display discriminative brain activity patterns to equally salient noxious and innocuous events. Here we examine the development of facial expression in 105 infants, aged between 28 and 42 weeks' gestation. We show that the presence of facial expression change after noxious and innocuous stimulation is age-dependent and that discriminative facial expressions emerge from approximately 33 weeks' gestation. In a subset of 49 infants, we also recorded EEG brain activity and demonstrated that the temporal emergence of facial discrimination mirrors the developmental profile of the brain's ability to generate discriminative responses. Furthermore, within individual infants, the ability to display discriminative facial expressions is significantly related to brain response maturity. These data demonstrate that the emergence of behavioural discrimination in early human life corresponds to our brain's ability to discriminate noxious and innocuous events and raises fundamental questions as to how best to interpret infant behaviours when measuring and treating pain in premature infants.


**INTRODUCTION:** Premature infants undergo numerous painful procedures during hospitalization. Some trials have examined the effectiveness and safety of combined nonpharmacological interventions in which two or more non-pharmacological interventions are used simultaneously or continuously to relieve repeated procedural pain via multisensory stimulation in preterm neonates. However, a systematic review of this topic has not yet been carried out.

**OBJECTIVE:** To review the evidence on the efficacy and safety of combined nonpharmacological interventions for repeated procedural pain in preterm neonates.

**METHOD:** Eight databases were searched using keywords to identify peer-reviewed journal articles in English or Chinese. Randomized controlled trials (RCTs) focusing on combined nonpharmacological interventions for repeated procedural pain in preterm neonates published from database inception until May 2019 were included.

**RESULTS:** Eight RCTs were retrieved that included ten different combined nonpharmacological interventions. Different study designs were used in the included trials, which did not allow us to carry out a meta-analysis. The findings from the included articles were categorized in terms of efficacy and safety. With respect to efficacy, 1. two trials reported that combined nonpharmacological interventions were more effective than usual care during painful procedures; 2. three trials reported that combined nonpharmacological interventions were more effective than single nonpharmacological interventions; 3. three trials reported the effects of different combinations of nonpharmacological interventions and found that their effect depends on intervention type rather than number of interventions. Only four trials reported on safety, and they found that combined nonpharmacological interventions were safe for repeated procedural pain in preterm neonates.

**CONCLUSION:** According to the literature, combined nonpharmacological interventions may be effective and safe for repeated procedural pain in premature infants. However, due to the diversity of interventions included in this systematic review, the evidence is not strong enough to produce a best practice guideline. Further research is needed with larger sample sizes and less heterogeneity to adequately explore the efficacy and safety of combined nonpharmacological interventions for repeated procedural pain in premature infants.

**PROBLEM:** Current research suggests behavioral and environmental interventions to prevent neonatal pain prior to an invasive procedure are rarely administered and seldom documented. The aim of this study was to systematically review findings from published randomized controlled trials that tested the effects of behavioral and environmental procedural pain management interventions on behavioral pain response in preterm infants.

**ELIGIBILITY:** Criteria: Randomized controlled trials examining the effects of behavioral and environmental pain management interventions on behavioral pain response in preterm infants were identified. Articles accepted for inclusion met the following criteria: English language, original, peer refereed, randomized controlled clinical trials published within the past 5 years, study sample: preterm infants, setting: neonatal intensive care units, study intervention behavioral and environmental, outcome pain measurement score from valid and reliable pain scale.

**SAMPLE:** Fourteen randomized controlled trials from a literature search of PubMed and Medline databases were included in this review.

**RESULTS:** Across all age groups, facilitated tucking, oral sucrose, and kangaroo care decreased behavioral and physiologic pain response alone and in combination with other behavioral and environmental interventions.

**CONCLUSION:** Among preterm infants, facilitated tucking, oral sucrose, and kangaroo care significantly mitigates biobehavioral pain response associated with acutely painful procedures.


**AIM:** To investigate the effect of a musical intervention on neonatal stress response to venepuncture as measured by salivary cortisol levels and pain profile scores.

**METHODS:** In a randomised control crossover trial, participants were randomised to both a control arm (sucrose) and intervention arm (sucrose and music) for routine venepuncture procedures. Salivary swabs were collected at baseline, 20 minutes post-venepuncture and 4 hours post-venepuncture. Pain levels were assessed using the Premature Infant Pain Profile (PIPP). 16 preterm neonates participated in both arms to complete the study.

**RESULTS:** Cortisol values were elevated at all timepoints in the intervention arm (baseline, 20 minutes, and 4 hours post-procedure) but not significantly so (p=0.056, p=0.3, and p=0.575 respectively). Median change in cortisol values from baseline was +128.48pg/ml (-47.66-517.02) at 20 minutes and +393.52pg/ml (47.88-1221.34) at 4 hours post-procedure in the control arm compared to -69.564pg/ml (-860.96-397.289) and +100.48pg/ml (-560.46-842.99) at 20 minutes and 4 hours post-procedure in the intervention arm. There was no statistically significant difference observed between groups (p=0.311 at 20 minutes, and p=0.203 at 4 hours post-procedure). PIPP scores were not significantly different between study arms.

**CONCLUSION:** Our findings did not support the additional benefit of music intervention on neonatal stress response to venepuncture in preterm infants.


Oral sucrose is included in almost all recommendations for treatment of pain in newborns, but evidence if multiple doses might be more effective than a single standard dose is lacking. We designed a single-centre, double-blind, randomised, controlled trial. We enrolled preterm infants needing the heel prick procedure. Each enrolled infant was randomised to receive a single standard dose of sucrose 2 min before or a double dose of sucrose 2 min before, and 30 s after heel prick. Primary outcome was the efficacy of the two interventions tested by the premature infant pain profile-PIPP scale obtained at 30 s, 60 s, and 120 s after heel prick. Secondary outcome was the evaluation of the concordance between the PIPP scale and other pain scores more feasible in clinical practice. Seventy-two infants were randomised. No difference in pain perception as measured by the PIPP scale was found between the groups: median PIPP values 4.0(IQR 3.0–4.0) vs 3.0(IQR 3.0–4.0) at baseline; 6.0(IQR 5.0–10.0) vs 6.0(IQR 4.0–8.5) at 30 s; 6.0(IQR 4.0–7.0) vs 5.0(IQR 4.0–8.5) at 60 s and 5.0(IQR 4.0–7.0) vs 5.0(IQR 4.0–7.5) at 2 min, in the experimental and standard treatment groups, respectively (p = 0.9020). There was no correlation between PIPP scores and other pain scales. Conclusion: We do not recommend doubling the dose during heel prick.

**AIM:** The primary objective was to assess the effect of prematurity at term-equivalent age on skin conductance and behavioural responses to acute stress. The secondary objective was to explore the reliability of skin conductance in detecting neonatal discomfort in preterm and full-term populations.

**METHODS:** Very preterm infants at term-equivalent age and healthy full-term neonates, 34 infants in each group, underwent the hip dysplasia screening test. The acute pain in newborn infants (APN) scale was scored before and 15, 45 and 90 seconds after stimulus. Skin conductance was measured in the 30-second time-lapse before and after stimulus.

**RESULTS:** The APN score was lower in preterm infants after intervention (term: 5.4 ± 2.8 vs. preterm: 3.9 ± 2.2; p = 0.03). Peaks-per-second, a skin conductance parameter, exhibited lower basal values in preterm infants than in term infants, with similar rise induced by stressful challenge. Peaks-per-second values were correlated to the 15-second APN score in both groups (term: r = 0.55, p < 0.001; preterm: r = 0.43, p = 0.01).

**CONCLUSION:** Preterm birth changed skin conductance signal and behavioural response to stress at term-equivalent age. The skin conductance device may be an objective tool for a continuous monitoring of acute neonatal stress.


**OBJECTIVE:** An estimation of the individual’s ability to cope with environmental adversity, that is, stress resiliency, can be extrapolated by measuring cardiac vagal tone, that is, high-frequency heart rate variability (HF-HRV); indeed, higher HF-HRV is associated with health and developmental advantages for preterm neonates. Previous studies show skin-to-skin contact (SSC) improves stress resiliency; however, linkages between SSC and HF-HRV on outcomes have not been assessed. We aimed to test the hypothesis that increased SSC frequency would enhance HF-HRV, reduce neonatal morbidity, and improve developmental outcomes.

**STUDY DESIGN:** Weekly electrocardiograms and clinical data were obtained from 101 preterm neonates. SSC frequency was determined from the electronic medical record.

**RESULTS:** At postnatal week 1, frequency of SSC and HF-HRV were positively correlated (p = .02); further, multiple stepwise regressions showed higher HF-HRV and SSC predicted reduced days on ventilation and oxygen, and shorter hospital stay (p < 0.001). Higher HF-HRV predicted lower postmenstrual age (PMA) at discharge (p < 0.01).

**CONCLUSION:** Higher SSC frequency was associated with increased HF-HRV during the first postnatal week. SSC and HF-HRV uniquely predicted diminished neonatal morbidity throughout hospitalization. Additionally, HF-HRV uniquely predicted earlier PMA at discharge. Augmenting SSC early in life enhances stress resiliency and improves health outcomes.


In response to the opioid crisis, the American Physical Therapy Association has strongly advocated for physical therapy as a safe alternative to pharmacological pain management through the “#ChoosePT” campaign and the dedication of a PTJ special issue to the nonpharmacological management of pain. Physical therapists not only play an important role in the rehabilitation of the nearly 2 million adolescents and adults addicted to prescription opioids but also provide care to infants born to mothers with various drug addictions. This Perspective article explores the incidence, pathophysiology, and risk factors for neonatal abstinence syndrome and describes the clinical presentations of withdrawal and neurotoxicity in infants. Discipline-specific recommendations for the physical therapist examination and plan of care, including pharmacological management considerations, are outlined. Nonpharmacological management, including supportive care, feeding, parent education, social aspects of care, and follow-up services, are discussed from a physical therapy perspective. Finally, this article reviews developmental outcomes in infants with neonatal abstinence syndrome and reflects on challenges and future directions of research in this area.

The biological embedding of early life stress exposure may result in life-long neurodevelopmental impairment in preterm infants. Infants hospitalized in the neonatal intensive care unit are exposed to significant experiential, environmental, and physiologic stressors over the course of their extended hospitalization. Stress exposure during the sensitive period of brain development may alter biological processes, including functioning of the immune system, the autonomic nervous system, and the hypothalamic-pituitary-adrenal axis as well as gene expression. These alterations may subsequently affect brain structure and function. Changes to these processes may mediate the relationship between neonatal stress exposure and neurodevelopment in preterm infants and represent potential therapeutic targets to improve long-term outcomes. The purpose of this paper is to introduce a conceptual model, based on published research, that describes the mechanisms mediating stress exposure and neurodevelopmental impairment in preterm infants and to provide the theoretical foundation on which to base future descriptive research, intervention studies, and clinical care.


Management of neonatal pain is not only ethical but is also essential. Barriers to pain management in infants include lack of safe and effective medications and fear of adverse effects of conventional pain medications. Sweet solutions given intraorally have been shown to reduce pain behaviors and associated symptoms. Sucrose and other sweet solutions are being increasingly used at the NICUs and immunization clinics. Sucrose for mild invasive procedures is effective and safe for those procedures that need to be repeated multiple times during the day. Only few studies examine the efficacy of sucrose for the management of inflammatory pain during infancy. In this study, Complete Freund’s Adjuvant (CFA) was used to induce inflammation in 5-day-old rat pups; CFA also produces inflammation that lasts for more than a day, thus can also be a model for chronic pain. Sucrose or ibuprofen was given to subset of pups shortly after CFA intraplantar injections. Thermal as well as mechanical pain sensitivity was assessed on subsequent days as well as during adolescence and early adulthood. Sucrose and ibuprofen were both effective in preventing hyperalgesia and allodynia produced by CFA. Interestingly, sucrose was even more effective than ibuprofen, and the analgesic effects continued further to adolescence and adult life of the rats. Thus, and according to the results of this study, sucrose seems to be just as effective for inflammatory pain as Ibuprofen. In addition, sucrose protects against later-in-life hypersensitivity consequences to neonatal pain.


**BACKGROUND:** This study presented the guidelines for the prevention and management of procedural pain management in Japan and investigated the impact of these guidelines on Japanese NICUs. The aim of this study was to investigate whether the published national guidelines influenced organizational factors that could lead to improved pain management and, if so, whether the number of units that perform pain assessments, the administration of local guidelines and collaboration among health care professionals had improved in the 5-year period from 2012 to 2017.

**METHOD:** An anonymous questionnaire was sent to 106 Level 3 neonatal intensive care units across Japan.

**RESULTS:** The response rate was 78% (81 units). In almost all cases, the implementation of organizational factors had increased. Forty-seven units (47%) reported that healthcare professionals collaborated in pain management, compared to 11 units (17.7%) in 2012. In addition, compliance with the guidelines for pain assessment improved over the five-year period. Twenty-four units (30%) reported that they used a structured scale for pain measurement, compared to 9 units (15%) in 2012.

**CONCLUSION:** The current study suggested that the national guidelines published in 2014 influenced the organizational factors that could lead to improved pain management in Japanese NICUs. The number of units that used a structured scale for pain measurement, the development of local guidelines and collaboration among health care professionals increased over the 5-year period from 2012 to 2017.
Infant massage is an ancient therapeutic technique used around the world. For infants who experience painful procedures, are exposed to the stressful NICU environment, and are separated from their parents, infant massage has been promoted as a method to reduce stress and promote bonding. In this article, we review the current literature on infant massage in the NICU. There is evidence that infant massage has beneficial effects on preterm infants in the NICU, including shorter length of stay; reduced pain; and improved weight gain, feeding tolerance, and neurodevelopment. Parents who performed massage with their infants in the NICU reported experiencing less stress, anxiety, and depression. Neonatal nurses can obtain education and certification in infant massage and can teach parents infant massage techniques, thereby promoting the health and well-being of parent-infant dyads.

