

## CHAPTER 12

# Prematurity

## Identifying Risks and Promoting Resilience

Prachi E. Shah

Joy Browne

Julie Poehlmann-Tynan

With advances in obstetric and neonatal care, survival rates for infants born preterm have increased in both the United States and other developed countries, resulting in a growing number of families facing the challenge of caring for vulnerable infants (Hamilton, Martin, Osterman, Curtin, & Matthews, 2015). With approximately one in 10 infants born preterm each year, prematurity constitutes a significant public health problem. The consequences of preterm birth affect the entire family and have long-standing impacts on the child born preterm, the caregiver, and the caregiver-child relationship. In addition to the child risks of neurodevelopmental and behavioral sequelae, which can persist throughout the life course, preterm birth can be a traumatic experience for families; this non-normative transition to parenthood is associated with anxiety, grief, depression, and trauma. In this chapter, we begin with an overview of prematurity, identifying risks to the infant, the caregiver, and the caregiving relationship, and consider resilience as a framework to individualize interventions designed to optimize outcomes. Finally, we consider intervention strategies and the role of infant mental health in the care of the preterm infant.

### Definition

“Preterm birth,” defined as birth prior to 37 weeks’ gestation, is a major public health prob-

lem that is associated with significant neonatal morbidity and mortality, and an increased risk for long-term adverse sequelae (McCabe, Carrino, Russell, & Howse, 2014). According to the World Health Organization (Beck et al., 2010), preterm birth can be divided into gestational age categories: extreme preterm (<28 weeks’ gestation), very preterm (28–31-6/7 weeks’ gestation), moderate preterm (32–33-6/7 weeks’ gestation), and late preterm birth (34–36-6/7 weeks’ gestation), with 75% of preterm infants born in the late preterm period (Davidoff et al., 2006). While early studies of preterm infants characterized the degree of prematurity by variations in birthweight, with birthweight classifications categorized as low birthweight (LBW: <2,500 g), very low birthweight (VLBW: <1,500 g), and extremely low birthweight (ELBW: <1,000 g), perinatal epidemiologists have suggested that gestational age is a better marker than birthweight for predicting preterm morbidities. As such, prematurity research has largely shifted to using variations in gestational age (rather than birthweight) as an indicator of risk (Kohn, Vosti, Lezotte, & Jones, 2000).

### *Prevalence and Global Impact of Prematurity*

Prevalence estimates of preterm birth from 39 developed countries of very high health index range from 5.3 to 14.7% (Chang et al., 2013), with substantially higher prevalence rates in de-

veloping countries. Worldwide, it is estimated that 14.9 million births, or 11.1% of all births are premature (Blencowe et al., 2012), with approximately 11 million (>70%) of all preterm births occurring in the developing countries in sub-Saharan Africa and South Asia (Beck et al., 2010). Prematurity is the most common cause of death in the neonatal period (Liu et al., 2015) resulting in 1 million neonatal deaths annually, and 28% of neonatal mortality worldwide. In the United States, the peak prevalence of preterm birth was 12.8% in 2006, with a gradual decrease in the prevalence from 2007 to 2015 (Hamilton et al., 2015). However, in 2016, the preterm birth rate increased to 9.6%, the first increase in a decade ([www.cdc.gov/nchs/fastats/births.htm](http://www.cdc.gov/nchs/fastats/births.htm)).

### Economic Impact of Prematurity

The estimated societal cost associated with preterm births was estimated at greater than \$26.2 billion in 2005, or \$51,600 per preterm infant (Behrman & Butler, 2007). The medical costs associated with the care of preterm infants consume more than \$6 billion (or 60%) of the total spending on neonatal care (St. John, Nelson, Cliver, Bishnoi, & Goldenberg, 2000), with increasing mortality, disability, and neonatal expenditure with decreasing gestational age (Gilbert, Nesbitt, & Danielsen, 2003). Beyond the immediate neonatal period, preterm birth is associated with significant physical, educational, and economic costs (Petrou, 2005). As such, even modest reductions in preterm birth would manifest a significant economic impact (Raju, 2006).

### Etiology of Preterm Birth

The causes of preterm birth are broadly classified into two groups: (1) provider-initiated preterm birth (e.g., induction of labor or elective cesarean section prior to 37 weeks for maternal or fetal indications, or nonmedical reasons) or (2) spontaneous preterm birth (Blencowe et al., 2012). In recent years, changes in obstetric practices in the United States have resulted in a decrease in nonelective delivery prior to 39 weeks' gestation (American College of Obstetricians and Gynecologists, 2013), which may partially explain the decrease in the prevalence of preterm births over the last few years (Hamilton et al., 2015).

The etiology of spontaneous preterm birth is largely unknown (Menon, 2008). Preterm birth is a complex disease with a multiplicity of risk factors, including medical and psychosocial risk factors (Table 12.1). There are numerous, well-established maternal risk factors for preterm birth (Frey & Klebanoff, 2016; Menon, 2008). In addition, there are well-described psychosocial risks associated with prematurity. Socioeconomic disadvantages characterized by poverty, limited maternal education, young maternal age, unmarried status, inadequate prenatal care, minority race (Jansen et al., 2009; Koullali, Oudijk, Nijman, Mol, & Pajkrt, 2016), individual and neighborhood poverty, the presence of stressful life events (Lu & Chen, 2004), and exposure to violence (Masho, Cha, Chapman, & Chelmos, 2017) are thought to contribute both individually and cumulatively to the pathogenesis of preterm birth. However, even after adjusting for the confounding effects of poverty and its associated comorbidities, maternal race continues to be a significant independent risk factor for preterm birth (Muglia & Katz, 2010). In the United States, there are well documented racial disparities in the prevalence of preterm birth (March of Dimes, 2014), with associated increased infant mortality in African Americans compared with other racial groups (Reagan & Salsberry, 2005). While risk factors associated with socioeconomic disadvantage have been implicated as an explanation for racial disparities in preterm birth, these risk factors do not adequately account for the preterm birth disparities in African Americans (Lu & Halfon, 2003), and currently there is a limited understanding of the origins of racial disparities in preterm birth, and what factors may mitigate these differences.

### Outcomes of Preterm Birth

#### *Neonatal Mortality and Perinatal Morbidity*

Prematurity is a significant cause of neonatal mortality worldwide, with 28% of all early neonatal deaths (deaths within the first 7 days of life) attributed to preterm birth (Lawn, Wilczynska-Ketende, & Cousens, 2006). Mortality rates increase proportionally with decreasing gestational age and are highest in infants born at less than 32 weeks' gestation (Simmons, Rubens, Darmstadt, & Gravett, 2010). Despite neonatal medical advances that have resulted in improved mortality, these surviving preterm in-

**TABLE 12.1. Risk Factors for Preterm Birth**

| Maternal risk factors   | Psychosocial risk factors  |
|---|--|
| <ul style="list-style-type: none"> <li>• Maternal body mass index (BMI): increased or decreased BMI</li> <li>• History of previous preterm birth</li> <li>• Uterine/cervical anomalies</li> <li>• Multiple gestation</li> <li>• Advanced maternal age</li> <li>• Genetic factors</li> <li>• Preeclampsia</li> <li>• Gestational bleeding</li> <li>• Abnormal placentation</li> <li>• History of urogenital infections</li> <li>• Teratogen exposure               <ul style="list-style-type: none"> <li>◊ Prenatal alcohol exposure</li> <li>◊ Prenatal drug exposure</li> <li>◊ Maternal smoking</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Poverty</li> <li>• Limited maternal education</li> <li>• Younger maternal age</li> <li>• Unmarried status</li> <li>• Inadequate prenatal care</li> <li>• History of stressful life events</li> <li>• Exposure to violence</li> <li>• Race/ethnicity: African American race</li> </ul> |

fants continue to have an increased risk of short- and long-term morbidities. In the perinatal period, many preterm infants experience problems with their lungs (apnea, chronic lung disease, or bronchopulmonary dysplasia), cardiovascular system (patent ductus arteriosus, hypotension), brain (intraventricular hemorrhage, white-matter abnormalities), temperature regulation (hypothermia), gastrointestinal system (necrotizing enterocolitis), blood (anemia, jaundice), and metabolism (hypoglycemia) (e.g., Stoll et al., 2010), with infants at lower gestational ages generally experiencing more medical complications that contribute to the long-term morbidities associated with prematurity.

