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Filippa, Manuela; Frassoldati, Rossella; Talucci, Giovanna; Ferrari, Fabrizio

www.jpnim.com Open Access eISSN: 2281-0692
Journal of Pediatric and Neonatal Individualized Medicine 2015;4(2):e040238
doi: 10.7363/040238
Received: 2015 Sept 21; accepted: 2015 Oct 10; published online: 2015 Oct 26

Review

Mothers singing and speaking to preterm infants in NICU

Manuela Filippa, Rossella Frassoldati, Giovanna Talucci, Fabrizio Ferrari

NICU and Department of Neonatology of Modena University Hospital, Modena, Italy

Proceedings

Proceedings of the 11th International Workshop on Neonatology and Satellite Meetings
Cagliari (Italy) · October 26th-31st, 2015
From the womb to the adult
Guest Editors: Vassilios Fanos (Cagliari, Italy), Michele Mussap (Genoa, Italy), Antonio Del Vecchio (Bari, Italy), Bo Sun (Shanghai, China), Dorret I. Boomsma (Amsterdam, the Netherlands), Gavino Faa (Cagliari, Italy), Antonio Giordano (Philadelphia, USA)

Abstract

Preterm infants are at greater risk for long-term morbidities, a problem representing also a growing public health concern. Early experiences can affect infants' brain development, especially if conducted during critical periods of important growth. Early interventions involving parents in preterm infants care improve developmental outcomes for preterm infants, minimizing also the stress of the Neonatal Intensive Care Unit (NICU) environment. Mother-infant separation and alteration of maternal care soon after birth can lead to a wide array of adverse physiological, emotional and behavioural consequences that can persist throughout life. It's suggested that Maternal Vocal Intervention (MVI) in NICU, as a specific form of environmental and interactional enrichment, as part of an individualized care and as a tool to involve families in early care of preterm infants, may be adopted by the health community as a standard of care.

Keywords

Maternal voice, singing, speaking, preterm infants, early intervention, NICU.

Corresponding author

Prof. Fabrizio Ferrari, Terapia Intensiva Neonatale, Azienda Ospedaliero-Universitaria di Modena, Policlinico, via del Pozzo 71, 41124 Modena, Italy; email: fabrizio.ferrari@unimore.it.

How to cite

Filippa M, Frassoldati R, Talucci G, Ferrari F. Mothers singing and speaking to preterm infants in NICU. J Pediatr Neonat Individual Med. 2015;4(2):e040238. doi: 10.7363/040238.

Introduction

Preterm birth rates are continuously increasing in almost all countries for which data are available [1, 2] and prematurity has a huge impact on families, societies and economies in both high and low-income countries. Many survivors face a lifetime of disability, including learning disabilities, visual and hearing impairments. Few of them suffer from cerebral palsy or other motor disabilities. Although advances made in prenatal and perinatal medicine have allowed greater numbers of preterm infants to survive, long-term morbidity remains a fundamental problem, representing also a growing public health concern. Early experience can affect infants brain development: especially when the nervous system is developing, during critical periods of important growth such as the preterm period and the first year of life, experience-dependent modification can occur in brain function. It has been proposed that epigenetic mechanisms, linking external or environmental factors with genetic and developmental modifications, may shed additional light on the role that adverse early experience has on long-term morbidities in preterm infants' development and on consequences in early care for preterm infants [3]. The Neonatal Intensive Care Unit (NICU) environment is source of multiple distress for infants, including disruption of behavioural and sleep state organization, overload of painful stimuli and exceeding levels of light and noise [4]. Developmental Care practices are oriented to minimize the stress of the NICU environment and to possibly mimic the intrauterine one. These interventions may include elements such as control of external stimuli trough individual care strategies [5], pain and stress management through analgesia or clustering of the nursing procedures, promotion of sleep and postural stability (nesting policy) and increase of family involvement in preterm infants care [6].