OBJECTIVES: Intravenous (IV) and intramuscular (IM) antibiotics have comparable efficacy in treating neonates undergoing sepsis evaluations. There are no clinical data favoring the use of either route regarding newborn pain and parental preferences. We hypothesized that pain associated with IM injections would worsen breastfeeding effectiveness and decrease parental satisfaction, making IV catheters the preferred route.

METHODS: This prospective cohort study took place in an academic institution with nurseries in 2 separate hospitals, 1 providing IV antibiotics, and the other, IM antibiotics. Newborns receiving 48 hours of antibiotics were compared by using objective pain and breastfeeding scores and parental surveys.

RESULTS: In 185 newborns studied, pain scores on a 7-point scale were up to 3.4 points higher in the IM compared with the IV group (P < .001). Slopes of repeated pain scores were 0.42 ± 0.08 and -0.01 ± 0.11 in the IM and IV groups, respectively (P = .002). Breastfeeding scores were similar between groups. Parents in the IV group were less likely to perceive discomfort with antibiotic administration (odds ratio [OR] 0.22; 95% confidence interval [CI] 0.06-0.74) but more likely to perceive interference with breastfeeding (OR 26; 95% CI 6.4-108) and bonding (OR 101; 95% CI 17-590) and more likely to prefer changing to the alternate route (OR 6.9; 95% CI 2.3-20).

CONCLUSIONS: IM antibiotics in newborns are associated with pain sensitization and greater pain than IV dosing. Despite accurately recognizing newborn pain with the IM route, parents preferred this to the IV route, which was perceived to interfere with breastfeeding and bonding.

The neonatal period is a highly sensitive time span during which stressful experiences may have an influence on later health outcomes. Medical procedures applied to newborn babies during hospitalization are stressors that trigger a physiological and psychological stress response. Stress response has been traditionally evaluated using scores based on behavioural signs such as facial expressions, limb movements, crying, etc., which are subjectively interpreted. Only few studies have employed measurable physiological signs to objectively evaluate the stress response to specific interventions.

The aim of this review is to inform of recently developed biochemical methods that allow clinicians to evaluate the stress response to medical procedures performed in the neonatal period in biological samples non-invasively obtained. Stress biomarkers are based on the physiological stress response mediated by the hypothysis-pituitary-adrenal axis and the sympathetic-adreno-medullary systems. Cortisol is at present the most widely employed laboratory determination to measure stress levels. In recent years, sequentially determined salivary cortisol levels have allowed non-invasive monitoring of newborn infants under stressful conditions in the NICU.

AIM: The aim of this study was to carry out a literature review and develop clinical guidelines for pain prevention and control during screening and laser photocoagulation for retinopathy of prematurity (ROP) in neonatal intensive care units (NICUs).

METHODS: The Italian Society of Neonatology assessed papers published between 1986 and June 2017 and used the Grading of Recommendations, Assessment, Development and Evaluation approach, to develop new guidelines on pain and ROP.

RESULTS: The Society’s pain experts assessed the full texts of 47 papers, including randomised or quasi-randomised controlled trials and case-control studies on nonpharmacological and pharmacological measures used in NICUs during the screening and laser photocoagulation of neonates for ROP. The literature suggested methods for reducing the stress and pain associated with ROP screening procedures. The panel concluded that the literature showed that it was feasible to provide laser photocoagulation for ROP in spontaneously breathing patients with adequate analgesia.

CONCLUSION: This literature review on managing pain in infants with ROP in NICUs led to the development of national guidelines, which will help physicians and nurses to reduce the stress and pain experienced by premature newborn infants during unavoidable screening and treatment for ROP.


OBJECTIVE: Neonates are exposed to multiple painful invasive procedures. Pain management in neonates is an ethical and important task for nurses. This study aimed to evaluate the effectiveness of familiar olfactory stimulation with lavender scent and glucose on the pain of blood sampling in term neonates.

DESIGN: A randomized, single blind clinical trial.

SETTING: Hashemi Nezhad Hospital (Mashhad, Iran).

INTERVENTION: Before and during blood sampling, one group was exposed to the scent of lavender (n = 40), the second group received 2 ml of edible glucose 30% (n = 40), two minutes before the blood sampling, and the third group received no specific intervention (n = 40).

MAIN OUTCOME MEASURES: Simultaneously with needle insertion, the Douleur Aigue du Nouveau-ne (DAN) scale was used to calculate the pain score. The duration of crying (in seconds) was measured from start to end (silence).

RESULTS: The study participants’ mean age was 5.49 ± 2.13 days; 60% of them were girls, and 65.8% had the gestational age of 38–39 weeks. The mean pain scores were 4.47 ± 1.81, 4.80 ± 1.92, and 5.97 ± 1.94 in the aromatherapy group, the glucose group, and the control group respectively (p < 0.001). No significant difference was recorded between the groups regarding the crying time (P = 0.12).

CONCLUSIONS: Our findings suggest that use of aromatherapy with lavender and edible glucose as easy and applicable nursing care can reduce the pain of blood sampling in term neonates and can be considered as effective interventions in neonate pain management, although more research is recommended.


BACKGROUND AND OBJECTIVES: Newborns at high risk in the intensive care unit are exposed to painful, repetitive and prolonged procedures that may be related to changes in brain development and behavioral abnormalities. The objective of this study was to relate pain and free cortisol of premature newborns undergoing therapeutic procedures in intensive care units.

METHODS: A quantitative, descriptive, cross-sectional study conducted with 32 premature newborns submitted to venipuncture, who were evaluated for pain and stress related to assisted ventilation; sedatives, prenatal corticoid, type of venipuncture, site, and the number of attempts.

RESULTS: Preterm newborns undergoing invasive ventilation had a predominance of moderate pain in 12 (37.5%) and cortisol increase in 14 (43.8%) of them. Venipuncture triggered moderate and intense pain, 10 (31.3%), and in 17 (53.1) the cortisol levels increased. More than half was due to peripherally inserted central catheter placement, so that 10 (43.8) had moderate pain. The results of the research suggest that the exposure of newborns to invasive procedures is stressful, especially when repeated several times.

CONCLUSION: Repeated venous puncture associated with therapeutic procedures intensified pain and altered cortisol, causing stress in premature newborns.

PURPOSE: Pain in the neonate is often challenging to assess but important to control. Physicians often must balance the need for optimal pain control with the need to minimize oversedation and prolonged opioid use. Both inadequate pain control and overuse of opioids can have long-term consequences, including poor developmental outcomes. The aim of this review is to introduce a comprehensive approach to pain management for physicians, nurses, and surgeons caring for critically ill neonates, focusing on nonopioid alternatives to manage procedural pain.

FINDINGS: After review, categories of opioid-sparing interventions identified included (1) nonopioid pharmacologic agents, (2) local and regional anesthesia, and (3) nonpharmacologic alternatives. Nonopioid pharmacologic agents identified for neonatal use included acetaminophen, NSAIDs, dexmedetomidine, and gabapentin. Local and regional anesthesia included neuraxial blockade (spinals and epidurals), subcutaneous injections, and topical anesthesia. Nonpharmacologic agents uniquely available in the neonatal setting included skin-to-skin care, facilitated tucking, sucrose, breastfeeding, and nonnutritive sucking.

IMPLICATIONS: The use of various pharmacologic and interventional treatments for neonatal pain management allows for the incorporation of opioid-sparing techniques in neonates who are already at risk for poor neurodevelopmental outcomes. A multifactorial approach to pain control is paramount to optimize periprocedural comfort and to minimize the negative sequelae of uncontrolled pain in the neonate.


INTRODUCTION: Nurses are in close contact with patients and their knowledge of pain assessment and management plays a key role in enhancing patients health. The purpose of this study was to investigate the assessment and management of pain by nursing staff in neonatal intensive care units (NICU).

MATERIALS AND METHODS: A descriptive cross-sectional study was conducted in 2018. The study population consisted of nurses with at least six months experience of working in the NICU of Ilam hospitals. The data were collected using a demographic questionnaire and a pain management questionnaire. Then, using spss16 software, descriptive statistics and independent t-test were performed with a significant level of less than 0.05.

RESULTS: The results showed that only a few nurses (7.1%) answered "always" to setting up measures for reducing pain or discomfort of neonatal. In the "Parents were allowed to relieve pain" item, many nurses 18 (31.0%) used this strategy only occasionally. Regarding non-pharmacological methods to reduce pain, only a small number of nurses 8 (13.8%) used this item "always".

CONCLUSION: Regarding the fact that pain assessment and management were not at the appropriate level for nurses, it is necessary to have appropriate educational interventions in this field.


BACKGROUND: Increasing comfort and physiological stabilization in preterm infants during neonatal care improves their neurophysiological development. Bathing procedures that support this development and will not expose the newborn to stress should be preferred.

OBJECTIVES: Our study aimed to examine the effectiveness of tub bathing and sponge bathing methods on the physiological parameters (i.e., heart rate, respiration rate, oxygen saturation, body temperature) and comfort of late preterm infants.

DESIGN: Randomized controlled trial. Study is registered at ClinicalTrials.gov NCT03796312.

SETTINGS: The trial was conducted in a neonatal intensive care unit of a university hospital in Antalya, Turkey.

METHODS: Late preterm infants (gestational age between 34 0/7 weeks and 36 6/7 weeks) were randomly assigned by a computer program to either intervention (tub bath) or control group (sponge bath). The physiological parameters and comfort of preterm infants in both groups were evaluated at 10 minutes before the bath. Infant comfort was reevaluated 10 minutes after the procedure, while physiological parameters were reevaluated after 15 and 30 minutes. Preterm infant heart rate, oxygen saturation, respiratory rate, body temperature and comfort behaviors were assessed by two independent evaluators who were blinded to the purpose of the study at different phases across the two bathing protocols. Written consent was obtained from
the university and hospital ethics committee where the research was performed, and from the families of the infants participating in the study. SPSS 20.0 and SAS 9.3 were used for data analysis. Data was analyzed by percentage distribution, mean, repeated analysis, variance analysis, Bonferroni analysis as a further analysis and t test in dependent groups.

RESULTS: Approximately 120 preterm infants completed the protocol (60 in each group). The two groups did not differ in gestational age, sex, weight or other demographic variables (p > 0.05). Tub bathing was more effective in reducing preterm infants’ comfort scores (9.47±2.55 vs. 14.85±4.77, p < 0.001) and heart rate than sponge bathing (132.88±12.00 vs. 144.00±17.74, p < 0.05). Preterm infants in the tub bathing group maintained their body temperature better than those in the sponge bathing group (36.75.±0.26 vs. 36.59±0.25, p < 0.05). There was no difference in oxygen saturation (98.35±0.88 vs. 97.85±1.36, p = 0.291) or respiratory rate (45.57±5.39 vs. 47.20±5.41, p = 0.472) between the tub and sponge bathing groups.

CONCLUSIONS: Tub bathing is a safer, more pleasurable/comfortable bathing option and is the recommended method for bathing healthy, late preterm infants.


BACKGROUND: Preterm infants spend the early days of their lives in neonatal intensive care units, where they undergo many minor painful procedures. There are many nonpharmacologic methods that can effectively reduce the pain response of neonates who undergo routine procedures.

AIMS: This study aimed to investigate whether oral glucose and listening to lullabies could bring pain relief during the removal and reinsertion of the tracheal tube and also oronasopharyngeal suctioning in premature infants to whom nasal continuous positive airway pressure was applied.

DESIGN: A double-blind, randomized controlled trial.

SETTING: This study was conducted in the neonatal intensive care unit in the tertiary setting between November 2012 and September 2013.

PARTICIPANTS/SUBJECTS: A total of 106 preterm infants were divided into three groups, including 37 infants in the control group, 35 infants in the lullaby group, and 34 infants in the glucose group.

METHODS: All preterm infants were randomly assigned to either the intervention groups or the control group. Pain responses were assessed using the Neonatal Infant Pain Scale and the Premature Infant Pain Profile.

RESULTS: An assessment of the pain severity of the preterm infants after the intervention indicated that the preterm infants in the lullaby and glucose groups had lower pain, whereas the preterm infants in the control group experienced more pain (p < .05).

CONCLUSION: The findings suggest that pain could be reduced significantly in preterm infants after the suggested intervention, although further studies are required to identify the benefits of lullabies or glucose in infants during other painful procedures.
and vulnerable hospitalised infants. The first Nordic implementation process of family-centred neonatal music therapy started in Sweden at the Central Hospital in Karlstad by the first author in March 2010 (Fig. 1). Live lullaby singing during painful procedures is the first clinical trial to measure the pain-relieving effects of live lullaby singing during venepuncture in preterm and term neonates.

**METHOD:** 38 infants were subjected to venepuncture with and without live lullaby singing, in a randomised order with a cross over design. Parent-preferred lullabies were performed live by a music therapy student and standard care (facilitated tucking and oral glucose) was provided for all infants. Behavioural and physiological pain responses were assessed. The data from the RCT was analysed with qualitative and quantitative methods.

**RESULTS:** During the lullaby procedures the physiological patterns were more stable and regular. Lullaby singing significantly calmed the infants’ respiration before venepuncture (Fig. 2). There were nonsignificant indications of fewer and shorter skin punctures with lullaby singing. The behavioural pain responses did not show any significant differences between the live lullaby singing and standard care procedures, however, nor did they indicate that live lullaby singing was harmful or stressful.

**CONCLUSION:** Live singing with infants is a biopsychosocial communicative interaction. A music therapist specialised in family-centred neonatal music therapy methods can mentor parents how to use live lullaby singing in connection to painful procedures. More research is needed to explore the potential benefits of family-centred music therapy as procedural support including the voice of the parents.


