LOW BIRTH-WEIGHT INFANTS AND THE IMPORTANCE OF EARLY INTERVENTION: ENHANCING MOTHER-INFANT INTERACTIONS
A LITERATURE REVIEW

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Introduction

Approximately 7% of all babies in the United States are born with low birth weight (LBW) or less than 2,500 grammes (National Center for Health Statistics, 1993).

In recent years the chances of survival of LBW infants have increased in many countries (Godbole et al., 1997). However, the increasing chance of survival of premature (LBW) babies, of whom some will be faced with developmental delay, means that these countries will be exposed to growing numbers of children requiring special services, such as early intervention strategies, in order to increase the likelihood that these children will reach their normal developmental milestones. LBW babies, especially very low birth weight (VLBW) babies with less than 1,500 grammes, have a high risk of experiencing medical complications, such as intraventricular haemorrhage (IVH) and resulting neurosensory impairment (Blair and Ramey, 1997).

In general, LBW infants may exhibit much more health, neurodevelopmental, psychological and intellectual disabilities than normal birth weight babies.

In the last few decades, as increasing numbers of smaller babies have survived due to technological advances, the need to deal with this array of medical complications has intensified.

While there is a large amount of literature on the medical problems of premature babies, psychological problems have received less attention. However, research suggests that a number of psychological difficulties are associated with prematurity (Chapieski and Evankovich, 1997).

While medical problems are often evidenced in preterm babies at birth and soon after, some of the psychological difficulties that arise in these children may not be clearly seen for a number of years. Some problems may not be identified until a child begins school at the age of five or six, because it is at this time that more rigid demands are placed on children.
(Leonard and Piecuch, 1997). In particular, it is not often until school age that specific learning disabilities are identified. According to Barsky and Siegel (1992) many children who began life with a very low birth weight experience problems when they begin school. As a result, supporting the developmental progress of LBW survivors has been one of the primary goals of developmental science.

**Developmental difficulties**

About 50% of prematurely born children weighing less than 1,500 grammes exhibit developmental problems by preschool age (Holdith-Davis et al., 2000). Low birth weight babies show an increase in later developmental difficulties (Minde, 1993). Nurcombe identified the following disabilities in these infants: specific learning disabilities, visual-motor impairments, lower intelligence quotients, poor perceptual motor skills, speech problems, motor problems causing them to be more clumsy children and physical difficulties2.

Several studies have concluded that intraventricular haemorrhage (IVH) is a risk factor for language delays (Singer et al., 2001). These investigators mention that left ventricular damage in particular may be responsible for the delay in expressive language observed in VLBW infants at 1 to 2 years of age. Vocabulary development and verbal reasoning in 3 year old VLBW children have been related to the presence and severity of IVH.

As noted before, babies with LBW often have medical problems and these may have detrimental effects on the central nervous system (Chapieski and Evankovich, 1997). Although, as a result of advances in neonatal care, most preterm babies will not develop severe physical, emotional and mental handicaps, these babies are at risk of minor handicaps (Ens-Dokkum et al., 1993). In general, preterm children display a greater prevalence of neurological dysfunction and neuropsychological impairment.

In spite of these difficulties for LBW babies, many studies state that newborn babies have millions of normal neurons (Neuberger, 1997). If these neurons are activated and used at the appropriate time, they could compensate these difficulties to a large extent.

**The importance of neural plasticity and critical periods**

The brain’s plasticity, that is its ability to change in important ways in response to experience, presents immense opportunities. We know that there are prime times for optimal development usually known as critical periods or plastic periods (Champion, 1998).

During infancy the human brain is remarkably plastic, largely because compared to other mammals it is at birth relatively underdeveloped (Kolb and Whishaw, 1996). The human infant is born comparatively premature, and during the first year of life its brain along with the rest of its body grows rapidly. This growth is to some extent context dependent, that means it is influenced by environmental factors. The concepts of critical and plastic periods are based on the assumption that neurological development depends on the exposure of the brain to a predictable timetable of developmental experience. Siegel (1999) states that the infant’s first experiences play a major role in brain development. Neural connections are created or strengthened depending on the type and quality of experience. Likewise, a
lack of stimulation may lead to a slowing down or termination of synaptic growth. When there is a disruption of the normal developmental timetable, as in premature birth, neural connections are not made properly. At the time when there are negative experiences or the absence of appropriate stimulation, disorganisation of brain growth is much more likely (Champion, 1998).

