



Temperament and behavior in toddlers born preterm with related clinical problems



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ABSTRACT

Objective: The aim of this study was to compare temperament and behavior profiles among groups of preterm toddlers differentiated by level of prematurity and the presence of bronchopulmonary dysplasia (BPD) or retinopathy of prematurity (ROP), controlling for neonatal clinical conditions and chronological age.

Method: The sample comprised 100 preterm toddlers segregated according to level of prematurity (75 very preterm and 25 moderate/late preterm) and presence of BPD (n = 36) and ROP (n = 63). Temperament was assessed by the Early Childhood Behavior Questionnaire and behavior by the Child Behavior Checklist. The MANOVA was performed with a post-hoc univariate test.

Results: The level of prematurity and the presence of BPD and ROP did not affect temperament and behavioral problems in toddlers born preterm. However, the covariates age and length of stay in NICU (Neonatal Intensive Care Unit) affected temperament and behavioral problems, respectively. The older toddlers showed higher inhibitory control and lower activity levels than younger toddlers (range of 18–36 months-old). Additionally, toddlers who stayed in the NICU longer showed more pervasive development and emotionally reactive problems than toddlers who stayed in NICU for less time.

Conclusion: The level of prematurity and the presence of bronchopulmonary dysplasia and retinopathy of prematurity did not affect temperament and behavioral problems in toddlers born preterm. However, a longer stay in the NICU increased the risk for behavioral problems, and age enhanced the regulation of temperament at toddlerhood.

1. Introduction

The rate of premature childbirth has been continuously increasing, reaching an annual birth rate of 15 million infants born prematurely [1]. In addition, preterm birth complications were responsible for the most neonatal deaths between 2000 and 2013 and were the second leading cause of death in children under five years of age [2]. Neonatal morbidities such as bronchopulmonary dysplasia (BPD) and severe retinopathy of prematurity (ROP) were related to late death or survival with disability at five years in children born preterm with very low birth weight [3]. Bronchopulmonary dysplasia is defined as oxygen-dependency at 28 days of postnatal age or at 36 weeks of gestational

age [4]. This is the most common chronic respiratory disease in infants and affects 25% of infants born with low birth weight and 50% of infants with birth weight < 1000 g [5]. Retinopathy of prematurity, in turn, is a disorder of the developing retina that affects preterm babies who have received intensive neonatal care, mainly oxygen therapy, with a prevalence of 60%. Retinopathy of prematurity is mostly mild and resolves spontaneously; however, it may lead to blindness in a small percentage of infants. Infants with a very low birth weight and a gestational age < 32 weeks are at major risk for ROP [6].

Biological immaturity at birth and neonatal diseases such as BPD and ROP in infants born preterm require medical assistance in a neonatal intensive care unit (NICU). Medical care of preterm neonates

Abbreviations: ADHD, attention deficit hyperactivity disorder; BPD, bronchopulmonary dysplasia; CAPES, Coordination for the Improvement of Higher Education Personnel; CBCL1½-5, Child Behavior Checklist 1½-5; CCEB, Criteria for Economic Classification in Brazil; CNPq, National Council for Scientific and Technological Development; CRIB, Clinical Risk Index for Babies; ECBO, Early Childhood Behavior Questionnaire; FAPESP, São Paulo Research Foundation; HCRPMS-USP, Hospital of Clinics of Ribeirão Preto Medical School, University of São Paulo; MANOVA, Multivariate Analysis of Variance; NICU, Neonatal Intensive Care Unit; NISS, Neonatal Infant Stressor Scale; No-BPD, without bronchopulmonary dysplasia; No-ROP, without retinopathy of prematurity; PT-M/T, moderate/late preterm; ROP, retinopathy of prematurity; VIF, variance inflation factor; VPT, very preterm

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involves repeated invasive and painful interventions, which occur in a chronic stress context [7]. This early neonatal pain-related stress experiences can cause damage to both early and later child development [8,9]. Additionally, the NICU environment has other factors that impair child development, such as a high noise level [10], high luminosity [11], repetitive tactile stimuli [12], and maternal separation [13]. Therefore, the NICU setting acts as a “multiple risk context” of experiences, which threaten the development of vulnerable tiny infants in the early stages of life.