### **Long-Term Outcomes and Morbidity**

#### *Health-Related Quality of Life*

Preterm birth is a risk factor for health problems and increased risk of rehospitalization in the first 5 years of life, with worsened health outcomes with decreasing gestation. The odds of more than three hospitalizations in early childhood is highest for infants born very preterm, odds ratio (OR) = 6.0 (95% confidence interval [CI] 3.2–11.4), compared with infants born moderately preterm, OR = 3.0 (95% CI 1.4–6.2), and infants born late preterm, OR = 1.9 (95% CI 1.3–2.7), suggesting a “dose–response” effect of prematurity (Boyle et al., 2012). Lower quality of life in adolescents born preterm has been reported in both parent and self-report measures (Wolke et al., 2013), with the presence

of health complications and disabilities (e.g., patent ductus arteriosus, attention-deficit/hyperactivity disorder [ADHD], severe neurodevelopmental impairment) significantly related to less optimal reported quality of life (Natalucci et al., 2017).

#### *Neurodevelopmental and Neurosensory Disabilities*

As they grow older, preterm infants experience increased risk for “low prevalence–high severity” neurodevelopmental disabilities such as epilepsy, cerebral palsy, intellectual disability, and neurosensory impairment, including hearing and vision impairment (Kodjebacheva & Sabo, 2016; Schieve et al., 2016). Cerebral palsy is a disorder of movement and posture associated with abnormalities of tone and reflexes, resulting in impairments in motor development. Intellectual disability is characterized by an intellectual quotient of  $IQ < 70$ . Preterm infants are also at risk for sensory–neural hearing loss, with severe hearing impairment requiring amplification and cochlear implants (van Dommelen, Verkerk, & van Straaten, 2015). Retinopathy of prematurity is associated with the development of myopia, strabismus, and retinal detachment, and is the leading cause of vision impairment in preterm infants (Holmstrom et al., 2014). A dose–response association has been observed between gestational age and the prevalence of neurodevelopmental disability and neurosensory impairment, with the highest prevalence associated with infants born <26 weeks’ gestation,

and birthweight <1,000 g (Allen, Cristofalo, & Kim, 2011).

### *Cognitive, Learning, and Language Outcomes*

Numerous population-based studies have demonstrated that preterm infants are at increased risk for “high prevalence–low severity” morbidities, characterized by cognitive problems and learning disabilities, with increased impairment associated with decreasing gestational age (Poulsen et al., 2013; Quigley et al., 2012; Shah, Kaciroti, Richards, & Lumeng, 2016). Preterm infants seem to be especially at risk for poor school readiness, and deficits in language, reading, and math academic achievement (Jaekel & Wolke, 2014; Putnick, Bornstein, Eryigit-Madzwanuse, & Wolke, 2017), with the highest odds of impairment demonstrated in infants born very preterm and extremely preterm. As a result, infants born preterm are at higher risk for lower educational attainment, and are more likely to use special education, repeat a grade, and exhibit less optimal academic skills than full-term children, with deficits lasting into adulthood (Eryigit-Madzwanuse, Baumann, Jaekel, Bartmann, & Wolke, 2015; Kelly, 2016).

### *Autism Spectrum Disorders*

Several studies have demonstrated that there is increased prevalence of autism spectrum disorders (ASD) in preterm infants compared with infants born full term. Preterm infants are more likely to have a positive screen on the Modified Checklist for Autism in Toddlers (M-CHAT) and to have deficits in social communication and interactive behavior (Johnson et al., 2010; Limperopoulos et al., 2008). Similar to other neurodevelopmental disabilities, there is a dose–response association between gestational age and prevalence of ASD with a threefold increased prevalence of ASD in children born <27 weeks’ gestation (Kuzniewicz et al., 2014), although there also remains an increased risk for autism in children born late and moderately preterm (Guy et al., 2015).

### ***Social–Emotional Outcomes: Interactive Behavior, Attachment, and Behavioral Outcomes***

#### *Preterm Interactive Behavior*

While it has been suggested that early in life, preterm infants are less alert and responsive, less able to provide clear signals, and more

easily stressed than healthy full-term infants (Greene, Fox, & Lewis, 1983), more recent work suggests that, on average, preterm infants’ quality of play, interest, and attention increases over the first 2 years, accompanied by a decrease in dysregulation and irritability (Poehlmann et al., 2011). Similarly, research describing parenting interaction styles also has demonstrated contradictory findings. While previous research indicated that mothers of preterm infants are less actively involved with their newborns and engage in more negative dyadic interactions, characterized by less sensitivity and more intrusiveness (Crnic, Ragozin, Greenberg, Robinson, & Basham, 1983; DiVitto & Goldberg, 1979), a recent meta-analysis indicated no consistent differences in maternal responsiveness and sensitivity to preterm infants across 34 studies (Bilgin & Wolke, 2015).

#### *Attachment*

Because of prolonged stays in the neonatal intensive care unit (NICU), resulting in early parent–infant separations, attachment security has been examined extensively in preterm infants. A 1992 meta-analysis examining the relative contributions of maternal and infant characteristics to attachment found that preterm birth alone was not associated with attachment insecurity (van IJzendoorn, Goldberg, Kroonenberg, & Frenkel, 1992), but subsequent research has demonstrated that preterm birth, in combination with other maternal risk factors (e.g., maternal depressive symptoms), was associated with insecure attachment at 12 months (Poehlmann & Fiese, 2001). In addition, although some researchers have demonstrated an association between preterm birth and distorted maternal representations (Forcada-Guex, Borghini, Pierrehumbert, Ansermet, & Muller-Nix, 2011), other researchers have found no differences in maternal representations between full-term and preterm infants (Korja et al., 2009; Tooten et al., 2014). However, although prematurity was not associated with disrupted maternal representations, disrupted maternal representations were mediated by the quality of interactive behavior to influence infant attachment classification (R. A. Hall et al., 2015).

#### *Attention, Behavior, and Emotional Problems*

Compared to full-term children, children born preterm have an increased risk for attention and

behavior problems in the school-age period, including an increased risk for ADHD, internalizing, and externalizing behavior problems (Bhutta, Cleves, Casey, Cradock, & Anand, 2002), with deficits in attention and executive function also present in adolescence (Rommel et al., 2017). ADHD is the most common behavioral disorder in preterm children, with a 2.64-increased odds of ADHD in preterm children compared to children born full term. Similar to other neurodevelopmental disabilities, the odds of ADHD increases with decreasing gestational age, with 2.1-fold increased odds of treatment for ADHD in children born <28 weeks' gestation (Lindström, Lindblad, & Hjern, 2011). Preterm children, especially those born extremely preterm (<28 weeks' gestation), and ELBW (<1,000 g) are also at increased risk of inattention, anxiety, obsessive-compulsive disorder, thought problems and social difficulties in school age and adolescence (Fevang, Hysing, Markestad, & Sommerfelt, 2016; Samuelsson et al., 2017), with some of these risks persisting into adulthood, especially for children born at earlier gestational ages (Heinonen et al., 2016).

### Caregiving Risks: Psychological Distress Associated with Preterm Birth

#### *Preterm Birth: A Non-Normative Transition to Parenthood*

Concomitant with the preterm birth of the infant is the “preterm birth of the parent.” In *The Motherhood Constellation*, Daniel Stern (1995) described several themes a woman experiences in pregnancy associated with her psychological transformation to motherhood:

1. *Life growth*: Can the mother maintain the life and growth of the baby?
2. *Primary relatedness*: Can the mother authentically emotionally engage with the baby to ensure the baby's psychic development?
3. *Supporting matrix*: Will she know how to create the necessary support systems to support the infant's development?

Preterm birth results in an unexpected disruption of this psychological transition to motherhood. A woman's ability to *maintain the life and growth of the baby* is interrupted when a baby is born prematurely, and the mother is suddenly confronted with her inability to carry a healthy

fetus to term (Kaplan & Mason, 1960). Furthermore, if the mother is faced with the potential loss of the baby, the typically joyful experience of childbirth is then overshadowed by preoccupation with the preterm infant's survival (Pederson, Bento, Chance, Evans, & Fox, 1987). The mother's ability to *emotionally engage with the baby in an authentic manner* may be hampered by feelings of failure and grief over the loss of the healthy baby that she did not deliver, and as the baby's chances for survival become more secure, the mother must resume the process of relating to her new infant, which was previously interrupted by the preterm birth experience. As the infant transitions toward discharge home, the mother is required to *create necessary support systems to ensure the baby's development*, especially for the preterm infant with complex medical needs (Caplan, Mason, & Kaplan, 1965). Because of the unexpected nature of preterm birth, and the uncertainties associated with it, the parent is forced to adjust expectations and hopes for the child in the face of medical and developmental uncertainties, and to mourn the “hoped-for child” while still embracing the child who was born (Emde, 1978; Stengel, 1982). This unexpected transition to parenthood is often associated with psychological distress.