Pain experienced during neonatal intensive care management can influence neurodevelopmental outcome and the somatosensory and/or emotional components of pain response in later life. Alterations in biological factors (e.g. peripheral and central somatosensory function and modulation, brain structure and connectivity) and psychosocial factors (e.g. gender, coping style, mood, parental response) that influence pain have been identified in children and young adults born very preterm or extremely preterm. Earlier gestational age at birth and cumulative pain exposure from tissue-breaking procedures and/or neonatal surgery influence the degree of change. In neonatal rodents, repeated needle insertion or hindpaw incision identify developmentally-regulated and activity-dependent long term alterations in nociceptive processing, and the efficacy of novel or current analgesic interventions can be compared. As prior neonatal experience and sex may influence current pain experience or the risk of persistent pain, these factors should be considered within the biopsychosocial assessment and formulation of pain in later life.


In 2011, the American Academy of Pediatrics (AAP) published a technical report on the lifelong effects of early toxic stress on human development, and included a new framework for promoting pediatric health: the Ecobiodevelopmental Framework for Early Childhood Policies and Programs. We believe that hospitalization is a specific form of toxic stress for the neonatal patient, and that toxic stress must be addressed by the nursing profession in order to substantially improve outcomes for the critically ill neonate. Approximately 4% of normal birthweight newborns and 85% of low birthweight newborns are hospitalized each year in the highly technological neonatal intensive care unit (NICU). Neonates are exposed to roughly 70 stressful procedures a day during hospitalization, which can permanently and negatively alter the infant’s developing brain. Neurologic deficits can be partly attributed to the frequent, toxic, and cumulative exposure to stressors during NICU hospitalization. However, the AAP report does not provide specific action steps necessary to address toxic stress in the NICU and realize the new vision for pediatric health care outlined therein. Therefore, this paper applies the concepts and vision laid out in the AAP report to the care of the hospitalized neonate and provides action steps for true transformative change in neonatal intensive care. We review how the environment of the NICU is a significant source of toxic stress for hospitalized infants. We provide recommendations for caregiving practices that could significantly buffer the toxic stress experienced by hospitalized infants. We also identify areas of research inquiry that are needed to address gaps in nursing knowledge and to propel nursing science forward. Finally, we advocate for several public policies that are not fully addressed in the AAP technical report, but are vital to the health and development of all newborns.

PURPOSE: To compare the effects of integrating mother’s breast milk (BM) with three different combinations of sensory stimuli on preterm infant pain during peripheral venipuncture procedures.

DESIGN: A prospective, repeated-measures randomized controlled trial.

METHODS: Preterm infants (gestational age between 28 and 37 weeks, and in stable condition) needing venipuncture were recruited by convenience sampling (N = 140) and randomly assigned to four treatment conditions: (a) routine care (condition 1); (b) BM odor or taste (condition 2); (c) BM odor or taste + heartbeat sounds (HBs; condition 3), and (d) BM odor or taste + HBs + non-nutritive sucking (NNS; condition 4). Pain scores were assessed based on the Premature Infant Pain Profile-Revised (PIPP-R) over nine phases: baseline (phase 0, 5 min without stimuli before venipuncture), disinfecting (phase 1), during venipuncture (phase 2), and a 10-min recovery (phases 3–8).

FINDINGS: Infants who received BM odor or taste + HBs + NNS had significantly lower increases in pain scores from baseline compared with controls across phases 1 through 8. Infants treated with either condition 2 or 3 demonstrated significant reductions in mild pain during disinfecting and recovery phases, as compared with the controls. When condition 2 was used as the reference, there were no significant differences in pain scores between the infants receiving condition 3 across the nine phases, suggesting mothers’ HBs have only mild analgesic effects on venipuncture pain.

CONCLUSIONS: Integration of mother’s BM odor or taste, HBs, and tactile NNS should be considered as an intervention for alleviation of procedural pain for preterm infants.

CLINICAL RELEVANCE: Clinicians should incorporate the integrated sensory intervention into caregiving support for preterm infants undergoing short painful procedures.

**BACKGROUND:** Premature neonates admitted to the neonatal intensive care unit (NICU) undergo sleep disorder due to various manipulations. The present study aimed to investigate the effect of clustered nursing care on sleep behaviors in premature neonates admitted to NICUs.

**METHODS:** This clinical trial study was conducted on 60 neonates selected through convenience sampling method out of the infants admitted to the NICU. First, in the control group, a constant nurse took care of the neonates in a complete shift. The nurse observed the neonates sleep behaviors every two min for 45 min and recorded them in the questionnaire. The intervention group was investigated one week after the control group. The neonates’ sleep behaviors were observed and recorded every two min by Prechtl instrument. All the data were analyzed by the Mann-Whitney U test using SPSS software version 16.

**RESULTS:** The mean sleep times in the control group were as follow: quiet sleep 5 min and 86 milliseconds, active sleep 21 min and 50 milliseconds, quiet wake 4 min and 6 milliseconds, alertness 9 min and 6 milliseconds, and cry 1 min and 76 milliseconds. On the other hand, in the neonates who received clustered care in the intervention group, the mean timings were as follow: quiet sleep time 19 min and 33 milliseconds, active sleep 24 min and 66 milliseconds, quiet wake 1 min and 76 milliseconds, alertness 2 min and 76 milliseconds, and cry 0.13 min. According to the mentioned times, it could be concluded that the neonates in the test group had a quiet and active sleep ($P <0.05$).

**CONCLUSION:** Findings of this study demonstrate that cluster care can significantly increase the time of quiet and active sleep in the newborns. Based on the result, it is recommended that this kind of care be provided in the NICU program, as well as in the syllabus of students and nursing retraining.


**BACKGROUND:** Skin-to-skin contact (SSC) has been widely studied in NICU and several meta-analyses have looked at its benefits both for the baby and the parent. Very few studies however have investigated benefit for communication.

**AIMS:** Investigate the immediate benefits of Supported Diagonal Flexion (SDF) positioning during SSC on the quality of mother-very preterm infant communication and to gain insight into how mothers’ and very-preterm infants’ communicative behaviours are coordinated in time just a few days after birth.

**SUBJECTS AND STUDY DESIGN:** Monocentric prospective matched-pair case-control study. Thirty-four mothers and their very preterm infants (27 to 31 + 6 weeks GA; mean age at birth 30 + 6 weeks GA) were assigned to one of the two SSC positioning, either the Vertical Control ($n = 17$) or the SDF Intervention positioning ($n = 17$). Mother and infant were filmed during the first 5 min of SSC, 15 days after the very first SSC (i.e. 18 days after very premature birth, i.e. on average 32.4 weeks GA).

**OUTCOME MEASURES:** Infants’ state of consciousness according to the Assessment of Preterm Infants’ Behavior scale. Onset and duration of infants’ and mothers’ smiles, gazes and vocalizations, and their temporal proximity inside a 1-sec time-window.

**RESULTS:** In the SDF Intervention Group, very preterm infants vocalized three times more and mothers vocalized, gazed at their baby’s face, and smiled more than in the Vertical Control Group. Moreover, in a one-second time-frame, temporal proximity of mother-infant behaviours was greater in the SDF Intervention Group.

**CONCLUSIONS:** Our study shows that SDF positioning creates more opportunities for mother-infant communication during SSC. SDF positioning fosters a greater multimodal temporal proximity thus supporting a more qualitative mother-infant communication.


**OBJECTIVE:** To compare the physiological variables and the sleep-wake pattern presented by preterm in nesting and hammock positions after diaper change.
METHOD: This is a crossover randomized controlled trial. It was conducted with 20 preterm infants who, after diaper change, were placed in nests or hammocks. These preterm infants were evaluated for physiological variables (heart rate and oxygen saturation) and behavioral variables (sleep and wakefulness).

RESULTS: There was no statistically significant difference in the studied variables between nesting and hammock positions. However, regarding the categorical variable sleep, the comparison between the research phases for the hammock position showed differences between the baseline phase and the immediate recovery (p=0.00), baseline and late recovery (p=0.00), response and immediate recovery (p=0.00), response and late recovery (p=0.00).

CONCLUSION: No differences were identified between the nest and the hammock; however, the use of the hammock favored the sleep of preterm infants compared to its non-use.


BACKGROUND: These days, most of the admitted infants in neonatal intensive care units (NICU) are premature infants. Infant massage and prone position has been recommended for several decades to have a positive effect on preterm and low birth weight infants. The objective of this study was to determine the effects of neonatal massage with prone positioning in preterm infants on Heart Rate (HR), and Oxygen Saturation (O₂Sa) status.

MATERIALS AND METHODS: This is a controlled randomized three-group clinical trial study conducted on hospitalized infants in selected hospitals of Alborz University of Medical Sciences in Karaj-Iran. There are about 75 preterm infants (33-37 weeks) who met inclusion criteria were randomly assigned to groups of position, massage as intervention groups, and a control group. Intervention (prone position and massage) was administrated for five straight days. The repeated measure ANOVA test was performed to evaluate and compare the effect of interventions. p value less than 0.05 was considered as statistical significance.

RESULTS: The Repeated Measure two-way Analysis of Variance (RM-ANOVA) result showed a significant difference in HR and SaO₂ in different time points among control, position and massage groups with RM-ANOVA (F₁₀,₃₆₀=10.376, p < 0.001). HR values was reduced and SaO₂ values was increased in intervention groups with RM-ANOVA (F₅,₃₆₀=2.323, p < 0.001).

CONCLUSIONS: Results showed that massage and prone position equally led to the reduction of HR and increase of SaO₂, compared to control group.


BACKGROUND: Sleep undergoes changes from birth to adulthood, while sleep disorders are associated with various cognitive deficiencies in childhood. In parallel, prematurity is known to predispose to poor neurodevelopmental outcomes. Our aim is to provide literature data about factors influencing sleep in the premature infants and sleep outcomes in this population.

METHODS: A systematic review was conducted using a variety of health-related databases. Original research papers were considered and no year-of-publication restriction was placed.

RESULTS: In total, 22 articles fulfilled our selection criteria. Available studies present remarkable heterogeneity in terms of methodological design. Compared to full term, premature infants exhibit significant differences in sleep structure, which mainly include differences in electroencephalographic spectral values, in total sleep time and in arousal threshold. Furthermore, prematurity seems to be a risk factor of sleep breathing disorders in childhood and adolescence. Data about the effect of methylxanthines and the environment of neonatal intensive care unit is controversial. With regard to the impact of prematurity-related sleep disorders on future neurodevelopment, available research papers are generally few.

CONCLUSIONS: The alterations in sleep patterns are an outcome of prematurity (immaturity of nervous system) as well as of postnatal factors and comorbidities. Sleep problems in this population of infants seems to be a missing piece of the puzzle of impaired neurodevelopment. Future studies should focus on interventions to improve sleep hygiene and limit neurodevelopmental problems.


BACKGROUND: Nutrition cares are of the main measures to save premature infants. In this regard, proper positioning is one of the key measures that is done by nurses; still there is a paucity of studies in this field and
the results of these few studies are an area of ongoing debates. In light of this, the present paper is an attempt to determine the effects of different positioning on gastric residual volume in premature infants in NICU.

METHODS: A clinical trial cross-over study was carried out on premature infants in NICU. The subjects, who had inclusion criteria, were selected through convenience sampling based on inclusion criteria and randomly allocated into three groups. Gastric residual volume before and one hour after feeding was measured and recorded for three positions including right-lateral, left-lateral, and prone. The data was analyzed via SPSS-21 using descriptive statistics such as mean, standard deviation, and frequency; and inferential statistics such as Chi Squared, Kruskal Wallis test, and Friedman test.

RESULTS: Totally, 135 infants in three groups were studied and the results showed that minimum and maximum gastric residual volumes were in prone (6.49 ± 8.25 ML) and supine (12.59 ± 11.9 ML) positions, respectively. However, Kruskal Wallis test did not show a significant relationship between the three positions under study and the mean gastric residual volume.

CONCLUSION: Prone position was featured with the lowest gastric residual volume and highest possibility of absorbing nutrient. Still, given the fact that no significant difference was found in the three groups, further and deeper studies are needed.


BACKGROUND: Premature infants are predisposed to developing deformational plagiocephaly. Deformational plagiocephaly may affect the infant’s social well-being and neurobehavioral development.

PURPOSE: This pilot study investigated the feasibility and safety of the preemie orthotic device (POD); a noncommercial, supportive orthotic device to manage deformational plagiocephaly.

METHODS: The setting for this prospective, descriptive, phase 1 clinical trial was 2 urban and 1 suburban neonatal intensive care units that provided care for critically ill premature and term infants. Participants included a convenience sample of 10 premature extremely low-birth-weight infants weighing less than 1 kg. All participants received the experimental treatment with the POD. Time spent on the device with and without the supportive foam insert, provider perception, adverse events, and head shape measurements were collected to assess feasibility and safety of the device.

RESULTS: Participants had a median gestational age of 25.4 weeks and median birth weight of 0.673 kg. The POD was used a median of 21.2 hours per day and the foam insert was used a median of 11.1 hours per day. At enrollment, 1 participant had a normal cranial index compared with 5 participants at study completion. All participants had normal cranial symmetry at study enrollment and completion. No device-related adverse events were reported.

IMPLICATION FOR PRACTICE: The POD was found to be feasible and safe. Staff had favorable responses to the device. Recommendations by nursing staff included enlarging the device to extend its use.

IMPLICATION FOR RESEARCH: Further studies are warranted to assess the POD’s effectiveness.


AIM: To investigate the effects of a swaddling device known as the Hugsy (Hugsy, Eindhoven, the Netherlands) towards improving autonomic regulation. This device can be used both in the incubator and during Kangaroo care to absorb parental scent and warmth. After Kangaroo care, these stimuli can continue to be experienced by infants, while in the incubator. Additionally, a pre-recorded heartbeat sound can be played.