It has been well documented from studies of deprivation as well as studies of normal development, that many aspects of perceptual, linguistic, cognitive and social-emotional development are heavily dependent on experience. For example, infants deprived of seeing or hearing the world normally (e.g. those born with strabismus, those born deaf or otherwise deprived of speech and language input) develop vision and language problems (Nelson and Bosquet, 2000). We know that children reared in poverty with few cognitive challenges greatly benefit from early enrichment. Siegel (1999) also discusses the most important aspects of experience in the first few years of life which is, of course, the relationship between baby and caregiver.

**Early intervention**

Early intervention practices for those infants who are born prematurely necessarily involve the dual themes of biological vulnerability and learning to be human (Champion, 1998). Shonkoff (1993) puts early intervention in this way: “Early childhood intervention is a reflection of our compassion for those who are vulnerable and our willingness to invest in the best possible future for all young children. As a science it draws support from the knowledge-base of developmental psychology and neurobiology”.

The significant plasticity of the human brain in the first few years of life suggests that it is important to provide early intervention for children born prematurely. As the brain is still forming during infancy there is tremendous scope for constructive modification. Infancy is a time when new neural connections are constantly being forged; connections which will later be relatively static. Hence it is possible to facilitate neural development through exposure to certain types of stimuli. While much remains to be discovered and understood about the interaction between brain development and early life experience, research to date indicates that particular experiences can modify the effect of prematurity¹. In a study by McCarton et al. (1996), the Infant Health and Developmental Program (IHDP) was designed as a multisite randomised clinical trial evaluating in the first 3 years of life the efficacy of centre-based educational intervention, home-based family support services and paediatric follow-up in reducing cognitive, behavioural and health problems among LBW infants. The cognitive and behavioural outcomes of the IHDP trial at age 3 and 5 years have been reported, as have the health outcomes at the age of 3 years. At the age of 3 years the children in the intervention group had significantly higher intelligence test scores and lower scores on a parental measure of reported behaviour problems than the children in the follow-up only group.

**Development and environment**

Physical health and emotional well-being are inseparable. In addition to good
nutrition children need the social and emotional contact that results from loving relationships with others.

When children are emotionally supported by caring adults, their prospects for learning are enhanced (Boyer, 1991). A caring environment builds emotional maturity and social competence. Such an environment is also consequential to cognitive and language development.

Understanding of the mutual influences between development and its contexts is emerging from many areas of research (McCollum, 2002). For instance, recent brain research indicates that the young brain is heavily influenced by different environmental influences at particular points in its development (Shore, 1997). Thus, whereas adequate nutrition in the mother influences foetal brain development, social interactions shape the brain’s development after birth.

As babies continue to grow, development continues to be influenced by experience. Opportunities, such as responsive caretakers, different people and places, play, communication and social activities, will all influence how the child develops. McCollum and Hemmeter (1997) stress that the parent-child relationship is a particularly important developmental context in which critical foundations continue to be laid for all areas of development.

**Hospital-based programme**

In order not only to ensure survival but also to foster development of the LBW and VLBW preterm babies, they are in need of care available only in the specialised medical-technological environments of new-born intensive care units (NICU) and special care nurseries.