#### *Maternal Psychological Distress and Preterm Birth*

In the NICU, the psychological distress associated with preterm birth is related to the parents' attempt to cope with a disrupted pregnancy, fears for the infant's survival, violated expectations for a healthy infant, a lack of physical contact with a medically fragile infant, and unexpected medical complications requiring intrusive medical interventions (Davis, Edwards, Mohay, & Wollin, 2003). The distress associated with preterm birth is not confined to the period of NICU hospitalization and can manifest as anxiety, postpartum depression, and posttraumatic stress disorder (PTSD) (Carson, Redshaw, Gray, & Quigley, 2015; Kersting et al., 2004; Shaw et al., 2006), which may have implications in the development of the parent-child relationship and later infant social-emotional development. As such, to optimize the outcomes of the preterm infant, it is also necessary to consider the effects of prematurity on the caregiver and identify areas of caregiver stress and vulnerability.

### ***Maternal Depression and Preterm Birth***

Feelings of depression related to preterm birth are common, with rates as high as 28–40% during the period of NICU hospitalization (Hawes, McGowan, O'Donnell, Tucker, & Vohr, 2016; Miles, Holditch-Davis, Schwartz, & Scher, 2007). The etiology of postpartum depression in mothers of preterm infants is likely multifactorial, and is related to biological and psychosocial elements, including previous maternal mental health history and the stresses associated with the preterm birth and NICU course (Poehlmann, Schwichtenberg, Bolt, & Dilworth-Bart, 2009; Tahirkheli, Cherry, Tackett, McCaffree, & Gillaspay, 2014). Symptoms of depression or distress may lessen over time, but compared to parents of low-risk infants, elevated depression may continue for weeks or months after NICU discharge (O'Brien, Asay, & McCluskey-Fawcett, 1999). It is also important to note that while maternal depressive symptoms and stress can occur following the birth of preterm infant, it is also possible that symptoms may have been present prior to pregnancy. Maternal depressive symptoms are associated with lower cognitive outcomes (McManus & Poehlmann, 2012) and insecure attachment (Poehlmann & Fiese, 2001) in preterm infants, with worse outcomes associated with greater chronicity of maternal depression (Trapolini, McMahon, & Ungerer, 2007).

Because mothers of preterm infants are likely to exhibit high levels of depressive symptoms following the child's birth, Poehlmann and colleagues (2009) examined the association between trajectories of maternal depressive symptoms in the first 2 years following preterm birth, and infant and caregiving factors. In her sample of 181 mother–preterm infant dyads, most mothers demonstrated a decrease in depressive symptoms in the first 2 years after NICU discharge, with decreasing depression trajectories associated with higher levels of family support. Mothers with higher cumulative risks showed less decline in depressive symptoms in the months following the child's birth, with the maternal sociodemographic risks contributing more to the persistence of depressive symptoms than infant medical risk (Poehlmann et al., 2009).

### ***Posttraumatic Stress and Preterm Birth***

Posttraumatic stress or acute stress disorder is also common in parents of preterm infants. While prevalence rates for PTSD have ranged from 1.7 to 9% in community samples (Beck,

Gable, Sakala, & Declercq, 2011), prevalence rates of PTSD in mothers of preterm infants in the NICU have ranged from 23 to 28% (Shaw et al., 2006). Many factors contribute to the traumatic stress associated with preterm birth. Across studies, parental traumatic stress is related to feelings of uncertainty regarding the infant's medical condition, experiences of alienation in the medically intrusive NICU environment, and feelings of being an “outsider” in the care of the infant, contributing to feelings of powerlessness (Latva, Korja, Salmelin, Lehtonen, & Tamminen, 2008; Obeidat, Bond, & Callister, 2009). Similarly, in a sample of 133 very preterm (VPT) infants, Woodward and colleagues (2014) found that for parents, some of the most stressful aspects of the NICU experience are physical separation of the parent from the infant, the perceived loss of parental role, and the feelings of helplessness in being unable to protect their infant from pain and painful procedures. These identified sources of stress for parents in the perinatal period have helped to inform the development of family-centered care and family-focused NICU interventions (described below) to better support parents in their adaptation to preterm birth.

### ***Maternal Resolution of Grief and Preterm Birth***

Feelings of loss and grief following preterm birth are well described and may persist for months after the infant's NICU discharge (Kaplan & Mason, 1960; Macey, Harmon, & Easterbrooks, 1987). The degree to which a mother can resolve feelings of grief and loss surrounding the premature delivery is thought to impact the mother–child relationship and may have implications for children's emerging attachment relationships. For example, Shah, Clements, and Poehlmann (2011) assessed 74 preterm infants and their mothers; the Reaction to Preterm Birth Interview (adapted from the Reaction to Diagnosis Interview) and maternal parenting quality were assessed when infants were 9 months' corrected age, and the Strange Situation was conducted when infants were 16 months' corrected age. One-third of mothers were classified as having unresolved grief regarding the premature birth. Controlling for covariates, maternal feelings of unresolved grief were associated with insecure infant–mother attachment at 16 months. If a mother had “unresolved grief” at 9 months, the infant was 2.94 times more likely to have insecure attachment at 16 months. Resolution of grief and interaction

quality were independent predictors of attachment security (Shah et al., 2011).

### **Maternal Psychological Distress and the Quality of Early Dyadic Interactions**

Parent–infant dyads who began their relationships under the stressful circumstances the NICU may continue to experience greater interactive difficulty than those who did not experience this difficult beginning (Muller-Nix et al., 2004). Premature birth and the subsequent NICU hospitalization may affect parental perceptions and attitudes, thereby distorting normal parent–child interactions and relationships (Poehlmann et al., 2011). Even after the infant leaves the hospital, the transition from hospital to home is a potentially stressful time for parents of preterm infants, as parents must assume total responsibility for an infant whose care has been previously managed primarily by others. In this transition, mothers of preterm infants often show symptoms of depression and anxiety (Poehlmann et al., 2009; Voegtline & Stifter, 2010), which is a risk factor for suboptimal early dyadic interactions (Muller-Nix et al., 2004; Singer et al., 2003). In a sample of 72 infants (47 preterm, gestational age [GA] <34 weeks), Muller-Nix and colleagues (2004) found that mothers of high-risk infants and mothers with perinatal traumatic stress were less sensitive and more controlling in 6-month dyadic interactions, with infants experiencing more “controlling” patterns of dyadic interaction manifesting more behavior and eating problems at 18 months (Forcada-Guex, Pierrehumbert, Borghini, Moessinger, & Muller-Nix, 2006). In a follow-up study with this cohort, an intervention targeting maternal posttraumatic stress symptoms resulted in lowered maternal stress symptoms and enhanced maternal sensitivity in dyadic interactions (Borghini et al., 2014). Taken together, this research suggests that while perinatal grief, distress, and trauma are common in mothers of preterm infants and associated with risks to the parent–child relationship, these areas of vulnerability may also serve as a focus for interventions to promote resilience.

### **Resilience in Preterm Infants**

Because prematurity is associated with myriad risks and adverse outcomes, much of the literature focusing on children born preterm and their families has been problem-focused and

oriented toward psychopathology. However, because heterogeneity in the outcomes of children born preterm is the rule rather than the exception, research is needed to elucidate the processes by which some, or even most, children born preterm do well, whereas others do not. Understanding who, when, and why some preterm children thrive is critical for informing interventions to assist those preterm children who are struggling, and a resilience framework provides the tools for studying these processes among children born preterm.

### **Fostering Resilience through the Caregiving Context**

Parent–child interaction quality is a robust predictor of developmental competence and problems for infants born preterm, including emerging self-regulation (Clark, Woodward, Horwood, & Moor, 2008) cognitive skills (Smith, Landry, & Swank, 2006; Treyvaud et al., 2016), behavior problems (Poehlmann et al., 2011), academic achievement (Jaekel, Pluess, Belsky, & Wolke, 2015), and resilience at school age (Poehlmann-Tynan et al., 2015). Parenting interactions that are characterized by greater synchrony, warmth, and sensitivity have been associated with more optimal neurodevelopment, social–emotional competence, and greater resilience (Treyvaud et al., 2009, 2012).