METHOD: Autonomic regulation was compared in preterm infants before, during and after Kangaroo care with and without the use of a swaddling device in a within-subject study carried out in a level III neonatal intensive care unit. Descriptive statistics and effect sizes were calculated corresponding to changes in heart rate, respiratory rate, oxygen saturation, temperature and heart rate variability on intervention versus control days.

RESULTS: In this study of 20 infants with a median (interquartile range) gestational age of 28.4 (27-29.9) weeks, Kangaroo care was associated with a decrease in heart rate, respiratory rate and heart rate variability on both intervention and control days. There were no differences between intervention and control days.

CONCLUSION: The use of an alternative swaddling device aimed at facilitating Kangaroo care did not enhance autonomic regulation, as measured by vital signs and heart rate variability.

Preterm infants are born with physiological handicaps. The sensory impact of the NICU has been postulated to influence the physiological, neuro-development outcome of preterm infants and the quality of life of these newborns. A study was conducted with the objectives to assess and evaluate the physiological parameters (temperature, respiratory rate, heart rate and oxygen saturation level) of preterm infants before and during ‘nesting’ and to assess and evaluate the comfort behavior of preterm infants before and during ‘nesting’. Total 30 preterm infants were selected purposively and data was collected using physiological parameter record sheet and modified comfort behavior scale. Temperature was assessed using digital thermometer, respiratory rate by counting rise and fall in the chest, pulse oxymeter was used to assess heart rate and oxygen saturation level. The findings of study revealed that there was significant effect of ‘nesting’ at 60th and 120th min on temperature (‘t’(29) = 7.86,11.2), respiratory rate(‘t’(29)= 6.43,5.03 ), heart rate ((t(29)= 6.61,2.47) and comfort behavior of preterm infants (‘t’(29)= 22.48, 22.03). there was no significant effect of ‘nesting’ on oxygen saturation level (‘t’ (29) = 0.80,1.08) of preterm infants.


This prospective repeated-measures study explored potential factors (postmenstrual age, body weight, gender, chronological age, illness severity, and circadian rhythm) related to preterm infants’ circadian sleep/wake patterns. Circadian sleep/wake patterns were measured using an Actiwatch for 3 continuous days in preterm infants (gestational age of 28-36.4 weeks) in a neonatal intensive care unit and hospital nursery. Potential factors associated with circadian sleep/wake patterns were analyzed using the generalized estimating equation. For our sample of 30 preterm infants, better sleep/wake patterns were associated with male gender, younger postmenstrual and chronological age, lower body weight, and less illness severity. Preterm infants’ total sleep time (B = 41.828, p < .01) and percentage of sleep time (B = 3.711, p < .01) were significantly longer at night than during the day. These findings can help clinicians recognize preterm infants’ sleep problems, signaling the need to provide individualized support to maintain these infants’ sleep quality during their early life.


Sleep-disordered breathing (SDB) is a significant cause of morbidity in neonates and young infants. SDB occurs more commonly in preterm infants and in neonates with underlying syndromes. Recent evidence shows that infants with obstructive sleep apnoea (OSA) or SDB have greater health care resource utilization, including longer hospital stay. Management of SDB includes non-invasive ventilation or surgical interventions tailored to the patient. Screening high risk newborns should allow for early diagnosis and timely therapeutic intervention for this population. However, the thresholds for diagnosing SDB and for guiding and implementing treatment in neonates remain unclear. A collective effort is required to standardize the practice worldwide. This article will discuss neonatal sleep physiology and characteristics of neonatal sleep, with an emphasis on the epidemiology and diagnosis of SDB in neonates and its implications for long term outcomes.


AIM: Prone and kangaroo care positioning of preterm infants during intragastric tube feeding were compared with regard to post prandial gastric residual volume, vital signs and infant comfort.

METHODS: The study sample included 30 28-36-birth-week old preterm infants who were hospitalized at the neonatal intensive care unit. Infants were fed in two positions: prone and kangaroo care. All the infants were placed in the prone position after feeding. Vital signs and comfort scores were recorded 30 min after feeding, and the gastric residual volume was measured 3 h after feeding.

RESULTS: After 3 h of feeding, the heart rate was lower in the kangaroo care position than in the prone position. After 30 min and 3 h of feeding, the mean comfort scores and the mean distress scores were lower in the kangaroo care position than in the prone position. It was also determined that there was no significant difference between the kangaroo care position and prone position regarding their effects on the residual volume measured 3 h after feeding.

CONCLUSIONS: The infants fed in the kangaroo care position have a lower heart rate, better comfort levels and less distress after feeding. These positive effects ensure that preterm infants experience less stress and
consume less energy. What is currently known? It has been determined that kangaroo care reduces the pain response and heart rate of the newborn, increases the duration of sleep, reduces the length of stay in the hospital, facilitates breastfeeding, reduces the risk of hypothermia, decreases the mother’s anxiety level by initiating the relationship between the mother and infant, and improves the infant’s growth and development. What does this article add? While there were no differences between prone and kangaroo positions during feeding with regard to gastric residual volumes, we found that the heart rate, comfort scores and distress scores were lower in the kangaroo care position than in the prone position.


BACKGROUND: Premature infants experience stressors such as external stimulation with sounds, light, touch, and open positioning in NICU that negatively affect outcomes.

PURPOSE: The purpose of this study was to measure the effectiveness of a developmental positioning intervention on length of stay, weight gain, and tone/flexion compared with neonates without structured positioning.

METHODS: Study design was quasi-experimental with nonequivalent groups. A retrospective chart review of 50 neonates with the inclusion criteria of 34 weeks of gestation or less and no anomalies provided a preintervention sample. After the education in-service on positioning, a convenience sample of 27 infants was enrolled. Infant Position Assessment Tool was used as a visual guide for positioning and scoring by the researcher for intervention fidelity. Hammersmith scoring was completed by the occupational therapist prior to discharge.

FINDINGS: The postintervention group was younger and sicker than the control group (P < .05). The postintervention sample (M = 7.05 where 7 = 29 to <30 weeks of gestation) was younger than the preintervention sample (M = 7.22). The postintervention sample was smaller (M = 1302.15 g) than the preintervention sample (M = 1385.94 g). Results showed that the postintervention group had clinically significant weight gain and mean Hammersmith score (3.28) was higher showing positioning positively affected tone and flexion scores.

IMPLICATIONS FOR PRACTICE: With greater structure and consistent attention to developmental positioning, outcomes are positively affected.

IMPLICATIONS FOR FUTURE RESEARCH: Further research with larger sample sizes will identify stronger associations and relationships between positioning and outcome measures.


BACKGROUND: Among the therapeutic alternatives complementary to humanized care, there is the vestibular stimulation. Provided by the gentle swing in a hammock, it simulates the containment and maternal movements found in the intrauterine environment and is considered a safe method that reduces stress levels in very low birthweight premature newborn (PTNB).

OBJECTIVE: To observe the time of hospitalization and the discharge weight of the PTNB that passed through the positioning in the hammock and kangaroo mother care.

METHODS: A quasi-experimental study involving two university hospitals including PTNB. The PTNB were allocated into two groups: Kangaroo Mother Care (KMC) composed by PTNB selected according to the maternal presence and vestibular stimulation (VS) composed by PTNB whose maternal presence was not possible. The KMC were kept in skin-to-skin contact with the mother. The VS were positioned in dorsal decubitus in a hammock of cotton adapted within the incubator. The time of hospitalization and weight monitoring were recorded daily by the nursing team in a collection form.

RESULTS: From the 40 PTNB included in this study, 47.5% were female and 40% had normal birth, 20 of them were allocated in the VS group and 20 in the KMC group. The time of hospitalization were not different between the groups (p=0.12), but the discharge weight were higher in the VS group (p<0.05).

CONCLUSION: The data indicate that the hospitalization time is similar between the PTNB who received KMC and VS, and that the discharge weight is higher for the group that received the VS.

BACKGROUND: Hammock positioning is now frequently used with preterm infants admitted to ICUs. However, few studies have investigated the extent to which hammock positioning reduces pain and improves the sleep-wakefulness state compared with traditional positioning.

METHODS: Twenty-six clinically stable newborns with gestational ages from 30 to 37 weeks who were breathing spontaneously were randomly assigned to 2 groups: a hammock-positioning group (n = 13), in which newborns were placed in hammocks in the lateral position, and a traditional-positioning group (n = 13), in which they were kept nested, also in the lateral position. The following variables were evaluated at the beginning and the end of the treatment: pain (with the Premature Infant Pain Profile, and Neonatal Facial Coding System), sleep-wakefulness state (with the Brazelton Neonatal Behavioral Assessment Scale), heart rate, breathing frequency, and peripheral SpO2.

RESULTS: The subjects in the hammock-positioning group showed an improvement in pain compared with the traditional-positioning group (Premature Infant Pain Profile score, 2.62 ± 1.89 vs 2.31 ± 1.97, ΔP = .008) and sleep-wakefulness state score (2.08 ± 0.64 vs 1.23 ± 0.44, Δ P < .001), reduced heart rate (151.69 ± 5.44 vs 142.77 ± 5.18 beats/min, Δ P < .001), breathing frequency (52.31 ± 4.05 vs 50.23 ± 2.55 beats/min, ΔP = .024), and increased peripheral SpO2 (94.69 ± 2.14 vs 98.00 ± 1.22%, Δ P < .001).

CONCLUSIONS: Hammock positioning was an effective treatment option to reduce pain and improve sleep-wakefulness state. It also helped to reduce heart rate and breathing frequency, and to increase peripheral SpO2, which made it a treatment option for preterm infants.


BACKGROUND: Approximately 10% of US newborns require a NICU. We evaluated whether the NICU acoustic environment affects neonatal sleep and whether exposure to the mother’s voice can modulate that impact.

METHODS: In a level IV NICU with single-infant rooms, 47 neonates underwent 12-hour polysomnography. Their mothers were recorded reading children’s books. Continuous maternal voice playback was randomized to either the first or second 6 hours of the polysomnogram. Regression models were used to examine sleep-wake stages, entropy, EEG power, and the probability of awakening in response to ambient noise during and without voice playback.

RESULTS: After epochs with elevated noise, the probability was higher with (versus without) maternal voice exposure of neonates staying asleep (P = .009). However, the 20 neonates born at ≥35 weeks’ gestation, in contrast to those born at 33 to 34 weeks, showed an age-related increase in percent time awake (R² = 0.52; P < .001), a decrease in overall sleep (R² = 0.52; P < .001), a reduction in rapid eye movement sleep bouts per hour (R² = 0.35; P = .003), and an increase in sleep-wake entropy (R² = 0.52; P < .001) all confined solely to the 6 hours of maternal voice exposure. These associations remained significant (P = .02 to P < .001) after adjustment for neurologic examination scores and ambient noise.

CONCLUSIONS: Hospitalized newborns born at ≥35 weeks’ gestation but not at 33 to 34 weeks’ gestation show increasing wakefulness in response to their mother’s voice. However, exposure to the mother’s voice during sleep may also help protect newborns from awakening after bursts of loud hospital noise.


STUDY OBJECTIVES: Preterm infants undergoing intensive care are often placed prone to improve respiratory function. Current clinical guidelines recommend preterm infants are slept supine from 32 weeks’ postmenstrual age, regardless of gestational age at birth. However, respiratory function is also related to gestational and chronological ages and is affected by sleep state. We aimed to identify the optimal timing for adopting the supine sleeping position in preterm infants, using a longitudinal design assessing the effects of sleep position and state on cardiorespiratory stability.

METHODS: Twenty-three extremely (24–28 weeks’ gestation) and 33 very preterm (29–34 weeks’ gestation) infants were studied weekly from birth until discharge, in both prone and supine positions, in quiet and active sleep determined by behavioral scoring. Bradycardia (heart rate ≤100 bpm), desaturation (oxygen saturation ≤80%), and apnea (pause in respiratory rate ≥10 s) episodes were analyzed.

RESULTS: Prone positioning in extremely preterm infants reduced the frequency of bradycardias and desaturations and duration of desaturations. In very preterm infants, prone positioning only reduced the frequency of desaturations. The position-related effects were not related to postmenstrual age. Quiet sleep in both preterm groups was associated with fewer bradycardias and desaturations, and also reduced durations of bradycardia and desaturations in the very preterm group.
CONCLUSIONS: Cardiorespiratory stability is improved by the prone sleep position, predominantly in extremely preterm infants, and the improvements are not dependent on postmenstrual age. In very preterm infants, quiet sleep has a more marked effect than the prone position. This evidence should be considered in individualizing management of preterm infant positioning.


BACKGROUND: Developmentally Supportive Care is a broad category of interventions that is designed to minimize the stress of the NICU environment which include care such as control of external stimuli, clustering of nursery care activities, and positioning or swaddling of the preterm infant so as to provide a sense of containment similar to the intrauterine experience. The preterm neonates often lack adequate muscle tone and are at risk for developing abnormal movement pattern as well as skeleton deformation. Positioning is one of the important aspects of Developmentally Supportive Care to keep the baby comfortable. It is a basic neonatal nursing care and includes keeping the baby in supine, prone and side lying. As postural stability is a foundational milestone for motor development and premature infants are unable to exhibit postural stability without support, standardizing the definition of optimal positioning will lead to consistency in practice. A neonatal positioning guideline implemented in NICU will help in the growth and development of preterm neonates.

MATERIALS AND METHODS: A prospective study was conducted in NICU of a tertiary medical College Hospital, Bangalore. It was an experimental study. Neonatal nurses who were involved in preterm infants care were selected by purposive sampling. Sample size was calculated based on the study by Jeansonetal. Pretest and posttest practices were assessed by taking the average of two observations for each nurse using infant positioning Assessment tool (IPAT). The nurses were trained by lecture followed by practical demonstration of neonatal positioning guidelines. After one week post test was repeated. Paired T test was used for comparing the positioning in pre and post intervention.