**Sensory stimulation**

Since the 1960s most investigations have been done by providing preterm babies with less or extra sensory stimulation via different sensory modalities. The goal of these investigations has been to determine the effect of environmental manipulations on the behaviour and development of preterm babies (Cornell and Gottfried, 1976). Supplemental stimulation is usually applied as soon as possible after birth. The stimuli either try to mimic the stimulation in the womb (i.e. heartbeat sounds) or of the extra-uterin world (see Field, 1980). Supplemental programmes have focused on unimodal sensory stimulation, such as extra sensory suck stimulation during tube-feeding or during painful procedures (Bernbaum et al., 1983), extra tactile stimulation provided to preterm infants ranging from bedding on lambskin (Scott et al., 1983), to nursing in hammocks (Helders, 1989), baby massages by gentle human touch provided by nursing staff and/or mothers (Jay, 1982), extra
auditory stimulation, including the plying of mother’s or any woman’s voice to heartbeat (Malloy, 1979) and added vestibular stimulation by the use of extra rocking, most frequently provided by oscillating waterbeds (e.g. Barnard and Bee, 1983).

However, there is a mismatch between the type, intensity and patterning of the stimulation in neonatal intensive care units (e.g. handling, noise, light levels, social contacts) and the infant’s developmental status. Different types of interventions, ranging from supporting the infant’s state (including pacifying) and graded arousing and social stimulation, are appropriate at different stages of the LBW infant’s development in hospital (Wolke, 1987).

In general, an individual care approach, educating nurses and parents on how to contain and promote the individual infant’s behavioural organisation (sleep - wake), appears to be the most promising approach for direct developmental support of LBW infants in hospital.

The NICU is technically advanced, but not enough for the baby to grow properly. The role of environment is crucial for brain development. The environment influences the development of the foetal brain through the various senses of the infant - the visual, auditory, cutaneous, tactile, somathetic, kinesthetic, olfactory and gustatory senses (Als, 1997). Therefore, before and after discharge from the NICU the mother-infant bonding has to be established and encouraged.

Mother-infant transition programme (MITP)

In the mother-infant transition programme Nurcombe et al. 1984 teaches mothers to interact more effectively with their infants. This programme was designed to optimise caregiving interactions by enhancing the mother’s adjustment to her low birth weight infant.

The stated aims are to enable the mother to appreciate her infant’s specific behavioural and temperamental characteristics; to sensitise her to the infant’s cues, especially those that signal overload, distress and readiness for interaction; to teach her to respond appropriately to those cues which facilitate mutually satisfying interaction.

The MITP utilised an in-NICU 7 day teaching programme in preparation for discharge. After an introductory overview of the project on day 1, the intervention focused on one behavioural subsystem per day and then addressed the implications of that subsystem’s functioning for daily caregiving and structuring of care and for transition to going home. Each session lasted 1 hour, and the programme was presented as follows:

Day 1 - the introduction of the project
Day 2 - the autonomic system
Day 3 - the motor system
Day 4 - the state regulation system
Day 5 - the social interaction system
Day 6 - integration of the system for daily care
Day 7 - preparing to go home

The sequence was followed by home visits at 3 days postdischarge for consolidation, at 3 weeks to enhance mutual enjoyment through play, at 1 month to assess temperamental patterns and at 3 months for review and termination of the project (Rauh et al., 1990).
**Enhancing interactions between mother and premature baby**

The child is an active participant in the social environment, constantly changing this environment at the same time he or she is being influenced by the mother-child relationship and the rest of the social environment. The child’s development status, therefore, is caused by the reciprocal relationship of the child and the social-environment system. Holditch-Davis *et al.* (2000) state that mothers who are not responsive to their children will not provide adequate stimulation for optimal cognitive maturation, and children with developmental delays are less likely to be satisfactory social partners.

The developmental tasks of the infant baby provide the context for parenting. During the first months of life an infant is learning to regulate all body systems. He/she is learning how to process the environment (e.g. sights, sounds, textures, smells) as well as how to regulate reactions to the environment. Learning to become soothed when comforted is an important developmental milestone (Greenspan and Lourie, 1981).

Barnard *et al.* (1985) suggest that the parent’s tasks during these early months are to recognise and respond to the cues the baby gives. Knowing the pattern of nonverbal communication cues, sleep-wake organisation, the way babies interact with their environment and the meaning of crying are all important in the first month of life. Physical contact with the baby, such as carrying the baby in a soft infant carrier, promotes immediate responses to the infant’s changes in activity. Crying behaviour is thus reduced, and the infant’s need for responsive caregiving is addressed.