### **Prematurity and Differential Susceptibility to Caregiving**

Within the population of preterm infants, there is emerging evidence that certain characteristics render preterm infants differentially susceptible to the effects of the early caregiving environment. Differential susceptibility is grounded in an evolutionary framework and considers that some children, because of genetic or other biological characteristics, are more *adversely* affected by *negative* caregiving environments, and conversely, are more *positively* affected by *supportive* caregiving environments (Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007). Temperamental reactivity (e.g., proneness to distress) has been examined as a potential susceptibility factor to variations in caregiving. In their sample of 153 preterm infant dyads, Poehlmann and colleagues (2011) found that maternal positive affect was associated with higher delay of gratification at 24 months ( $\beta = 0.48, p < .01$ ) in infants with high levels of proneness to distress, but not in

infants with low levels of proneness to distress (beta = 0.08,  $p = .51$ ). In addition, variations in intrusive, anxious parenting behaviors at 9 months were related to effortful attention at 24 months, when infants were rated as high in difficulty (beta = 0.45,  $p < .01$ ) but not at low levels of difficulty (beta = -0.12,  $p = .38$ ), and more intrusive, anxious parenting behaviors were related to toddler internalizing behavior problems at high levels of infant distress (beta = -0.34,  $p < .05$ ), but not at low levels of infant distress (beta = -0.07,  $p = .55$ ) (Poehlmann, Schwichtenberg, Schlafer, Bianchi, & Friberg, 2007). At 36 months, infants who were more prone to distress also exhibited more externalizing problems if they experienced more critical parenting at 9 months (beta = -0.20,  $p < .05$ ) but fewer externalizing problems with more positive parenting. Similarly, variations in maternal positive affect (beta = 0.25,  $p < .01$ ) and intrusive behaviors (beta = 0.23,  $p < .05$ ) at 9 months predicted 36-month cognition at high but not low levels of infant temperamental distress (Poehlmann et al., 2012).

Several more recent studies have examined whether the degree of prematurity could also be a susceptibility factor, with better outcomes in environments with more optimal parenting and worse outcomes in the context of more negative parenting. Shah, Robbins, Coelho, and Poehlmann (2013) found that cognitive outcomes of very preterm infants appeared to be differentially susceptible to parenting effects compared with infants born late preterm. Very preterm infants had higher IQs at 36 months in the context of less negative parenting, but lower IQs at 36 months in the context of more negative parenting, (beta = 0.406,  $p = .01$ ), with no differential effects of parenting observed in late preterm infants (beta = 0.148,  $p = .381$ ).

Gueron-Sela, Atzaba-Poria, Meiri, and Marks (2015) similarly examined the potential moderating role of the caregiving environment on the cognitive and social-emotional outcomes of preterm infants compared with full-term infants. Preterm infants who were exposed to high maternal stress or low-quality interactions (e.g., “suboptimal caregiving”) at 6 months demonstrated the lowest social competence at 12 months, whereas preterm infants who were exposed to low maternal stress or high-quality interactions (e.g., “more optimal caregiving”) demonstrated the highest social competence at 12 months, consistent with the differential-susceptibility model. Interestingly, prematurity

acted as a risk factor in infants’ cognitive development at 12 months, with infants born prematurely manifesting lower cognitive development in the context of more maternal distress compared with infants born full term, but no cognitive advantage in the context of low maternal distress, consistent with the stress-diathesis model (Gueron-Sela et al., 2015). These studies, taken together, suggest that infant outcomes are either directly or differentially influenced by the quality of early caregiving, which suggests that intervention efforts should consider opportunities to support the caregiver-preterm infant dyad, especially across the NICU-to-home transition.

### **Interventions to Support the Parent-Infant Dyad and Holistic Care of the Preterm Infant**

#### ***Organizational Interventions: Transition to Single-Family Rooms in the NICU***

Recently, environmental design standards that support family presence have been promoted in the reorganization of many NICUs (White, Smith, Shepley, & Committee to Establish Recommended Standards for Newborn ICU Design, 2013). These designs represent a shift from large, open bays with multiple babies in close proximity to one another, to single-family rooms (Lester et al., 2014), with the eventual aim of promoting “couplet care,” in which the family can reside in one family room for the entire intensive care experience (Ortenstrand et al., 2010). The transition to single-family rooms aimed to protect the infant from intrusive environmental stimuli, while also providing opportunities to facilitate round-the-clock family presence (Kuhn et al., 2013; Santos, Pearce, & Stroustrup, 2015). In addition to the transition to single-family rooms, some intensive care units have instigated a “neuroprotective” approach, emphasizing developmentally appropriate care during the sensitive periods of rapid brain development. This approach emphasizes partnering with families to promote supportive positioning and handling, safeguarding sleep, minimizing stress and pain, protecting skin, and optimizing nutrition to foster a “healing environment” in the NICU.

#### ***Evidence-Based NICU Interventions***

Several NICU interventions have been developed to target infant regulation and the quality



of the early caregiving relationship. The most widely studied interventions include Kangaroo Care (KC), the Newborn Individualized Developmental Care and Assessment Program (NIDCAP), and the Family Nurture Intervention (FNI).

KC (also referred to as skin-to-skin care), one of the most commonly instituted NICU interventions, is designed to promote early co-regulation and relationships between the parent and baby. KC is an evidence-based practice that has been increasingly promoted for term, typically developing, and high-risk newborns (Boundy et al., 2015). Early studies on KC have demonstrated short-term benefits in survival, neurodevelopment, breastfeeding duration, and early maternal–infant bonding (N. Charpak, Ruiz-Pelaez, Figueroa, & Charpak, 2001; Tessier et al., 2003). A recent randomized controlled trial (RCT) evaluated the effects of KC into early adulthood and found social and behavioral protective effects. Parents experiencing KC were noted to be more protective and nurturing, and children experiencing KC manifested decreased externalizing and socially deviant behavior in early adulthood (Charpak et al., 2016).

NIDCAP, an evidence-based approach to individualized developmental caregiving in the NICU, is designed to identify both what is supportive and regulating, and what is disruptive to infant neurodevelopment, and it provides suggestions for strategies to enhance the infant's neurobehavioral organization. Numerous studies have demonstrated significant positive medical, neurodevelopmental, and social–emotional short- and long-term outcomes as a result of implementation of the NIDCAP program (Als et al., 1994, 2003; Westrup, Bohm, Lagercrantz, & Stjernqvist, 2004).

The FNI (Welch et al., 2014) promotes early holding interaction between the mother and the baby, emphasizing an emotional exchange to foster dyadic coregulation (Hane et al., 2015; Welch et al., 2012). Outcomes studies of the FNI approach have demonstrated benefits to infant behavioral regulation and brain organization, and enhanced maternal–infant connectivity and less postpartum depression (Welch et al., 2013, 2014). The aforementioned programs and approaches have been shown to enhance infant, parent, and dyadic co-regulation, and to foster parent–infant relationships and interactions, consistent with infant mental health principles and practice.

## **The Role of Infant Mental Health in the Care of the Preterm Infant**

Infants who begin their lives in an NICU often have challenges to their early regulation, as well as later cognitive, social, and emotional development. Based on outcome evidence that demonstrates the importance of and contributions to early secure and nurturing relationships with a primary caregiver, it is evident that an emphasis on supporting strong parent–infant relationships should begin as early as possible. Infant mental health is an emerging field that emphasizes prevention, promotion, intervention, and treatment in support of early mental health and social–emotional development using a relationship-based, reflective stance (Browne, Martinez, & Talmi, 2016). As a foundation, infant mental health promotes the idea of optimal infant/child social–emotional development in the context of healthy relationships with caregivers (Zeanah & Zeanah, 2001). Infant mental health work in the NICU is multidisciplinary, focusing on support for infants, families, and staff, with the primary goal of fostering nurturing relationships between the infant and primary caregivers (typically the parents). The second, but equally important, goal is to support the professional staff through the practice of reflective consultation, and to aid them in implementing practices and procedures to enhance opportunities for ongoing social and emotional development (Lorrain, 2016).

### ***The Role of an Infant Mental Health Specialist in Supporting Parental Adaptation to Preterm Birth***

Parents who unexpectedly find themselves in an NICU after a high-risk birth are known to experience myriad stressful events that may contribute to the development of postpartum depression, anxiety, and PTSD, which can serve as a source of challenge in the early dyadic relationship. These inherent vulnerabilities in the preterm infant–caregiver relationship provide a natural opportunity to incorporate the role of an infant mental health clinician in the holistic care of the preterm infant. Much of infant mental health work in hospital NICUs focuses on supporting early relationship development using a reflective approach. While the infant is in the NICU, the infant mental health clinician can provide support to parents in their psychological adjustment and coping with a medically fragile infant, and is well positioned to advo-

cate for appropriate resources and systems integration of mental health support for families (Hall et al., 2015; Hyman & Hall, 2015). Based on the needs of the family, the role of the infant mental health clinician in the NICU may be individualized and may include administering and interpreting screening and assessment measures, providing basic mental health intervention, and, when appropriate, referring parents to other community mental health resources. As the practice of infant mental health centers on fostering the development of the early relationship, the infant mental health clinician can assist parents in fostering their infant's regulation in the NICU, emphasizing the organizing effects of the parent–infant relationship. As the infant continues to develop organization around these functional areas, the infant mental health clinician can also be sure that there are referrals for continuing support around these areas as the family transitions home.