RESULTS: Pre-test practice concludes that100% (25) of the staff nurses were in the category of ‘need for repositioning’ and 100% (25) of the nurses were in the category of ‘acceptable positioning’ in post-test (P <0.001) with respect to all the positioning parameters. The mean Pretest score was 4.14 ±1.02 and post test mean score was 10.17 ± 0.57(P <0.001). There was a significant association in practice score with respect to years of experience in NICU (P<0.05).

CONCLUSION: There was a significant improvement in the infant positioning scores in the post test after introducing the positioning guidelines and training the nurses, compared to the pretest scores.
ASSESSMENTS AND PRODUCT DEVELOPMENT


**BACKGROUND:** Premature infants may demonstrate feeding difficulties requiring an instrumental swallowing assessment. Fiberoptic endoscopic evaluation of swallowing (FEES) is one assessment that can evaluate bottle feeding and breastfeeding.

**PURPOSE:** This pilot study investigated the safety and feasibility of FEES for neonatal intensive care unit (NICU) infants during breastfeeding.

**METHODS:** The setting for this prospective, descriptive study was an urban level III NICU that provided care for premature and critically ill infants. Participants were 5 infants recruited from a convenience sample who were at least 37 weeks postmenstrual age, demonstrated feeding difficulties during a bedside feeding and swallowing examination, and were breastfeeding. Each participant received a FEES assessment while breastfeeding (FEES-B). Adverse events and vital signs including prefeeding and postfeeding respiratory rate, heart rate, and oxygen saturation level were recorded to assess safety. Visualization of milk, laryngeal penetration, and tracheal aspiration assessed feasibility.

**RESULTS:** Participants had a mean postmenstrual age of 39.8 weeks. No adverse events, including epistaxis or laryngospasm, were reported; there were no instances of autonomic instability; and there were no statistically significant differences between prefeeding and postfeeding respiratory rate, heart rate, or oxygen saturation level. Two infants successfully breastfed during FEES-B. Human milk was observable, and laryngeal penetration was noted with 1 infant.

**IMPLICATION FOR PRACTICE:** FEES-B was found to be safe, with limited data supporting feasibility. Infants demonstrated no physiologic instability during FEES-B, and milk was visualized in the pharynx during breastfeeding with 2 infants.

**IMPLICATION FOR RESEARCH:** Further studies are warranted to assess effectiveness of FEES-B in infants.


**BACKGROUND:** Feeding difficulties are common and important in premature infants. In order to identify neonatal feeding difficulties, clinicians and nurses require assessment tools to conduct an objective evaluation of infant oral feeding (breast/bottle-feeding). Early identification of infants with feeding difficulty is critical to implement appropriate therapies and optimize the infant’s nutrition and oral feeding skill development. The aim of this study was to validate the Early Feeding Skills (EFS) Instrument for the Evaluation of Oral Feeding in Premature Infants.

**METHODS:** In this descriptive cross-sectional study, the researcher initially got permission from the designer of the tool through email. Then, the main version of this tool was translated into Persian using the standard backward/forward method. Subsequently, the formal and content validity of the questionnaire was confirmed. After visiting a neonatal specialist, the assessment of preterm infants’ oral feeding skills was performed using the EFS Instrument by observing the infants (n=180) during feeding. The exploratory factor analysis and Cronbach’s alpha were utilized to determine the construct validity and assess the reliability of the instrument, respectively.

**RESULTS:** All items of the EFS Instrument had formal validity. Two items were removed from the instrument, based on content validity. On the basis of factor analysis, the items with a minimum factor load of 0.4 were evaluated and according to the factor load of all items (above 0.4), EFS Instrument had the appropriate construct validity. The Cronbach’s coefficient of the instrument was obtained 0.88.

**CONCLUSION:** The EFS Instrument obtained the required reliability and validity for the evaluation of preterm infants oral feeding.


**BACKGROUND:** Despite evidence for the efficacy of strict neonatal abstinence syndrome (NAS) treatment protocols, no national standardized education, diagnosis or treatment strategy is available.
OBJECTIVES: To describe the development and preliminary usability of an electronic bedside primer and decision support tool for medical providers, with embedded, interactive education and reference modules.

METHODS: A panel of NAS experts established a standard operating procedure for the best practices of NAS management and developed an interactive mobile primer and reference and assessment tool to assess NAS with a curriculum and decision support system. We tested the feasibility and usability of this tool with n=8 users, including registered nurses, last-year undergraduate nursing students and neonatal physicians.

RESULTS: Participants rated the usability of the modules positively, with an average rating of 4.5 (scale of “1=Strongly disagree” to “5= Strongly agree”). Participants appreciated the ability to score the infant at the bedside using real time electronic entry. Seven users noted that the electronic device entry would be as accurate as paper or computer-based Electronic Medical Records entry and one user indicated it would potentially be more accurate during post-usability interviews. Users recommended improvements to the curriculum, including increasing detail of definitions and adding videos for additional NAS signs.

CONCLUSION: The assessment tool appears to be acceptable and usable by potential users. The strong ratings across users provides support for further testing whether its acceptability and usability remain high in a hospital setting, while assessing the impact on clinical outcomes such as newborn hospital length of stay.


Family Centered Care (FCC) has been widely adopted as the framework for caring for infants in the Neonatal Intensive Care Unit (NICU) but it is not uniformly defined or practiced, making it difficult to determine impact.

Previous studies have shown that implementing the Family Integrated Care (FiCare) intervention program for preterm infants in the NICU setting leads to significant improvements in infant and family outcomes. Further research is warranted to determine feasibility, acceptability and differential impact of FiCare in the US context.

The addition of a mobile application (app) may be effective in providing supplemental support for parent participation in the FiCare program and provide detailed data on program component uptake and outcomes.


*IMPORTANCE:* Because children in a preverbal stage of development are unable to voice their feelings, they completely depend on their caregiving team for the interpretation and management of their pain and discomfort. Thus, accurately validated scales to assess pain and sedation levels are crucial.

*OBJECTIVE:* To provide clinicians a complete overview on the validity and reliability of the existing pain and sedation scales for different target populations (preterm infants, term infants, and toddlers) and in different clinical contexts.

*EVIDENCE REVIEW:* BIOSIS Previews, Cumulative Index to Nursing and Allied Health Literature, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Embase, MEDLINE, PsycCRITIQUES, PsycINFO, PSYNDEXplus Literature and Audiovisual Media, and PSYNDEXplus Tests were the databases screened from their inception to August 2018. All studies examining the validity or reliability of a given pain or sedation scale for patients in a preverbal stage of development were included in this systematic review. Those scales that were tested for at least construct validity, internal consistency, and interrater reliability were subsequently scored using the consensus-based standards for the selection of health measurement instruments (COSMIN) checklist.

*FINDINGS:* In total, 89 validation articles comprising 65 scales were included. Fifty-seven scales (88%) were useful for assessing pain, 13 scales (20%) for assessing sedation, and 4 scales (6%) for assessing both conditions. Forty-two (65%) were behavioral scales, and 23 (35%) were multidimensional scales. Eleven scales (17%) were validated for infants on mechanical ventilation. Thirty-seven scales (57%) were validated for preterm infants, 24 scales (37%) for term and preterm infants, 7 scales (11%) for term-born children, 7 scales (11%) for preterm infants, term infants, and toddlers, and 17 scales (26%) for term infants and toddlers.

Twenty-eight scales (43%) considered construct validity, internal consistency, and interrater reliability. Clinicians should consider using scales that are validated for at least construct validity, internal consistency, and interrater reliability, combining this information with the population of interest and the construct the scale is intended to measure.

INTRODUCTION: For preterm infants in the neonatal intensive care unit, early exposure to repeated procedural pain is associated with negative effects on the brain. Skin-to-skin contact with parents has pain-mitigating properties, but parents may not always be available during procedures. Calmer, a robotic device that simulates key pain-reducing components of skin-to-skin contact, including heart beat sounds, breathing motion, and touch, was developed to augment clinical pain management.

OBJECTIVE: Our objective was to evaluate the initial efficacy of Calmer for mitigating pain in preterm infants. We hypothesized that, compared to babies who received a human touch–based treatment, facilitated tucking, infants on Calmer would have lower behavioural and physiological pain indices during a single blood test required for clinical care.

METHODS: Forty-nine preterm infants, born between 27 and 36 weeks of gestational age, were randomized either to facilitated tucking or Calmer treatment. Differences between groups in changes across 4 procedure phases (baseline 1, baseline 2, poke, and recovery) were evaluated using (1) the Behavioral Indicators of Infant Pain scored by blind coders from bedside videotape and (2) heart rate and heart rate variability continuously recorded from a single-lead surface ECG (lead II) (Biopac, Canada) sampled at 1000 Hz using a specially adapted portable computer system and processed using Mindware.

RESULTS: No significant differences were found between groups on any outcome measures.

CONCLUSION: Calmer provided similar treatment efficacy to a human touch–based treatment. More research is needed to determine effects of Calmer for stress reduction in preterm infants in the neonatal intensive care unit over longer periods.


INTRODUCTION: One of the most challenging decisions is to assess the preterm infant’s transition from tube feeding to oral feeding. Thus, we require a reliable tool for determining the time to start oral feeding. This study aimed to measure the interrater and intrarater reliability of the Preterm Infant Oral Feeding Readiness Assessment scale (PIOFRA).

MATERIALS AND METHODS: This study was an observational, cross-sectional study. The study participants were preterm infants who had been hospitalized in the Neonatal Intensive Care Unit of Shariati Hospital affiliated to Tehran University of Medical Sciences, between December 2017 and February 2018. The inclusion criteria were absence of neurological and gastrointestinal disorders or major congenital anomalies, Apgar score 3 or more in the first 1 minute, and 5 or more in the first 5 minutes. The exclusion criteria included family’s unwillingness to participate in the study, infant’s death, or a sudden change that affects neonates’ nutritional status, like cerebral hemorrhage or intestinal problems.

RESULTS: The interrater and intrarater reliability of the total PIOFRA scale was good Intraclass Correlation Coefficients (ICC>0.75). The interrater and intrarater reliability of most items were good and excellent, with weighted kappa more than 0.50, with the exception of lip posture and especially stress sign, with weighted kappa less than 0.40.

CONCLUSION: Generally, most items of the PIOFRA scale had acceptable interrater and intrarater reliability. Also, the interrater and intrarater reliabilities of the total POFRAs score was good.


OBJECTIVE: This study aimed to evaluate the concordance of a new scoring system for neonatal abstinence syndrome (NAS) and NAS scores to the traditional Modified Finnegan Neonatal Abstinence Scoring Tool (M-FNAST) score. The NAS score is based on the physiology of withdrawal, with equal emphasis on behavior, and neurological signs.

STUDY DESIGN: The NAS scores for a control group of 202 healthy, term neonates were compared with those for 45 term neonates with NAS. The NAS and M-FNAST scores obtained simultaneously in 45 term neonates with NAS were compared using correlation, linear regression, and receiver operating characteristic curve analysis to determine the validity, reliability, and specificity of the NAS scores.

RESULTS: The association between the NAS and M-FNAST scores was high (Spearman’s correlation, 83%; linear regression, 83%), with an area under the curve of the NAS score of 1.00 (p < 0.01). A cut-off NAS score ≥4 identified NAS neonates with a sensitivity of 100% and specificity of 96%. The values of intraclass correlation, interrater agreement, and Cronbach’s α were 0.63, 0.88, and 0.63, respectively.
CONCLUSION: The new NAS scoring system is valid, reliable, physiologically based, and correlates closely with the M-FNAST score. The NAS scores may require further validation before its use in clinical practice.


AIM: The Baby Moves smartphone application is designed for parents to video their infants' spontaneous movement for remote General Movements Assessment (GMA). We aimed to assess the engagement with Baby Moves amongst high- and low-risk infants' families and the socio-demographic variables related to engagement.

METHODS: Families of extremely preterm (EP; <28 weeks' gestational age) or extremely low-birthweight (ELBW; <1000 g) infants and term-born controls from a state-wide geographical cohort study were asked to download Baby Moves. Baby Moves provided reminders and instructions to capture videos of their infants' general movements. Parents were surveyed about Baby Moves' usability.

RESULTS: The parents of 451 infants (226 EP/ELBW; 225 control) were recruited; 416 (204 EP/ELBW; 212 control) downloaded Baby Moves, and 346 (158 EP/ELBW; 188 control) returned at least one scorable video for remote GMA. Fewer EP/ELBW families submitted a scorable video than controls (70 vs. 83%, respectively; odds ratio (OR) 0.48, 95% confidence interval (CI) 0.3–0.79, P = 0.003), but the difference diminished when adjusted for socio-demographic variables (OR 1.09, 95% CI 0.59–2.0, P = 0.79). Families who received government financial support (OR 0.28, 95% CI 0.1–0.78, P = 0.015), who spoke limited English at home (OR 0.39, 95% CI 0.22–0.69, P = 0.001) or with lower maternal education (OR 0.38, 95% CI 0.21–0.68, P = 0.001) were less likely to return a scorable video. Surveyed parents responded mostly positively to Baby Moves' usability.

CONCLUSIONS: Most parents in this study successfully used Baby Moves to capture infant movements for remote GMA. Families of lower socio-demographic status used Baby Moves less.