Many studies with preterm infants suggest that parents who can understand their infant’s way of organising and communicating are much more likely to enjoy parenting and responding to the infants in a sensitive and growth-fostering manner. Simple questions to parents about when they think babies hear, see and are ready to learn reveal that, when parents believe babies can engage in the environment, their behaviour toward their infants becomes more responsive and growth-enhancing (Snyder *et al.*, 1979).

While many researchers often centre on direct stimulation of LBW infants in order to improve the lives of these babies, improvement of the situation of the caregivers is also very important.

Home visits by a nurse and occupational therapist, teaching the mother about infant development and instructing her in games, could lead to enhancement of interaction between mother and LBW baby. Two clinical studies of home monitoring and teaching programmes which commenced shortly after discharge of the infants from hospital reported positive effects on the preterm infants’ development (Barnard *et al.*, 1987).

Parker *et al.* (1992) provided an intervention to the mothers of 26 LBW preterm infants. The intervention of this study was to teach mothers to observe and to contingently and appropriately respond to their infants developmental needs. This was accomplished by direct instruction by an infant development specialist in weekly meetings. Results from this study are for the most part positive with intervention effects for mental development and mother-child interaction, and were obtained in comparisons with randomly assigned LBW preterm controls.

In general, these studies showed that integrated intervention approaches, combining sensory stimulation in the neonatal intensive care unit with parent centred interventions in hospital and continuing
Conclusion

From this review it should be clear that progress in medical technology and neonatal intensive care is responsible for survival of many LBW premature babies in recent years. In addition, it is important not only to ensure survival, but also to foster best development of this increasing population.

Since prenatal and perinatal complication (e.g. neonatal cerebral haemorrhages) occurring in preterm babies might constitute a potential risk to brain development, one might expect these babies to have more problems in the area of learning, behaviour, cognition, language, sensory-motor and neuropsychological development later in life. Therefore, these babies will be at risk for developmental delays. Coupled with this, premature infants are particularly vulnerable to the effects of psychosocial deprivation (i.e., poor mother-child interaction).

According to Barnard et al. (1993) preterm infants are at higher risk for developmental disabilities than are full-term infants. An early difficulty is the poor quality of parent-child interaction. Three factors are thought to relate to this problem. First, preterm infants are generally more unresponsive and/or irritable. Second, parents lack the knowledge to compensate for the infants’ lack of organisation and responsiveness and third, some parents lack the resources or are too overwhelmed by the preterm birth to pay close attention to their infant’s developmental needs. Hence, giving attention to LBW babies’ development is very crucial.

One implication of this review is the assumption that, like most other children, the LBW babies are more likely to benefit from a supportive environment. Therefore, mothers may need nursing support to maintain a high level of positive interaction with the baby and to provide appropriate stimulation to foster sensory-motor, language, social, emotional and behaviour growth. Early intervention programmes seem to be advisable for these mothers and their babies. Intervention programmes for LBW babies typically provide a supplemental stimulation for the neonate. Teaching the mother exercises and age-appropriate stimulation to facilitate development of premature babies have been proven to be effective.

Footnotes


Summary

Although low birth weight (LBW) babies are not an homogeneous group and therefore not at an equal risk for developmental delays, research evidence shows that they are vulnerable to medical complications, such as neurological dysfunction and other neurodevelopmental problems. In addition, by school age LBW
children are at increased risk of having learning and behavioural problems.

Therefore, to prevent medical complications and later developmental delays, LBW babies might need intensive care in order to compensate medical problems along with proper stimulation (e.g. sensory stimulation) during hospitalisation. Soon after discharge from the newborn intensive care unit, stimulation of the baby has to be started. To do this, we have to improve and enhance the mother-baby interactions.

The purpose of this article is to describe the LBW babies’ problems and to highlight the importance of mother-baby interactions so that LBW babies can achieve their potential.

References