The infant mental health clinician can also facilitate a parent's involvement in the care of the preterm infant while in the NICU, and can identify barriers to parent engagement. The infant mental care professional can create opportunities to ensure that the parents receive current and frequent communication about the baby, and promote opportunities for the parents to feel included in decision making about their infant's care. In addition, there has been increasing emphasis on the role of “parental resilience resources” to help families better cope with the challenges of having an infant in the NICU. They include a variety of strategies that involve coping, spiritual beliefs, personality traits, and social supports. The infant mental health clinician who can identify, capitalize on, and provide insight into parent resilience resources not only facilitates parental and family coping but also assists professional staff in understanding how best to identify and support a family's strengths, and facilitate their engagement and involvement in their infant's care (Browne et al., 2016).

### ***Collaborative Care: The Role of the Infant Mental Health Specialist in Supporting the NICU Staff***

Using a reflective stance, the infant mental health clinician can also provide support to the professional staff that allows the integration of challenging events experienced by infants, families, and members of the medical team. While the NICU care of the preterm infant is a well-

scribed source of trauma for parents, it may also be a source of trauma for NICU providers. The NICU staff members must often participate in invasive and hurtful but necessary procedures, or bear witness to infant death and the family's related grieving, which over time, can take a toll on the professionals' work and personal lives. Through the practice of reflective consultation, the infant mental health clinician can help staff members reflect on their own experiences of stress, vulnerability, and their need for support in their professional role (Lorrain, 2016). This collaborative partnership can help facilitate the crucial “parallel process” necessary for infant mental health practice, whereby the infant mental health clinician helps the NICU providers express the thoughts, feelings, and experiences that emerge from their intimate infant–parent encounters, especially in the context of stressful NICU events. In doing so, the infant mental health clinician serves as source of reassurance, support, and encouragement for the NICU provider, thereby acting as a “safe base” for the provider, who can then serve as a “safe base” for the parent, so that the parent can then be a “safe base” for the infant (Weatherston & Browne, 2016). This reflective stance and the elements of reflective practice can be woven into interventions and supports that bridge the transition from the hospital to home.

### ***The Role of an Infant Mental Health Specialist in Facilitating the Transition Discharge to Home***

For families who are leaving the NICU or other intensive care and going home with their child, the transition is often accompanied by intense and complex emotions. While NICU discharge readiness for infants reflects attainment of physiological maturity, “discharge readiness” for parents is defined as the masterful attainment of technical skills and knowledge, emotional comfort, and confidence with infant care at the time of discharge. Discharge preparation for the parents is the process of facilitating comfort and confidence, as well as the acquisition of knowledge and skills to successfully transition home. A comprehensive approach to discharge/transition planning that includes psychosocial support and a focus on the caregiver–child relationship offers families the support they need at a potentially vulnerable time in their lives (Murch & Smith, 2016). An infant mental health clinician can play an instrumental role in facilitating the transition to home by identify-

ing resources and facilitating referrals to appropriate community-based supports. These supports may include referrals to early intervention programs, community infant mental health supports, home visiting, and ongoing developmental care in a neonatal follow-up clinic for high-risk infants. Infant mental health clinicians who practice in both intensive care and home- and community-based settings have an opportunity to serve as a “bridge of continuity,” and can be a valuable source of support for high-risk infants and their families in the transition from the NICU to home.

## Conclusions

Application of infant mental health principles into the NICU is necessary to design and deliver high-quality care to high-risk infants, their families, and the professionals who work with them. Infant mental health professionals are well positioned to promote prevention and intervention approaches that encompass optimal infant, family, and staff experiences. An infant mental health focus in the NICU should address parent mental health issues resulting from intensive care, paying special attention to traumatic events that may have occurred before pregnancy, during the birth, and the continuum to home. Such adverse factors have been shown to influence the infant and caregiver relationship and resulting well-being. As such, a relationship-focused approach, both in the NICU and beyond, can help facilitate the parent’s adaptation to preterm birth and provide the relational “holding environment” (Winnicott, 1963) necessary to foster resilience in infants born preterm.

## REFERENCES

- Allen, M. C., Cristofalo, E. A., & Kim, C. (2011). Outcomes of preterm infants: Morbidity replaces mortality. *Clinics in Perinatology*, 38(3), 441–454.
- Als, H., Gilkerson, L., Duffy, F. H., McAnulty, G. B., Buehler, D. M., Vandenberg, K., et al. (2003). A three-center, randomized, controlled trial of individualized developmental care for very low birth weight preterm infants: Medical, neurodevelopmental, parenting, and caregiving effects. *Journal of Developmental and Behavioral Pediatrics*, 24(6), 399–408.
- Als, H., Lawhon, G., Duffy, F. H., McAnulty, G. B., Gibes-Grossman, R., & Blickman, J. G. (1994). Individualized developmental care for the very low-birth-weight preterm infant: Medical and neuro-functional effects. *Journal of the American Medical Association*, 272(11), 853–858.
- American College of Obstetricians and Gynecologists. (2013). Medically indicated late-preterm and early-term deliveries (ACOG Committee Opinion No. 560). *Obstetrics and Gynecology*, 121, 908–910.
- Beck, C. T., Gable, R. K., Sakala, C., & Declercq, E. R. (2011). Posttraumatic stress disorder in new mothers: Results from a two-stage U.S. national survey. *Birth*, 38(3), 216–227.
- Beck, S., Wojdyla, D., Say, L., Betran, A. P., Merialdi, M., Requejo, J. H., et al. (2010). The worldwide incidence of preterm birth: A systematic review of maternal mortality and morbidity. *Bulletin of the World Health Organization*, 88, 31–38.
- Behrman, R. E., & Butler, A. S. (Eds.). (2007). *Preterm birth: Causes, consequences, and prevention*. Washington, DC: National Academies Press.
- Belsky, J., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). For better and for worse: Differential susceptibility to environmental influences. *Current Directions in Psychological Science*, 16(6), 300–304.
- Bhutta, A. T., Cleves, M. A., Casey, P. H., Cradock, M. M., & Anand, K. J. S. (2002). Cognitive and behavioral outcomes of school aged children who were born preterm. *Journal of the American Medical Association*, 288(6), 728–737.
- Bilgin, A., & Wolke, D. (2015). Maternal sensitivity in parenting preterm children: A meta-analysis. *Pediatrics*, 136(1), e177–e193.
- Blencowe, H., Cousens, S., Oestergaard, M. Z., Chou, D., Moller, A. B., Narwal, R., et al. (2012). National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: A systematic analysis and implications. *Lancet*, 379, 2162–2172.
- Borghini, A., Habersaat, S., Forcada-Guex, M., Nessi, J., Pierrehumbert, B., Ansermet, F., et al. (2014). Effects of an early intervention on maternal post-traumatic stress symptoms and the quality of mother–infant interaction: The case of preterm birth. *Infant Behavior and Development*, 37(4), 624–631.
- Boundy, E. O., Dastjerdi, R., Spiegelman, D., Fawzi, W. W., Missmer, S. A., Lieberman, E., et al. (2015). Kangaroo mother care and neonatal outcomes: A meta-analysis. *Pediatrics*, 137(1). [Epub ahead of print]
- Boyle, E. M., Poulsen, G., Field, D. J., Kurinczuk, J. J., Wolke, D., Alfirevic, Z., et al. (2012). Effects of gestational age at birth on health outcomes at 3 and 5 years of age: Population based cohort study. *British Medical Journal*, 344, e896.
- Browne, J. V., Martinez, D., & Talmi, A. (2016). Infant Mental Health (IMH) in the Intensive Care Unit: Considerations for the infant, the family and the staff. *Newborn and Infant Nursing Reviews*, 16(4), 274–280.
- Caplan, G., Mason, E. A., & Kaplan, D. M. (1965). Four