Physical activity (PA) is important from birth to promote health and motor development. Parents of young children are gatekeepers of opportunities for PA, yet little is known about their perceptions of PA. We describe the development of the Parent Perceptions of Physical Activity Scale (PPPAS) across two studies (N = 241 parents). In Study 1, 143 parents of infants and toddlers recruited from neonatal intensive care units (NICUs) and childcare centers completed a 48-item PPPAS. In Study 2, 98 parents of premature infants completed the revised 34-item PPPAS. Study 1 principal components analysis (PCA) identified three components (benefits of, barriers to, and perceived influence on PA), and the scale was reduced. Scores for Perceived Barriers to PA were significantly different between groups, U = 1,108, z = -4.777, p < .0001, with NICU parents reporting more barriers to PA than childcare parents. In Study 2, PCA revealed the same components, and the scale was further reduced to 25 items. Three subscales measuring perceived benefits of, barriers to, and influence over an infant's PA produced Cronbach's alphas of .93, .85, .81, respectively. Results demonstrated sufficient construct validity and internal consistency of PPPAS scores, supporting its use in future PA research.


BACKGROUND AND OBJECTIVE: The emergence of the nonnutritive suck (NNS) pattern in preterm infants reflects the integrity of the brain and is used by clinicians in the neonatal intensive care unit (NICU) to assess feeding readiness and oromotor development. A critical need exists for an integrated software platform that provides NNS signal preprocessing, adaptive waveform discrimination, feature detection, and batch processing of big data sets across multiple NICU sites. Thus, the goal was to develop and describe a cross-platform graphical user interface (GUI) and terminal application known as NeoNNS for single and batch file time series and frequency-domain analyses of NNS compression pressure waveforms using analysis parameters derived from previous research on NNS dynamics.

METHODS: NeoNNS was implemented with Python and the Tkinter GUI package. The NNS signal-processing pipeline included a low-pass filter, asymmetric regression baseline correction, NNS peak detection, and NNS burst classification. Data visualizations and parametric analyses included time- and frequency-domain view, NNS spatiotemporal index view, and feature cluster analysis to model oral feeding readiness.
RESULTS: 568 suck assessment files sampled from 30 extremely preterm infants were processed in the batch mode (<50 minutes) to generate time- and frequency-domain analyses of infant NNS pressure waveform data. NNS cycle discrimination and NNS burst classification yield quantification of NNS waveform features as a function of postmenstrual age. Hierarchical cluster analysis (based on the Tsfresh python package and NeoNNS) revealed the capability to label NNS records for feeding readiness.

CONCLUSIONS: NeoNNS provides a versatile software platform to rapidly quantify the dynamics of NNS development in time and frequency domains at cribside over repeated sessions for an individual baby or among large numbers of preterm infants at multiple hospital sites to support big data analytics. The hierarchical cluster feature analysis facilitates modeling of feeding readiness based on quantitative features of the NNS compression pressure waveform.


The Neonatal Intensive Care Unit (NICU) is a highly stressful environment for parents. The Parental Stressor Scale: Neonatal Intensive Care Unit (PSS: NICU) has been validated and used in several languages aside Arabic. This study aimed at translating the scale to Arabic (A-PSS: NICU) and validating it using a cohort of parents of infants admitted to the NICU. Between August 2015 and May 2017, the reliability and construct validity of the A-PSS: NICU were tested on 207 mothers and fathers in two tertiary care hospitals within Greater Beirut. Participants answered the A-PSS: NICU questionnaire, and were interviewed by a clinical psychologist who used the Hamilton Anxiety Rating Scale (HAM-A). An exploratory factor analysis revealed that the A-PSS: NICU is composed of four factors. The A-PSS: NICU overall reliability was excellent (Cronbach’s alpha .92). The A-PSS: NICU scores correlated positively and significantly with those of the HAM-A (r = .24, p < .0001). The A-PSS: NICU is a valid and reliable measure of parents’ stress in the NICU. Using this scale may prove to be beneficial to Arabic-speaking parents as it assists health professionals in identifying potential stressors that can be addressed during the infants’ stay within the NICU.


BACKGROUND: The application of fiberoptic endoscopic evaluation of swallowing (FEES) in the pediatric dysphagia protocol requires specialized knowledge of pediatric conditions that result in dysphagia, recognition of normal and abnormal laryngopharyngeal anatomy and function across ages, and the ability to identify maturational changes in anatomy and function of the aerodigestive tract that pertain to airway protection and swallowing function.

METHODS: Over the past 25 years, we have performed over 7,000 collaborative Otolaryngology and Speech-Language Pathology FEES examinations in patients ranging from 2 days of age to young adults. During this time period, we have monitored the safety of the procedure, explored the feasibility and utility of FEES across conditions, compared and contrasted FEES to the videofluoroscopic evaluation of swallowing (VFSS), and developed specific pediatric FEES protocols with operational definitions for identification and interpretation of swallowing parameters.

RESULTS: FEES has proved to be a safe procedure in patients across ages. There have been no significant adverse events. FEES is comparable to the VFSS in the assessment of events before and after the swallow. It provides unique information regarding laryngopharyngeal anatomy and function, airway protection integrity, sensory threshold, and secretion management ability, as well as pharyngeal swallowing dynamics and the efficacy of compensatory swallowing strategies.

CONCLUSIONS: There are specific indications and contraindications for pediatric FEES, and unique components that characterize the pediatric FEES protocols across ages and conditions. FEES procedures performed jointly by an Otolaryngologist and Speech-Language pathologist offer a team approach to interpretation and management recommendations.

BACKGROUND: The Neonatal Eating Assessment Tool—Breastfeeding is a valid and reliable 62-item parent-report assessment of symptoms of problematic breastfeeding behavior intended for infants less than 7 months old.

RESEARCH AIM: The aim of this study was to describe the Neonatal Eating Assessment Tool—Breastfeeding total score and subscale scores within a sample of full-term, healthy, typically-developing infants under 7 months old.

METHODS: Parents of healthy, full-term breastfeeding infants ($N = 475$) less than 7 months old completed the Neonatal Eating Assessment Tool—Breastfeeding through an online survey. Descriptive statistics were calculated for the total score and seven subscale scores within each age group: 0–2, 2–4, 4–6, and 6–7 months.

RESULTS: Neonatal Eating Assessment Tool—Breastfeeding total scores were highest (i.e., more problematic symptoms) at 0–2 months and decreased in older infant age groups. All subscale scores also had a downward trajectory in symptoms of problematic breastfeeding except the subscale Compelling Symptoms of Problematic Feeding, which was very low across age groups. Scores on the Infant Regulation subscale remained elevated for the first 6 months of life, then declined markedly in the 6–7 month age group.

CONCLUSION: The Neonatal Eating Assessment Tool—Breastfeeding now has reference values to facilitate interpretation of scores and guide decision-making, personalization of interventions, and assessment of response to interventions. For research, the Neonatal Eating Assessment Tool—Breastfeeding can be used to follow longitudinal development of breastfeeding as well as to test efficacy of breastfeeding interventions.


BACKGROUND: Early identification of feeding difficulty in infancy is critical to supporting breastfeeding and ensuring optimal nutrition for brain development. The Neonatal Eating Assessment Tool (NeoEAT) is a parent-report assessment that currently has two versions: NeoEAT – Breastfeeding and NeoEAT – Bottle-feeding for use in breast and bottle-fed infants, respectively. There are currently no valid and reliable parent-report measures to assess feeding through a combination of both breast and bottle delivery. The purpose of this study was to conduct a factor analysis and test the psychometric properties of a new measure, the NeoEAT – Mixed Breastfeeding and Bottle-Feeding (NeoEAT – Mixed Feeding), including internal consistency reliability, test-retest reliability, construct validity and known-groups validity.

METHODS: Parents of infants younger than 7 months who had fed by both bottle and breast in the previous 7 days were invited to participate. Internal consistency reliability was tested using Cronbach’s $\alpha$. Test-retest reliability was tested between scores on the NeoEAT – Mixed Feeding completed 2 weeks apart. Construct validity was tested using correlations between the NeoEAT – Mixed-Feeding, the Infant Gastroesophageal Reflux Questionnaire - Revised (I-GERQ-R), and the Infant Gastrointestinal Symptoms Questionnaire (IGSQ). Known-groups validation was tested between healthy infants and infants with feeding problems.

RESULTS: A total of 608 parents participated. Exploratory factor analysis revealed a 68-item scale with 5 subscales. Internal consistency reliability (Cronbach’s $\alpha = .88$) and test-retest reliability ($r = 0.91; p < .001$) were both acceptable. Construct validity was demonstrated through correlations with the I-GERQ-R ($r = 0.57; p < .001$) and IGSQ ($r = 0.5; p < .001$). Infants with feeding problems scored significantly higher on the NeoEAT – Mixed Feeding, indicating more problematic feeding symptoms, than infants without feeding problems ($p < .001$), supporting known-groups validity.

CONCLUSIONS: The NeoEAT – Mixed Feeding is a 68-item parent-reported measure of breast- and bottle-feeding behavior for infants less than 7 months old that now has evidence of validity and reliability for use in clinical practice and research. The NeoEAT – Mixed Feeding can be used to identify infants with problematic feeding, guide referral decisions, and evaluate response to interventions.


BACKGROUND: Parents of preterm infants increasingly use their mobile phone to search for health information. In a recent review, websites targeted toward parents with infants in the neonatal intensive care
unit (NICU) were found to have poor to moderate quality educational material; however, there is a dearth of literature regarding mobile apps for NICU parents.

**OBJECTIVE:** This study aimed to identify and evaluate apps targeting parents of infants in the NICU for quality of information, usability, and credibility.

**METHODS:** We systematically searched the Apple App Store and Google Play using 49 key terms (e.g., "preterm infant") from July 26 to August 18, 2017. English apps targeting NICU parents that cost less than $20 were included. Apps for health care professionals, e-books/magazines, or nonrelevant results were excluded. In total, 3 tools were used for evaluation: Mobile Application Rating Scale (MARS) to measure quality; Patient Education Materials Assessment Tool for Audiovisual Materials (PEMAT-AV) to measure the app's content usability; and Trust it or Trash It to measure credibility.

**RESULTS:** The initial search yielded 6579 apps, with 49 apps eligible after title and description screening. In total, 27 apps met the eligibility criteria with 9 apps available in both app stores; of those, the app with the most recent update date was chosen to be included in the analysis. Thus, 18 unique apps were included for final analysis. Using MARS, 7 apps (7/18, 39%) received a good score on overall quality (i.e., 4.0 out of 5.0), with none receiving an excellent score. In addition, 8 apps (8/18, 44%) received a PEMAT-AV score between 51% and 75% on the understandability subscale, and 8 apps (8/18, 44%) scored between 76% and 100% on the actionability subscale. Trust It or Trash It deemed 13 apps (13/18, 72%) as trash for reasons including no identification of sources or lack of current information, with only 5 (5/18, 28%) deemed trustworthy. Reviewer's expert evaluation found 16 apps contained content that matched information provided by multiple sources; however, most apps did not meet other objective measurement items to support credibility. When comparing the MARS overall quality and subjective quality scores with trustworthiness of apps, there was no statistically significant difference. A statistically significant difference was found between the 2 MARS quality scores, indicating that, on average, apps were ranked significantly lower on subjective quality compared with overall quality measures.

**CONCLUSIONS:** This evaluation revealed that of the available apps targeting NICU parents, less than half should be considered as acceptable educational material. Over two-thirds of the apps were found to have issues regarding credibility and just over a quarter were considered good quality. The apps currently available for NICU parents are lacking and of concern in terms of quality and credibility.


**BACKGROUND:** A clinical feeding assessment instrument to assist with early identification of oropharyngeal dysphagia (OPD) in neonates was developed.

**OBJECTIVE:** To investigate the validity and reliability of the Neonatal Feeding Assessment Scale (NFAS) in comparison to the modified barium swallow study (MBSS) as gold standard.

**METHOD:** A within-subject design was implemented. A group of 48 late premature neonates (mean gestational age 35.5 weeks) were sampled in the neonatal intensive care unit.

**RESULTS:** The NFAS consists of six subsections, including physiological stability, infant state, stress cues, screening of muscle tone and control, oral peripheral examination and feeding/swallowing assessment. 93% of participants (14/15) received confirmatory diagnosis of OPD on MBSS. The NFAS presented with high sensitivity (78.6%) and specificity (88.2%) scores. The positive predictive value was 78.6%. Subsequently the accuracy of the NFAS to identify the presence of OPD accurately was 85.4% when compared to MBSS. Inter-rater reliability was determined on 35% of the sample. The inter-rater agreement on overall instrument outcome was substantial beyond chance.

**CONCLUSION:** The NFAS may be of use to clinicians to support the early identification of OPD in this population, especially in resource constrained settings working without access to MBSS and to reach under served neonates.


Optimizing neurodevelopment is a key goal of neonatal occupational therapy. In preterm infants, repeated procedural pain is associated with adverse effects on neurodevelopment long term. Calmer is a robot designed to reduce infant pain. The objective of this study was to examine the effects of Calmer on heart rate variability (HRV) during routine blood collection in preterm infants. In a randomized controlled pilot trial, 10 infants were assigned to either standard care (n = 5, facilitated tucking [FT]) or Calmer treatment (n = 5). HRV was recorded continuously and quantified using the area (power) of the spectrum in high and low frequency (HF: 0.15-
0.40Hz/ms²; LF: 0.04-0.15 Hz/ms²) regions. Changes in HRV during three, 2-min phases (Baseline, Heel Poke, and Recovery) were compared between groups. Calmer infants had 90% greater parasympathetic activation ([PS] reduced stress) during Baseline, 82% greater PS activation during Poke, and 24% greater PS activation during Recovery than FT infants. Calmer reduced physiological preterm infant pain reactivity during blood collection.

**BACKGROUND:** Late preterm and early term births account for ~25% of live births. Infants born prior to term are at significantly higher risk for subsequent morbidity and mortality.

**AIMS:** Determine autonomic regulation differences in infants (35–40 weeks gestation) during sleep at birth and one-month after delivery.

**STUDY DESIGN:** Consecutive enrollment until at least 20 infants per group: 75 late preterm (35–36 weeks gestation), 110 early term (37–38 weeks), and 130 full term (39–40 weeks). Assess autonomic parameters 12–84 h after delivery and again at one month of life.