Between other sources of distress, mother-infant separation and alteration of maternal care soon after birth and during the following weeks (i.e. in a very sensitive period for mother infant attachment), can lead to a wide array of adverse physiological, emotional and behavioural consequences that can persist throughout life [7]. Specific early interventions aiming at sustaining early contact between parents and preterm infants, such as skin-to-skin care [8, 9] have shown to correlate with a better outcome of the preterm infant and of the dyad and are today well diffused in NICUs. Recent studies reported in systematic reviews and meta-analyses show the importance of early interventions involving parents. Since the early post-partum period, the parents involved in the care and nursing of their babies can understand their parental role as promoter of the stability and of the neurobehavioural competences of their babies. However, in the interventions for preterm infants and their parents, outcomes for both parents and preterm infants should be measured to better understand the mechanisms for change [10, 11].

The *primary objective* of this paper is to describe the rationale for Maternal Vocal Intervention (MVI) in NICU, as a specific form of environmental and interactional enrichment, as part of an individualized care and as a tool to involve families in early care of preterm infants.

Maternal Vocal Intervention as an early emotional vocal contact that enriches the NICU environment and promotes language development

Supporting early vocal contact between mothers and preterm newborn infants means sustaining a form of *early acoustic stimulation* that can significantly impact the functional development of the auditory brain system in humans [12], with long-term impacts on communication and language development. When infants listen to their mother's voice, a voice that is well-known [13] and emotionally salient, brain activation is modulated in several areas, including those involved in emotional processing (amygdala, orbito-frontal cortex), distinguishing familiar to strangers' voices [14]. Reciprocally, intimate social partners intuitively exaggerate prosody both at linguistic and emotional levels, by modifying suprasegmental and segmental features of vocalization [15]. More specifically, preterm infants are sensitive and responsive to infant-directed speech. Talking in a simulated face-to-face situation to very low birth weight preterm infants, as opposed to mere presence of a social partner, was found to help infants to achieve a quiet, visually attentive state [16]. It also led to an

increment in eye opening and attentive state [17, 18]. The extent of preterm infants' responses was related to gestational age as well as to infant's behavioural state [19]. Further, the impact of adult vocalization on infant's language development emerged quite clear: increased levels of adult language induced vocalizations in preterm infants in the NICU [20] and preterm infants' exposure to adult language in the NICU was associated with better cognitive and language outcomes at 7 and 18 months' corrected age [21].

Maternal Vocal Intervention as a tool to involve parents in early care for their preterm babies

Another reason for promoting mothers singing and speaking to preterms in the NICU is that MVI is a relational-based maternal intervention and can become a possible efficient tool to sustain mother-infant early contact, enhancing fundamental regulatory processes.

Preterm birth carries severe risk factors for a dysfunctional mother-infant interaction cycle with potential for developing lower maternal sensitivity and responsiveness and higher maternal control. Both these forms of dysfunctional regulatory patterns show a lack of mother-infant synchronicity. Preterm newborn infants show cardio-respiratory instability and poor behavioural state organization either during the preterm period and at term age; visual and auditory responses of preterm infants reaching term age show poorer performances to their full term peers along with a lower level of alertness [22]. Dyad synchrony is an essential element as to the interactive regulation between organisms developing attachment behaviors [23]. In the regulatory process of human attachment, maternal vocalizations to infants are "biologically relevant signals" [24] and deeply affect brain development: the mother's external regulation of the infant's state during particular critical periods may represent the essential factor influencing the experience-dependent growth of brain areas, eliciting, between other effects, high levels of metabolic energy for the tuning of right brain cortical-subcortical circuits involved in processing socioemotional information [25]. Moreover, a number of experimental studies confirm that early maternal care at this stage can affect infant's ability to react and to positively adapt to stressful conditions: skin-to-skin contact [26], maternal tactile stimulation [27] and parental active closeness can support preterm infant's resilience in the face of high levels of stress conditions inherent to the NICU environment. The identification of effective mother-infant interventions that can be easily introduced in the clinical NICU setting is needed in order to maximize implementation across NICUs.

Conclusions

In conclusion, MVI is a relational-based form of early intervention involving parents, easy and cheap to import within the NICU world: no special competences or refined training of the staff is required. If actual and further research will provide strong evidence in favor of the positive effect of MVI on brain maturation of the preterm infant, this simple strategy may be adopted by the health community as a standard of care, in the framework of parent-centered early interventions, in close cooperation with the relevant stakeholders, in particular parents, and the medical community.

Declaration of interest

The Authors declare that there is no conflict of interest.

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