- studies of crisis in parents of prematures. *Community Mental Health Journal*, 1(2), 149–161.
- Carson, C., Redshaw, M., Gray, R., & Quigley, M. A. (2015). Risk of psychological distress in parents of preterm children in the first year: Evidence from the UK Millennium Cohort Study. *BMJ Open*, 5(12), e007942.
- Chang, H. H., Larson, J., Blencowe, H., Spong, C. Y., Howson, C. P., Cairns-Smith, S., et al. (2013). Preventing preterm births: Analysis of trends and potential reductions with interventions in 39 countries with very high human development index. *Lancet*, 381, 223–234.
- Charpak, N., Ruiz-Pelaez, J. G., Figueroa, C. Z., & Charpak, Y. (2001). A randomized, controlled trial of kangaroo mother care: Results of follow-up at 1 year of corrected age. *Pediatrics*, 108(5), 1072–1079.
- Charpak, N., Tessier, R., Ruiz, J. G., Hernández, J., Uriza, F., Villegas, J., et al. (2016). Twenty-year follow-up of Kangaroo Mother Care versus traditional care. *Pediatrics*, 139(1). [Epub ahead of print]
- Clark, C., Woodward, L., Horwood, L., & Moor, S. (2008). Development of emotional and behavioral regulation in children born extremely preterm and very preterm: Biological and social influences. *Child Development*, 79(5), 1444–1462.
- Crnic, K. A., Ragozin, A. S., Greenberg, M. T., Robinson, N. M., & Basham, R. B. (1983). Social interaction and developmental competence of preterm and full-term infants during the first year of life. *Child Development*, 54(5), 1199–1210.
- Davidoff, M., Dias, T., Damus, K., Russell, R., Bettegowda, V., Dolan, S., et al. (2006). Changes in the gestational age distribution among US singleton births: Impact on rates of late preterm birth, 1992 to 2002. *Seminars in Perinatology*, 30(1), 8–15.
- Davis, L., Edwards, H., Mohay, H., & Wollin, J. (2003). The impact of very premature birth on the psychological health of mothers. *Early Human Development*, 73(1–2), 61–70.
- DiVitto, B., & Goldberg, S. (1979). The effects of newborn medical status on early parent–infant interaction. In T. M. Field, A. M. Sostek, S. Goldberg, & H. H. Shuman (Eds.), *Infants born at risk* (pp. 311–332). Jamaica, NY: Spectrum.
- Emde, R. (1978). Adaptation to the birth of a Down's syndrome infant: Grieving and maternal attachment. *Journal of the Academy of Child and Adolescent Psychiatry*, 17, 299–323.
- Eryigit-Madzwamuse, S., Baumann, N., Jaekel, J., Bartmann, P., & Wolke, D. (2015). Neuro-cognitive performance of very preterm or very low birth weight adults at 26 years. *Journal of Child Psychology and Psychiatry*, 56(8), 857–864.
- Fevang, S. K., Hysing, M., Markestad, T., & Sommerfelt, K. (2016). Mental health in children born extremely preterm without severe neurodevelopmental disabilities. *Pediatrics*, 137(4). [Epub ahead of print]
- Forcada-Guex, M., Borghini, A., Pierrehumbert, B., Ansermet, F., & Muller-Nix, C. (2011). Prematurity, maternal posttraumatic stress and consequences on the mother–infant relationship. *Early Human Development*, 87(1), 21–26.
- Forcada-Guex, M., Pierrehumbert, B., Borghini, A., Moessinger, A., & Muller-Nix, C. (2006). Early dyadic patterns of mother–infant interactions and outcomes of prematurity at 18 months. *Pediatrics*, 118, 107–114.
- Frey, H. A., & Klebanoff, M. A. (2016). The epidemiology, etiology, and costs of preterm birth. *Seminars in Fetal and Neonatal Medicine*, 21(2), 68–73.
- Gilbert, W. M., Nesbitt, T. S., & Danielsen, B. (2003). The cost of prematurity: Quantification by gestational age and birth weight. *Obstetrics and Gynecology*, 102(3), 488–492.
- Greene, J. G., Fox, N. A., & Lewis, M. (1983). The relationship between neonatal characteristics and three-month mother–infant interaction in high-risk infants. *Child Development*, 54(5), 1286–1296.
- Gueron-Sela, N., Atzaba-Poria, N., Meiri, G., & Marks, K. (2015). The caregiving environment and developmental outcomes of preterm infants: Diathesis stress or differential susceptibility effects? *Child Development*. [Epub ahead of print]
- Guy, A., Seaton, S. E., Boyle, E. M., Draper, E. S., Field, D. J., Manktelow, B. N., et al. (2015). Infants born late/moderately preterm are at increased risk for a positive autism screen at 2 years of age. *Journal of Pediatrics*, 166(2), 269–275.
- Hall, R. A., Hoffenkamp, H. N., Tooten, A., Braeken, J., Vingerhoets, A. J., & van Bakel, H. J. (2015). Longitudinal associations between maternal disrupted representations, maternal interactive behavior and infant attachment: A comparison between full-term and preterm dyads. *Child Psychiatry and Human Development*, 46(2), 320–331.
- Hall, S. L., Cross, J., Selix, N. W., Patterson, C., Segre, L., Chuffo-Siewert, R., et al. (2015). Recommendations for enhancing psychosocial support of NICU parents through staff education and support. *Journal of Perinatology*, 35(Suppl. 1), S29–S36.
- Hamilton, B. E., Martin, J. A., Osterman, M. J., Curtin, S. C., & Matthews, T. J. (2015). Births: Final data for 2014. *National Vital Statistics Report*, 64(12), 1–64.
- Hane, A. A., Myers, M. M., Hofer, M. A., Ludwig, R. J., Halperin, M. S., Austin, J., et al. (2015). Family nurture intervention improves the quality of maternal caregiving in the neonatal intensive care unit: Evidence from a randomized controlled trial. *Journal of Developmental and Behavioral Pediatrics*, 36(3), 188–196.
- Hawes, K., McGowan, E., O'Donnell, M., Tucker, R., & Vohr, B. (2016). Social emotional factors increase risk of postpartum depression in mothers of preterm infants. *Journal of Pediatrics*, 179, 61–67.
- Heinonen, K., Kajantie, E., Pesonen, A. K., Lahti, M., Pirkola, S., Wolke, D., et al. (2016). Common mental disorders in young adults born late-preterm. *Psychological Medicine*, 46(10), 2227–2238.
- Holmstrom, G. E., Kallen, K., Hellstrom, A., Jakobsson,