**SUBJECTS:** 329 newborns met inclusion criteria. Exclusions: maternal age < 18 years, major maternal medical problems, psychiatric medications, drug use, Apgar <8 at 5 min, medical complications requiring other than standard care, non-English or non-Spanish speaking.

**OUTCOME MEASURES:** Heart rate and two measures of heart rate variability in active and quiet sleep at birth and at one month of life.

**RESULTS:** Late preterm and early term newborns demonstrate immature patterns of autonomic regulation at birth. Heart rate decreased with gestational age in both sleep states whereas the standard deviation of R-R intervals and beat-to-beat variability in heart rate both increased with gestational age in both sleep states. One month after delivery, i.e. at term-equivalent age, late preterm infants continued to have higher heart rates than infants born full term; and their heart rate was also significantly higher when compared to that of full term newborns at birth, i.e. their autonomic signature did not “normalize” over the first four weeks of life. Early term infants, however, did not differ from full term infants when they reached a postmenstrual age of 44 weeks.

**CONCLUSION:** The specific patterns of immature autonomic regulation in late preterm and early term infants during early postnatal life may underlie their increased morbidity and mortality in infancy and later in development. Future studies should address how early autonomic measures might relate to adverse outcomes. Results suggest the need for autonomic nomograms at birth and at one month after delivery that are stratified by both gestational week and sleep state.


**OBJECTIVE:** The impact of tracheostomy on language and cognitive development in infants with severe bronchopulmonary dysplasia (BPD) is not known. We hypothesize that tracheostomy has an independent negative impact on language and cognitive development in infants with severe BPD.

**STUDY DESIGN:** This is a retrospective cohort study of de-identified data of infants with severe bronchopulmonary dysplasia who received tracheostomy at <2 years of age, compared with infants with severe BPD without tracheostomy. The primary outcomes measured were total language and cognitive scores at 2–3 years of age as determined by Bayley Scales of Infant and Toddler Development, 3rd Edition.

**RESULTS:** A total of 26 patients with tracheostomies and 28 patients without tracheostomies were analyzed. There was no significant difference in total language development or cognitive development between patients with tracheostomies and those without. Insurance status had an effect on language and cognition while controlling for trach status.

**CONCLUSIONS:** Tracheostomy does not independently impact the language and cognitive development of infants with severe BPD.


Telemedicine, or the use of electronic communication technology to improve patient health, is becoming more widely adopted as a means of bringing together patients, providers and family members to facilitate evaluation, monitoring, diagnosis and treatment. A particularly vulnerable group consists of children with dependence on technology, such as chronic mechanical ventilation. This chapter will provide an overview of how telehealth technology is currently being used, for supporting this patient population through 1) inpatient support 2) integration with the medical home 3) bridging care transitions 4) remote patient management and
5) multispecialty consultations. We will also discuss the impact on quality and cost, the current research environment and practical points for implementation into clinical practice.


BACKGROUND: Volunteers can provide staff-directed sensory inputs to infants hospitalized in the NICU, but research on volunteer programs is limited. PURPOSE: To evaluate the feasibility of a developmental care partner (DCP) program in a level III NICU and determine its relationship with provider burnout and infant infection rates.

METHODS: DCPs were trained to provide sensory input to infants, based on the behavioral cues observed by the occupational therapists and nursing staff, in medically stable infants. Feasibility was assessed by documenting the process of training and utilizing volunteers, as well as tracking duration and frequency of DCP visits. Staff burnout measures were assessed using the Maslach Burnout Inventory Human Services Survey (MBI-HSS) before and after implementation. Infant infection rates before and after the introduction of volunteers were compared.

RESULTS: Seventy-two volunteers were interested, and 25 (35%) completed the DCP competencies and provided sensory exposures to 54 neonates, who were visited an average of 8 times (range 1-15). Twelve (48%) DCPs did once-per-week visits, and 9 (36%) did at least 50 contact hours. MBI-HSS scores for staff emotional exhaustion (P < .001) and depersonalization (P < .006) were lower after DCP implementation. There were no differences in infant infection rates before and after DCP implementation (Fisher exact P = 1.000).

IMPLICATIONS FOR PRACTICE: Volunteer-based DCP programs may be feasible to implement in community hospitals and could help reduce staff emotional exhaustion and depersonalization without increasing the incidence of infant infections.

IMPLICATIONS FOR RESEARCH: Future research on NICU volunteer programs with larger sample sizes and different infant populations is warranted.


PURPOSE: The purpose of this quality improvement project was to determine if non-pharmacologic strategies such as a rooming-in approach to care for newborns at risk of developing neonatal abstinence syndrome (NAS) would reduce total length of stay (LOS) and reduce the need for pharmacologic treatment.

DESIGN AND METHODS: This was a quality improvement project utilizing a retrospective chart review. Records of newborns with in-utero methadone or buprenorphine exposure were reviewed who were born between January 2016–July 2017 and July 2017–August 2018 at Wellspan Health York Hospital. Starting in July 2017, newborns exposed to opioids who transitioned normally remained with their mothers for monitoring in the newborn nursery. Monitoring for withdrawal was continued on the pediatric floor after the mother’s discharge from the post-partum floor.

RESULTS: The primary outcome of total LOS was reduced from 14 days to 10.1 days (p = 0.014). The total length of pharmacologic treatment decreased from 15.68 days to 9.71 days (p = 0.023).

CONCLUSIONS: A rooming-in approach to care including management on a pediatric floor can reduce total length of stay and the duration of pharmacologic treatment in newborns with NAS. Newborns with NAS can be safely managed in an inpatient pediatric floor.

PRACTICE IMPLICATIONS: Implementing a rooming-in approach to care of newborns at risk of developing NAS can improve outcomes through a decreased length of hospital stay and decreased duration of pharmacologic treatment. This approach improves access to critical care services by safely monitoring newborns with NAS on an inpatient pediatric floor.


OBJECTIVES: Opioid-exposed neonates (OENs) are a population at risk for postdischarge complications. Our objective was to improve completion of a discharge bundle to connect patients with outpatient resources to mitigate postdischarge risks.
METHODS: Team Hope, a hospital-wide initiative to improve the care of OENs, examined the completion of a discharge bundle from September 2017 through February 2019. A complete discharge bundle was defined as referral to a primary care physician, referral to early intervention services, referral to in-home nursing assessment and educational services, referral to the development clinic if diagnosed with neonatal abstinence syndrome, and referral to the gastroenterology or infectious disease clinic if exposed to hepatitis C virus. After obtaining baseline data, simple interventions were employed as education of providers, social workers, and case management; reminder notes in the electronic health record; and biweekly reminders to resident physicians. A statistical process control chart was used to analyze our primary measure, with special cause variation resulting in a shift indicated by 8 consecutive points above or below the mean line.

RESULTS: One hundred nineteen OENs were examined with an initial discharge bundle completion of 2.6% preimplementation. Referral to early intervention services and the development clinic were the least successfully completed elements before intervention implementation. After the development of the discharge bundle in July 2018, special cause variation was achieved, resulting in a mean-line shift with 60.3% now having a complete bundle for 83 OENs.

CONCLUSIONS: We implemented a standardized discharge bundle that improved our discharge processes for OENs.


OBJECTIVES: To analyze activities involving veteran resource parents and patients in a family partnership program; their perspectives were also explored.

STUDY DESIGN: The multiple roles assumed by family stakeholders in neonatal initiatives were reviewed. Quality control questionnaires were distributed to resource parents and patients and providers who worked with them. Mixed methods were used to analyze results.

RESULTS: Thirty resource parents and patients were involved in a total of 653 activities related to clinical care (n = 413), teaching (n = 31), and research (n = 209); 7 initiatives were described to illustrate the positive impact of family stakeholders on clinical care, teaching, and/or research. Resource parents and patients had different degrees and intensity of involvement: all were involved in low-risk initiatives and 9 in more complex activities. In the questionnaire, family stakeholders all described positive impacts associated with their participation and benefits to themselves, such as meaning making. Three resource parents reported traumatic memories that occurred during medical simulations. The majority of providers report that resource parents and patients improved their projects, but some also report this new collaboration is complex.

CONCLUSIONS: Although stakeholder participation increasingly is recommended, practical knowledge and the impact of their participation is scarce. Having several resource parents and patients bring their contributions may be more valuable than a few “expert stakeholders.” Recruiting and orienting resource parents and patients toward different types of activities should take into account the complexity and risks of the tasks. Family stakeholders are appreciated and have a positive impact on projects in which they are involved.


OBJECTIVE: To determine the impact of policy changes for pulse oximetry oxygen saturation (SpO₂) alarm limits on neonatal mortality and morbidity among infants born very preterm.

STUDY DESIGN: This was a retrospective cohort study of infants born very preterm in the Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network. Infants were classified based on treatment at a hospital with an SpO₂ alarm policy change and study epoch (before vs after policy change). We used a generalized linear mixed model to determine the effect of hospital group and epoch on the primary outcomes of mortality and severe retinopathy of prematurity (ROP) and secondary outcomes of necrotizing enterocolitis, bronchopulmonary dysplasia, and any ROP.

RESULTS: There were 3809 infants in 10 hospitals with an SpO₂ alarm policy change and 3685 infants in 9 hospitals without a policy change. The nature of most policy changes was to narrow the SpO₂ alarm settings. Mortality was lower in hospitals without a policy change (aOR 0.63; 95% CI 0.50-0.80) but did not differ between epochs in policy change hospitals. The odds of bronchopulmonary dysplasia were greater for hospitals with a policy change (aOR 1.65; 95% CI 1.36-2.00) but did not differ for hospitals without a policy change. Severe ROP and necrotizing enterocolitis did not differ between epochs for either group. The adjusted odds of any ROP were lower in recent years in both hospital groups.
CONCLUSIONS: Changing SpO2 alarm policies was not associated with reduced mortality or increased severe ROP among infants born very preterm.


BACKGROUND: Neonatal hyperbilirubinemia (NNH) is one of the leading causes of admissions in nursery throughout the world. It affects approximately 2.4-15% of neonates during the first 2 weeks of life.
AIMS: To evaluate the role of massage therapy for reduction of NNH in both term and preterm neonates.
METHOD: The literature search was done for various randomized control trials (RCTs) by searching the Cochrane Library, PubMed, and EMBASE.
RESULTS: This review included total of 10 RCTs (two in preterm neonates and eight in term neonates) that fulfilled inclusion criteria. In most of the trials, Field massage was given. Six out of eight trials reported reduction in bilirubin levels in term neonates. However, only one trial (out of two) reported significant reduction in bilirubin levels in preterm neonates. Both trials in preterm neonates and most of the trials in term neonates (five trials) reported increased stool frequencies.
CONCLUSION: Role of massage therapy in the management of NNH is supported by the current evidence. However, due to limitations of the trials, current evidences are not sufficient to use massage therapy for the management of NNH in routine practice.


BACKGROUND: Transient hypothyroxinaemia of prematurity (THOP) has been associated with neurodevelopmental deficits with a paucity of literature leading to variable practice.
AIM: Evaluation of the relationship between free T4 (fT4) levels at 2 weeks after birth and early markers of neurodevelopmental outcome.
STUDY DESIGN: A retrospective study of prospectively collected data from infants born <29 weeks' gestation, admitted to NICU between January 2012 and December 2014. The primary outcomes were the relationship between fT4 levels at 2 weeks, Prechtl General Movement Assessment (GMA) at 36 weeks and 3 months postterm age, and Bayley Scales of Infant Development (BSID-III) at 2 years postterm age. Secondary outcomes were survival free of disability and other neonatal morbidities.
RESULTS: Of 122 infants, 101 infants had normal fT4 levels (No-THOP) and 21 had fT4 levels >1SD below the mean (THOP group). There was increased frequency of abnormal GMA in the No-THOP group compared with the THOP group at 36 weeks (abnormal writhing GMs: 43% vs 21%, p = 0.15) and 3 months corrected age (absent fidgety GMs: 7.6% vs 0%, p = 0.36), though not statistically significant. The neurodevelopmental outcome was worse in the No-THOP group compared with the THOP group with significantly lower mean cognitive and motor scores at 2 year of corrected age (90 ± 13.8 vs 100 ± 8.3, p = 0.01 and 91 ± 15.2 vs 100 ± 13.2, p = 0.04 respectively).
CONCLUSIONS: This is the first report describing General Movements (GMs) in preterm infants with THOP. We found worse neurodevelopmental outcome in No-THOP infants reflected by significantly worse cognitive and motor outcomes at 2 years corrected age.


OBJECTIVE: To assess the contribution of maternal and newborn characteristics to variation in neonatal intensive care use across regions and hospitals.
STUDY DESIGN: This was a retrospective population-based live birth cohort of newborn infants insured by Texas Medicaid in 2010-2014 with 2 subcohorts: very low birth weight (VLBW) singletons and late preterm singletons. Crude and risk-adjusted neonatal intensive care unit (NICU) admission rates, intensive and intermediate special care days, and imaging procedures were calculated across Neonatal Intensive Care Regions (n = 21) and hospitals (n = 100). Total Medicaid payments were calculated.
RESULTS: Overall, 11.5% of live born, 91.7% of VLBW, and 37.6% of infants born late preterm were admitted to a NICU, receiving an average of 2 days, 58 days, and 5 days of special care with payments per newborn inpatient episode of $5231, $128 075, and $10 837, respectively. There was little variation across regions and hospitals in VLBW NICU admissions but marked variation for NICU admissions in late preterm newborn infants
and for special care days and imaging rates in all cohorts. The variation decreased slightly after health risk adjustment. There was moderate substitution of intermediate for intensive care days across hospitals (Pearson r VLBW -0.63 P < .001; late preterm newborn -0.53 P < .001).