- P. G., Serenius, F., Stjernqvist, K., et al. (2014). Ophthalmologic outcome at 30 months' corrected age of a prospective Swedish cohort of children born before 27 weeks of gestation: The extremely preterm infants in Sweden study. *JAMA Ophthalmology*, *132*(2), 182–189.
- Hynan, M. T., & Hall, S. L. (2015). Psychosocial program standards for NICU parents. *Journal of Perinatology*, *35*(Suppl. 1), S1–S4.
- Jaekel, J., Pluess, M., Belsky, J., & Wolke, D. (2015). Effects of maternal sensitivity on low birth weight children's academic achievement: A test of differential susceptibility versus diathesis stress. *Journal of Child Psychology and Psychiatry*, *56*(6), 693–701.
- Jaekel, J., & Wolke, D. (2014). Preterm birth and dyscalculia. *Journal of Pediatrics*, *164*(6), 1327–1332.
- Jansen, P. W., Tiemeier, H., Jaddoe, V. W. V., Hofman, A., Steegers, E. A. P., Verhulst, F. C., et al. (2009). Explaining educational inequalities in preterm birth: The generation r study. *Archives of Disease in Childhood: Fetal and Neonatal Edition*, *94*(1), F28–F34.
- Johnson, S., Hollis, C., Kochhar, P., Hennessy, E., Wolke, D., & Marlow, N. (2010). Autism spectrum disorders in extremely preterm children. *Journal of Pediatrics*, *156*(4), 525–531.
- Kaplan, D. M., & Mason, E. A. (1960). Maternal reactions to premature birth viewed as an acute emotional disorder. *American Journal of Orthopsychiatry*, *30*, 539–547.
- Kelly, M. M. (2016). Educational implications of preterm birth: A national sample of 8- to 11-year-old children born prematurely and their full-term peers. *Journal of Pediatric Health Care*, *30*(5), 464–470.
- Kersting, A., Dorsch, M., Wesselmann, U., Lüdorff, K., Withaut, J., Ohrmann, I., et al. (2004). Maternal post-traumatic stress response after the birth of a very low birthweight infant. *Journal of Psychosomatic Research*, *57*, 473–476.
- Kodjebacheva, G. D., & Sabo, T. (2016). Influence of premature birth on the health conditions, receipt of special education and sport participation of children aged 6–17 years in the USA. *Journal of Public Health (Oxf)*, *38*(2), e47–e54.
- Kohn, M. A., Vosti, C. L., Lezotte, D., & Jones, R. H. (2000). Optimal gestational age and birth-weight cutoffs to predict neonatal morbidity. *Medical Decision Making*, *20*(4), 369–376.
- Korja, R., Savonlahti, E., Haataja, L., Lapinleimu, H., Manninen, H., Piha, J., et al. (2009). Attachment representations in mothers of preterm infants. *Infant Behavior and Development*, *32*(3), 305–311.
- Koullali, B., Oudijk, M. A., Nijman, T. A. J., Mol, B. W. J., & Pajkrt, E. (2016). Risk assessment and management to prevent preterm birth. *Seminars in Fetal and Neonatal Medicine*, *21*(2), 80–88.
- Kuhn, P., Zores, C., Langlet, C., Escande, B., Astruc, D., & Dufour, A. (2013). Moderate acoustic changes can disrupt the sleep of very preterm infants in their incubators. *Acta Paediatrica*, *102*(10), 949–954.
- Kuzniewicz, M. W., Wi, S., Qian, Y., Walsh, E. M., Armstrong, M. A., & Croen, L. A. (2014). Prevalence and neonatal factors associated with autism spectrum disorders in preterm infants. *Journal of Pediatrics*, *164*(1), 20–25.
- Latva, R., Korja, R., Salmelin, R. K., Lehtonen, L., & Tamminen, T. (2008). How is maternal recollection of the birth experience related to the behavioral and emotional outcome of preterm infants? *Early Human Development*, *84*(9), 587–594.
- Lawn, J. E., Wilczynska-Ketende, K., & Cousens, S. N. (2006). Estimating the causes of 4 million neonatal deaths in the year 2000. *International Journal of Epidemiology*, *35*(3), 706–718.
- Lester, B. M., Hawes, K., Abar, B., Sullivan, M., Miller, R., Bigsby, R., et al. (2014). Single-family room care and neurobehavioral and medical outcomes in preterm infants. *Pediatrics*, *134*(4), 754–760.
- Limperopoulos, C., Bassan, H., Sullivan, N. R., Soul, J. S., Robertson, R. L., Jr., Moore, M., et al. (2008). Positive screening for autism in ex-preterm infants: Prevalence and risk factors. *Pediatrics*, *121*(4), 758–765.
- Lindström, K., Lindblad, F., & Hjern, A. (2011). Preterm birth and attention-deficit/hyperactivity disorder in schoolchildren. *Pediatrics*, *127*(5), 858–865.
- Liu, L., Oza, S., Hogan, D., Perin, J., Rudan, I., Lawn, J. E., et al. (2015). Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: An updated systematic analysis. *Lancet*, *385*, 430–440.
- Lorrain, B. (2016). Reflective peer consultation as an intervention for staff support in the NICU. *Newborn and Infant Nursing Reviews*, *16*(4), 289–292.
- Lu, M. C., & Chen, B. (2004). Racial and ethnic disparities in preterm birth: The role of stressful life events. *American Journal of Obstetrics and Gynecology*, *191*(3), 691–699.
- Lu, M. C., & Halfon, N. (2003). Racial and ethnic disparities in birth outcomes: A life-course perspective. *Maternal and Child Health Journal*, *7*(1), 13–30.
- Macey, T. J., Harmon, R. J., & Easterbrooks, M. A. (1987). Impact of premature birth on the development of the infant in the family. *Journal of Clinical and Child Psychology*, *55*(6), 846–852.
- March of Dimes. (2014). Prematurity Campaign: 2014 Progress Report. Retrieved from [www.marchofdimes.org/materials/prematurity-campaign-progress-report-2014.pdf](http://www.marchofdimes.org/materials/prematurity-campaign-progress-report-2014.pdf).
- Masho, S. W., Cha, S., Chapman, D. A., & Chelmsow, D. (2017). Understanding the role of violence as a social determinant of preterm birth. *American Journal of Obstetrics and Gynecology*, *216*(2), 183.e181–183.e187.
- McCabe, E. R. B., Carrino, G. E., Russell, R. B., & Howse, J. L. (2014). Fighting for the next generation: US prematurity in 2030. *Pediatrics*, *134*(6), 1193–1199.
- McManus, B. M., & Poehlmann, J. (2012). Parent–child interaction, maternal depressive symptoms and pre-

- term infant cognitive function. *Infant Behavior and Development*, 35(3), 489–498.
- Menon, R. (2008). Spontaneous preterm birth, a clinical dilemma: Etiologic, pathophysiologic and genetic heterogeneities and racial disparity. *Acta Obstetrica et Gynecologica Scandinavica*, 87(6), 590–600.
- Miles, M. S., Holditch-Davis, D., Schwartz, T. A., & Scher, M. (2007). Depressive symptoms in mothers of prematurely born infants. *Journal of Developmental and Behavioral Pediatrics*, 28(1), 36–44.
- Muglia, L. J., & Katz, M. (2010). The enigma of spontaneous preterm birth. *New England Journal of Medicine*, 362(6), 529–535.
- Muller-Nix, C., Forcada-Guex, M., Pierrehumbert, B., Jaunin, L., Borghini, A., & Ansermet, F. (2004). Prematurity, maternal stress and mother–child interactions. *Early Human Development*, 79(2), 145–158.
- Murch, T. N., & Smith, V. C. (2016). Supporting families as they transition home. *Newborn and Infant Nursing Reviews*, 16(4), 298–302.
- Natalucci, G., Bucher, H. U., Von Rhein, M., Borradori Tolsa, C., Latal, B., & Adams, M. (2017). Population based report on health related quality of life in adolescents born very preterm. *Early Human Development*, 104, 7–12.
- Obeidat, H. M., Bond, E. A., & Callister, L. C. (2009). The parental experience of having an infant in the newborn intensive care unit. *Journal of Perinatal Education*, 18(3), 23–29.
- O'Brien, M., Asay, J. H., & McCluskey-Fawcett, K. (1999). Family functioning and maternal depression following premature birth. *Journal of Reproductive and Infant Psychology*, 17(2), 175–188.
- Ortenstrand, A., Westrup, B., Brostrom, E. B., Sarman, I., Akerstrom, S., Brune, T., et al. (2010). The Stockholm Neonatal Family Centered Care Study: Effects on length of stay and infant morbidity. *Pediatrics*, 125(2), e278–285.
- Pederson, D. R., Bento, S., Chance, G. W., Evans, B., & Fox, A. M. (1987). Maternal emotional responses to preterm birth. *American Journal of Orthopsychiatry*, 57(1), 15–21.
- Petrou, S. (2005). The economic consequences of preterm birth during the first 10 years of life. *BJOG: An International Journal of Obstetrics and Gynaecology*, 112(Suppl. 1), 10–15.
- Poehlmann, J., & Fiese, B. H. (2001). The interaction of maternal and infant vulnerabilities on developing attachment relationships. *Development and Psychopathology*, 13(1), 1–11.
- Poehlmann, J., Hane, A., Burnson, C., Maleck, S., Hamburger, E., & Shah, P. E. (2012). Preterm infants who are prone to distress: Differential effects of parenting on 36-month behavioral and cognitive outcomes. *Journal of Child Psychology and Psychiatry*, 53(10), 1018–1025.
- Poehlmann, J., Schwichtenberg, A. J., Bolt, D., & Dilworth-Bart, J. (2009). Predictors of depressive symptom trajectories in mothers of preterm or low birth weight infants. *Journal of Family Psychology*, 23(5), 690–704.
- Poehlmann, J., Schwichtenberg, A. J., Bolt, D. M., Hane, A., Burnson, C., & Winters, J. (2011). Infant physiological regulation and maternal risks as predictors of dyadic interaction trajectories in families with a preterm infant. *Developmental Psychology*, 47(1), 91–105.
- Poehlmann, J., Schwichtenberg, A. M., Schlafer, R., Bianchi, J. P., & Friberg, B. (2007, August). *Emerging self-regulation in high risk infants: Differential susceptibility to parenting?* Paper presented at the annual convention of the American Psychological Association, San Francisco, CA.
- Poehlmann-Tynan, J., Gerstein, E. D., Burnson, C., Weymouth, L., Bolt, D. M., Maleck, S., et al. (2015). Risk and resilience in preterm children at age 6. *Development and Psychopathology*, 27(3), 843–858.
- Poulsen, G., Wolke, D., Kurinczuk, J. J., Boyle, E. M., Field, D., Alfirevic, Z., et al. (2013). Gestational age and cognitive ability in early childhood: A population-based cohort study. *Paediatric and Perinatal Epidemiology*, 27(4), 371–379.
- Putnick, D. L., Bornstein, M. H., Eryigit-Madzwamuse, S., & Wolke, D. (2017). Long-term stability of language performance in very preterm, moderate-late preterm, and term children. *Journal of Pediatrics*, 181, 74–79.
- Quigley, M. A., Poulsen, G., Boyle, E., Wolke, D., Field, D., Alfirevic, Z., et al. (2012). Early term and late preterm birth are associated with poorer school performance at age 5 years: A cohort study. *Archives of Disease in Childhood: Fetal and Neonatal Edition*, 97(3), F167–F173.
- Raju, T. N. K. (2006). Epidemiology of late preterm (near-term) births. *Clinics in Perinatology*, 33(4), 751–763.
- Reagan, P. B., & Salsberry, P. J. (2005). Race and ethnic differences in determinants of preterm birth in the USA: Broadening the social context. *Social Science and Medicine*, 60(10), 2217–2228.
- Rommel, A. S., James, S. N., McLoughlin, G., Brandeis, D., Banaschewski, T., Asherson, P., et al. (2017). Association of preterm birth with attention-deficit/hyperactivity disorder-like and wider-ranging neurophysiological impairments of attention and inhibition. *Journal of the American Academy of Child and Adolescent Psychiatry*, 56(1), 40–50.
- Samuelsson, M., Holsti, A., Adamsson, M., Serenius, F., Hagglof, B., & Farooqi, A. (2017). Behavioral patterns in adolescents born at 23 to 25 weeks of gestation. *Pediatrics*, 140(1), e20170199.
- Santos, J., Pearce, S. E., & Stroustrup, A. (2015). Impact of hospital-based environmental exposures on neurodevelopmental outcomes of preterm infants. *Current Opinion in Pediatrics*, 27(2), 254–260.
- Schieve, L. A., Tian, L. H., Rankin, K., Kogan, M. D., Yeargin-Allsopp, M., Visser, S., et al. (2016). Population impact of preterm birth and low birth weight on

- developmental disabilities in US children. *Annals of Epidemiology*, 26(4), 267–274.
- Shah, P. E., Clements, M., & Poehlmann, J. (2011). Maternal resolution of grief after preterm birth: Implications for infant attachment security. *Pediatrics*, 127(2), 284–292.
- Shah, P. E., Kaciroti, N., Richards, B., & Lumeng, J. C. (2016). Gestational age and kindergarten school readiness in a national sample of preterm infants. *Journal of Pediatrics*, 178, 61–67.
- Shah, P. E., Robbins, N., Coelho, R. B., & Poehlmann, J. (2013). The paradox of prematurity: The behavioral vulnerability of late preterm infants and the cognitive susceptibility of very preterm infants at 36 months post-term. *Infant Behavior and Development*, 36(1), 50–62.
- Shaw, R. J., Deblois, T., Ikuta, L., Ginzburg, K., Fleisher, B., & Koopman, C. (2006). Acute stress disorder among parents of infants in the neonatal intensive care nursery. *Psychosomatics*, 47(3), 206–212.
- Simmons, L. E., Rubens, C. E., Darmstadt, G. L., & Gravett, M. G. (2010). Preventing preterm birth and neonatal mortality: Exploring the epidemiology, causes, and interventions. *Seminars in Perinatology*, 34(6), 408–415.
- Singer, L. T., Fulton, S., Davillier, M., Koshy, D., Salvatore, A., & Baley, J. E. (2003). Effects of infant risk status and maternal psychological distress on maternal–infant interactions during the first year of life. *Journal of Developmental and Behavioral Pediatrics*, 24(4), 233–241.
- Smith, K., Landry, S. H., & Swank, P. R. (2006). The role of early maternal responsiveness in supporting school aged cognitive development for children who vary in birth status. *Pediatrics*, 117, 1608–1617.
- St. John, E. B., Nelson, K. G., Cliver, S. P., Bishnoi, R. R., & Goldenberg, R. L. (2000). Cost of neonatal care according to gestational age at birth and survival status. *American Journal of Obstetrics and Gynecology*, 182(1), 170–175.
- Stengel, T. J. (1982). Infant behavior, maternal psychological reaction, and mother–infant interactional issues associated with the crisis of prematurity: A selected review of the literature. *Physical and Occupational Therapy in Pediatrics*, 2(2/3), 3–24.
- Stern, D. (1995). *The motherhood constellation*. New York: Basic Books.
- Stoll, B. J., Hansen, N. I., Bell, E. F., Shankaran, S., Laptook, A. R., Walsh, M. C., et al. (2010). Neonatal outcomes of extremely preterm infants from the NICHD Neonatal Research Network. *Pediatrics*, 126(3), 443–456.
- Tahirkheli, N. N., Cherry, A. S., Tackett, A. P., McCaffree, M. A., & Gillaspay, S. R. (2014). Postpartum depression on the neonatal intensive care unit: Current perspectives. *International Journal of Women's Health*, 6, 975–987.
- Tessier, R., Cristo, M. B., Velez, S., Giron, M., Nadeau, L., de Calume, Z. F., et al. (2003). Kangaroo Mother Care: A method for protecting high-risk low-birth-weight and premature infants against developmental delay. *Infant Behavior and Development*, 26(3), 384–397.
- Tooten, A., Hall, R. A., Hoffenkamp, H. N., Braeken, J., Vingerhoets, A. J., & van Bakel, H. J. (2014). Maternal and paternal infant representations: A comparison between parents of term and preterm infants. *Infant Behavior and Development*, 37(3), 366–379.
- Trapolini, T., McMahon, C. A., & Ungerer, J. A. (2007). The effect of maternal depression and marital adjustment on young children's internalizing and externalizing behaviour problems. *Child: Care, Health and Development*, 33(6), 794–803.
- Treyvaud, K., Anderson, V. A., Howard, K., Bear, M., Hunt, R. W., Doyle, L. W., et al. (2009). Parenting behavior is associated with the early neurobehavioral development of very preterm children. *Pediatrics*, 123(2), 555–561.
- Treyvaud, K., Doyle, L. W., Lee, K. J., Ure, A., Inder, T. E., Hunt, R. W., et al. (2016). Parenting behavior at 2 years predicts school-age performance at 7 years in very preterm children. *Journal of Child Psychology and Psychiatry*, 57(7), 814–821.
- Treyvaud, K., Inder, T. E., Lee, K. J., Northam, E. A., Doyle, L. W., & Anderson, P. J. (2012). Can the home environment promote resilience for children born very preterm in the context of social and medical risk? *Journal of Experimental Child Psychology*, 112(3), 326–337.
- van Dommelen, P., Verkerk, P. H., & van Straaten, H. L. M. (2015). Hearing loss by week of gestation and birth weight in very preterm neonates. *Journal of Pediatrics*, 166(4), 840–843.
- van IJzendoorn, M. H., Goldberg, S., Kroonenberg, P. M., & Frenkel, O. J. (1992). The relative effects of maternal and child problems on the quality of attachment: A meta-analysis of attachment in clinical samples. *Child Development*, 63(4), 840–858.
- Voegtline, K. M., & Stifter, C. A. (2010). Late-preterm birth, maternal symptomatology, and infant negativity. *Infant Behavior and Development*, 33(4), 545–554.
- Weatherston, D. J., & Browne, J. V. (2016). What is infant mental health and why is it important for high-risk infants and their families? *Newborn and Infant Nursing Reviews*, 16(4), 259–263.
- Welch, M. G., Hofer, M. A., Brunelli, S. A., Stark, R. I., Andrews, H. F., Austin, J., et al. (2012). Family nurture intervention (FNI): Methods and treatment protocol of a randomized controlled trial in the NICU. *BMC Pediatrics*, 12, 14.
- Welch, M. G., Hofer, M. A., Stark, R. I., Andrews, H. F., Austin, J., Glickstein, S. B., et al. (2013). Randomized controlled trial of Family Nurture Intervention in the NICU: Assessments of length of stay, feasibility and safety. *BMC Pediatrics*, 13, 148.
- Welch, M. G., Myers, M. M., Grieve, P. G., Isler, J. R., Fifer, W. P., Sahni, R., et al. (2014). Electroencephalographic activity of preterm infants is increased by Family Nurture Intervention: A randomized con-

- trolled trial in the NICU. *Clinical Neurophysiology*, 125(4), 675–684.
- Westrup, B., Bohm, B., Lagercrantz, H., & Stjernqvist, K. (2004). Preschool outcome in children born very prematurely and cared for according to the Newborn Individualized Developmental Care and Assessment Program (NIDCAP). *Acta Paediatrica*, 93(4), 498–507.
- White, R. D., Smith, J. A., Shepley, M. M., & Committee to Establish Recommended Standards for Newborn ICU Design. (2013). Recommended standards for newborn ICU design, eighth edition. *Journal of Perinatology*, 33(Suppl. 1), S2–S16.
- Winnicott, D. W. (1963). Psychiatric disorder in terms of infantile maturational processes. In *The maturational processes and the facilitating environment* (pp. 230–241). New York: Routledge.
- Wolke, D., Chernova, J., Eryigit-Madzwamuse, S., Samara, M., Zwierynska, K., & Petrou, S. (2013). Self and parent perspectives on health-related quality of life of adolescents born very preterm. *Journal of Pediatrics*, 163(4), 1020–1026.
- Woodward, L. J., Bora, S., Clark, C. A., Montgomery-Honger, A., Pritchard, V. E., Spencer, C., et al. (2014). Very preterm birth: Maternal experiences of the neonatal intensive care environment. *Journal of Perinatology*, 34(7), 555–561.
- Zeanah, C. H., & Zeanah, P. D. (2001). Towards a definition of infant mental health. *Zero to Three*, 22(1), 13–20.