CONCLUSIONS: Across all risk groups, the variation in NICU use was poorly explained by differences in newborn illness levels and is likely to indicate varying practice styles. Although the “right” rates are uncertain, it is unlikely that all of these use patterns represent effective and efficient care.


Premature infants are at risk for cerebral palsy (CP) that is typically diagnosed between 18-24 months. We present a case study of an infant who was discharged from the neonatal intensive care unit (NICU) without obvious neurological deficits but was later diagnosed with hemiplegic CP. The infant was enrolled in an infant motor study, which included neuroimaging and developmental motor assessments. At term, anatomical MRI showed bilateral periventricular leukomalacia, abnormal brain metabolites in frontal white matter via MR spectroscopy (MRS), and low fractional anisotropy (FA) values obtained from diffusional kurtosis imaging (DKI) in several cortical white matter tracts compared to a group of typically developing infants without neuroimaging abnormalities. In addition, the infant scored below average on a developmental assessment administered at term and three months as well as on the standard Bayley III assessment at 12 months. Abnormal neuroimaging and low scores on the early developmental assessment prompted referral for intervention services at two months. With intensive therapy, by 45 months, the infant was average in self-care, mobility, and communication skills, although below average in visual motor and gross motor coordination. This case highlights the clinical impact of early detection and referral using combined neuroimaging and developmental testing.


Autism spectrum disorders (ASD) are considered as a common neurodevelopmental disorder that their etiology is not known yet. The relation between neonatal jaundice and the odds of developing ASD has investigated previously. This association in some studies was significant, while some other demonstrated there is no association. We conducted a meta-analysis by pooling the results of observational studies to examine the association between neonatal jaundice and the risk of ASD among children. We identified all published studies up to April 2018 by search in Web of Sciences, PubMed as well as Scopus, and references of published manuscripts. The pooled odds ratios (OR), relative ratio (RR) and their 95% confidence intervals (CI) were calculated as random effect estimates of association among studies. In the other word to explore any potential source of heterogeneity between studies we conducted subgroup analysis. The pooled estimates of OR and RR showed a considerable relation between neonatal jaundice and ASD among children (OR = 1.35, 95% CI = 1.02 to 1.68) and (RR = 1.39, 95% CI = 1.05 to 1.74). A larger effect size was shown in pooled estimated crude OR compared adjusted OR (1.75(0.96, 2.54) vs. 1.19(1.07, 1.30)) This study showed that neonatal jaundice may be associated with ASD and it can increase the risk of ASD among children.


OBJECTIVE: To assess the neurodevelopmental outcome of children with spina bifida aperta (SBA) treated prenatally as compared to those treated postnatally.

METHODS: We performed a systematic review of the literature in PubMed/MEDLINE, EMBASE, Web of Science and The Cochrane Library, comparing the neurological outcome of infants with SBA treated prenatally vs postnatally. Only randomized controlled trials (RCTs) and non-randomized prospective controlled studies were included. The primary outcome assessed was neurodevelopmental impairment at the age of 1 year or later. Secondary outcomes were preterm birth, need for ventriculoperitoneal (VP) shunt by 12 months of age, absence of signs of hindbrain herniation at the first postnatal magnetic resonance imaging (MRI) evaluation and independent ambulation evaluated at 30 months.

RESULTS: Of 11 359 studies identified through the electronic search, six met the inclusion criteria and were assessed in full text and two, one RCT and one prospective cohort study, were ultimately included in the meta-analysis. Sensitivity analysis did not show any difference between the outcomes of the RCT alone and those of
the pooled RCT and prospective cohort study. This allowed neurodevelopmental assessment of 213 children between 14 and 53 months of age. Neurodevelopment was assessed by the Bayley Scales of Infant Development II (BSID-II) mental development index corrected for chronological age, with a cut-off of ≥ 70 (representing no more than 2 SD below the mean). The presence of neurodevelopmental impairment was similar between children who underwent prenatal (25/105 (23.8%)) and those who had postnatal (30/108 (27.8%)) repair of SBA (odds ratio (OR), 0.82 (95% CI, 0.43-1.56); P = 0.54), although the risk of prematurity was higher in the prenatal-repair group (OR, 17.62 (95% CI, 7.60-40.87); P < 0.0001). For every two fetuses operated on before birth, there was, compared with those operated on after birth, one additional premature birth (number needed to harm = 2 (95% CI, 1-3)). The need for VP shunt placement by 12 months of age was lower in the prenatal-repair group (45/109 (41.3%)) than in children that had postnatal repair (93/112 (83.0%); OR, 0.14 (95% CI, 0.08-0.26); P < 0.0001). Data on neurodevelopmental impairment in children with a shunt were available only for patients from the prenatal-surgery group of the RCT; in this subgroup, the likelihood for impairment was similar between children who did (7/39 (17.9%)) and those who did not (4/48 (8.3%)) have shunt placement (P = 0.21). At first postnatal MRI evaluation, no signs of hindbrain herniation were detected in 28/88 (31.8%) children who were operated on prenatally compared with 4/89 (4.5%) who had postnatal repair (OR, 9.45 (95% CI, 3.12-28.64); P < 0.0001). Independent ambulation at 30 months was achieved by 41/109 (37.6%) children who underwent prenatal repair compared with 21/111 (18.9%) who had postnatal repair (OR, 2.59 (95% CI, 1.39-4.86); P = 0.003).

CONCLUSION: The risk of neurodevelopmental impairment in infants with SBA was similar between those who underwent prenatal and those who had postnatal surgical repair, despite an increased risk of prematurity in the prenatally repaired group. Copyright © 2018 ISUOG. Published by John Wiley & Sons Ltd.


There is increasing evidence of ongoing changes occurring in short-term and long-term motor and language outcomes in former premature infants. As rates of moderate to severe cerebral palsy (CP) have decreased, there has been increased awareness of the impact of mild CP and of developmental coordination disorder on the preterm population. Language delays and disorders continue to be among the most common outcomes. In conjunction with medical morbidities, there is increased awareness of the negative impact of family psychosocioeconomic adversities on preterm outcomes and of the importance of intervention for these adversities beginning in the neonatal ICU.


OBJECTIVE: To examine the impact of medical complexity among very preterm infants on health care resource use, family, and neurodevelopmental outcomes at 18 months’ corrected age.

METHODS: This observational cohort study of Canadian infants born < 29 weeks’ gestational age in 2009–2011 compared infants with and those without medical complexity defined as discharged home with assistive medical technology. Health care resource use and family outcomes were collected. Children were assessed for cerebral palsy, deafness, blindness, and developmental delay at 18 months. Logistic regression analysis was performed for group comparisons.

RESULTS: Overall, 466/2,337 infants (20%) needed assistive medical technology at home including oxygen (79%), gavage feeding (21%), gastrostomy or ileostomy (20%), CPAP (5%), and tracheostomy (3%). Children with medical complexity were more likely to be re-hospitalized (OR 3.6, 95% CI 3.0–4.5) and to require ≥2 outpatient services (OR 4.4, 95% CI 3.5–5.6). Employment of both parents at 18 months was also less frequent in those with medical complexity compared to those without medical complexity (52 vs. 60%, p < 0.01). Thirty percent of children with medical complexity had significant neurodevelopmental impairment compared to 13% of those without medical complexity (p < 0.01). Lower gestational age, lower birth weight, bronchopulmonary dysplasia, sepsis, and surgical necrotizing enterocolitis were associated with a risk of medical complexity.

CONCLUSION: Medical complexity is common following very preterm birth and has a significant impact on health care use as well as family employment and is more often associated with neurodevelopmental disabilities. Efforts should be deployed to facilitate care coordination upon hospital discharge and to support families of preterm children with medical complexity.

Tens of thousands of infants are impacted yearly by prenatal opioid exposure. The term neonatal opioid withdrawal syndrome (NOWS) is now replacing the more familiar term neonatal abstinence syndrome (NAS). Ongoing debate continues related to standard regimens for treatment of this oftentimes perplexing condition. Historically, treatment has focused on pharmacologic interventions. However, there is limited research that points to nonpharmacologic methods of treatment as viable options, whether alone or in addition to pharmacologic interventions. This article, utilizing a review of pertinent literature, outlines the physical aspects of NOWS, including its pathophysiology and the resulting physical clinical signs. In addition, we present an overview of how age-appropriate, nonpharmacologic interventions, centered on developmental care, may be a valuable approach to organize and prioritize routine care for these infants, their families, and the health care team facing the challenges of NOWS. Finally, the need for further research to better define evidence-based standards of care for these infants and their families is discussed.


**OBJECTIVE:** Among extremely preterm infants, we evaluated whether bevacizumab therapy compared with surgery for retinopathy of prematurity (ROP) is associated with adverse outcomes in early childhood.

**METHODS:** This study was a retrospective analysis of prospectively collected data on preterm (22–26 + 6/7 weeks’ gestational age) infants admitted to the Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network centers who received bevacizumab or surgery exclusively for ROP. The primary outcome was death or severe neurodevelopmental impairment (NDI) at 18 to 26 months’ corrected age (Bayley Scales of Infant and Toddler Development, Third Edition cognitive or motor composite score <70, Gross Motor Functional Classification Scale level ≥2, bilateral blindness or hearing impairment).

**RESULTS:** The cohort (N = 405; 214 [53%] boys; median [interquartile range] gestational age: 24.6 [23.9–25.3] weeks) included 181 (45%) infants who received bevacizumab and 224 (55%) who underwent ROP surgery. Infants treated with bevacizumab had a lower median (interquartile range) birth weight (640 [541–709] vs 660 [572.5–750] g; P = .02) and longer durations of conventional ventilation (35 [21–58] vs 33 [18–49] days; P = .04) and supplemental oxygen (112 [94–120] vs 105 [84.5–120] days; P = .01). Death or severe NDI (adjusted odds ratio [aOR] 1.42; 95% confidence interval [CI] 0.94 to 2.14) and severe NDI (aOR 1.14; 95% CI 0.76 to 1.70) did not differ between groups. Odds of death (aOR 2.54 [95% CI 1.42 to 4.55]; P = .002), a cognitive score <85 (aOR 1.78 [95% CI 1.09 to 2.91]; P = .02), and a Gross Motor Functional Classification Scale level ≥2 (aOR 1.73 [95% CI 1.04 to 2.88]; P = .04) were significantly higher with bevacizumab therapy.

**CONCLUSIONS:** In this multicenter cohort of preterm infants, ROP treatment modality was not associated with differences in death or NDI, but the bevacizumab group had higher mortality and poor cognitive outcomes in early childhood. These data reveal the need for a rigorous appraisal of ROP therapy.


Preterm babies who require respiratory support are often connected to invasive ventilation equipment or oxygen administration equipment. The practical difficulties that families might face in being with, and caring for, their baby can cause additional anxiety and upset. Nine databases were systematically searched from 1990 to 2019. Primary qualitative studies from OECD countries with a substantial focus on support and information needs of parents and carers of preterm babies requiring respiratory support on the Neonatal Intensive Care Unit (NICU) were included. A meta-synthesis was used to analyse included evidence. Six themes were identified from 18 included studies: social and psychological support, staff support, parent-to-parent support, hospital environment, employment support and information formats. This review of qualitative studies identified potential benefits of implementing support valued by parents or carers of preterm babies receiving respiratory care.


Neonatal intensive care unit (NICU) admissions have been increasing. Home visiting services are an integral part of caring for high-risk children with limited resources. The effectiveness of physician-led home visiting
programs on post-NICU health outcomes is not well studied. The Pediatric Visiting Doctors (PVD) program provides home-based primary care for high-risk children including NICU graduates, for 6 months after discharge. The team consisted of a pediatrician, and care coordinator or social worker. The study compares the characteristics and care utilization of PVD program participants with a hospital-based pediatric clinic population.

A retrospective cohort study of PVD infants born from 2013–2016, who were enrolled after referral during their NICU admission, was conducted. Data were also obtained on infants who were hospital clinic patients born during the same time frame, with parents residing in the PVD catchment area, and had a minimum 72-hour NICU stay. Between group differences were assessed; and logistic regression and generalized linear models were used to adjust for uneven group characteristics.

Forty-six PVD participants completed the program, and 91 comparison infants had at least 6 months of post-NICU clinic visits. PVD program completers received a median of 5 home visits. There were no differences in emergency care use or hospitalization. PVD program participants were more likely to attend development clinic compared to the non-PVD group (59% vs 12%, p = 0.002).

Physician-led home visiting services is a feasible way of providing clinical care to this population. Additional research is needed to assess patient-centered outcomes of these programs.


**BACKGROUND:** Traditionally, the care of infants in neonatal care units has been professionally centered, paying less attention to family support. In recent years, many interventions have been developed to improve family-centered care and thereby parent and infant outcomes. Understanding the key factors of implementation of these interventions would help improve clinical practice. The aim of this study was to describe the staff’s perceptions of the implementation of the Close Collaboration with Parents Training Program and to identify the barriers and facilitators of the implementation.

**METHODS:** A descriptive qualitative interview study was conducted in eight neonatal intensive care units in Finland. Nineteen unit managers and 32 nurses were interviewed after their unit had finished the 1.5-year training program. Data were analyzed using thematic content analysis.

**RESULTS:** Key factors facilitating the implementation of the training program were multidisciplinary commitment and the staff’s motivation to change their professional role to work as the parents’ facilitator. Observable benefits promoted the implementation, as well as experiential learning as a facilitation method. The role of mentor was remarkable as a facilitator. In addition, contextual elements such as support from leadership and proper timing were important.

**CONCLUSIONS:** Implementation of family-centered care is facilitated by staff who is prepared to accept parents as partners and adopt a new professional role. Enough time for preparation, readiness for the change, solid support from the leadership, and a multidisciplinary approach are needed as well. Mentoring was found to be one of the key factors facilitating the change.