In general, because of birth conditions and clinical complications, preterm children have more risk of developmental problems than full-term children [14]. Preterm children show more behavioral problems than their full-term counterparts [15,16]. Further, since 2002, Aylward highlighted that the differences between preterm and full-term samples were well established; researchers needed to focus on the subgroups of the preterm population stratified by gestational age [17].

Prematurity appears to affect the temperament of children. Temperament is defined as constitutionally based individual differences in reactivity and self-regulation that appear early on in development and are influenced over time by heredity, maturation, and experience [18]. Rothbart's approach to temperament showed that temperament includes three factors: negative affectivity, surgency, and effortful control. Negative affectivity is one of the first aspects of temperament to emerge in an individual and is initially related to irritation and discomfort [19]. Surgency also appears early in development. Individual differences in surgency can be observed in infants within two to three months of birth, in smiling and laughter, vocal reactivity, and physical activity [20]. Effortful control is related to the development of executive attention [21], which rapidly develops in children between two and seven years old [22]. Early in development, preterm infants show more high-intensity pleasure; however, at three months of age [23] and six months of age, preterm infants are less rhythmic, more distractible, less approaching, and less intense [24] in comparison to full-term infants of the same age. Furthermore, preterm toddlers show higher scores in high-intensity pleasure [15,16], perceptual sensitivity [15,16], and motor activation [16], but they show lower scores in cuddliness [15,16] than full-term toddlers.

It is important to note that temperament and behavioral problems are related, as temperament with the failure of self-regulation is associated with the presence of behavioral problems [25,26]. In full-term children, externalizing behavioral problems has predicted high negative affectivity and low effortful control [25,27]. Internalizing behavioral problems, in turn, have been associated with high negative affectivity [25,27], low effortful control [27], and low surgency [25,27] in full-term children. Furthermore, higher levels of effortful control have been shown to act as a protective factor for total behavioral problems [26], attention problems, and attention deficit hyperactivity disorder (ADHD) [28] in preterm children.

An earlier gestational age in premature birth is associated with a higher risk for developmental problems, demonstrating the effect of the body's immaturity in the neonatal phase on later developmental outcomes [14]. Additionally, a recent systematic review showed that prematurity associated with other neonatal risks increases the risk for behavioral and emotional problems [29]. The presence of BPD in children born preterm was related to more attention problems [30] and ADHD at five years of age [31]. Later, at school age, the presence of BPD in children born preterm was still related with ADHD [32] and autistic traits [33]. In addition, the presence of ROP in children born preterm was associated with emotional problems [33]. However, despite the high prevalence of ROP in children born preterm, according to our findings, only one previous study [33] investigated the relationship between ROP and behavioral problems.

Some studies showed the effect of medical procedures and pain reactivity on temperament during the NICU [28,34]. A higher stability of positive affectivity, smiling and laughter, at age six to 12 months was noted in infants who did not require a ventilator relative to infants who

were on ventilators [28]. Furthermore, higher biobehavioral reactivity to pain and distress in the neonatal period predicted higher negative affectivity in toddlers born preterm [34]. However, few studies have investigated the effect of neonatal risks on the temperament of children born preterm. Despite the high prevalence of DBP and ROP in children born preterm, we did not find any studies that had evaluated the effect of these diseases on temperament. Because of the association of temperament and behavioral problems, we hypothesized that neonatal risks factors also influence the temperament of children born preterm. Therefore, it is necessary to investigate the relationships between neonatal clinical risk and temperament in children born preterm.

The aim of the present study was to compare the temperament and behavioral profile among groups of children born preterm differentiated by the level of prematurity, the presence of bronchopulmonary dysplasia, and the presence of retinopathy of prematurity, controlling for other neonatal clinical conditions and chronological age. The hypothesis of the study is that toddlers born preterm with lower gestational age, presence of BPD, and ROP will present less regulated temperament and more behavioral problems than toddlers with higher gestational age and without BPD and ROP. We expected that with the findings of this study, it would be possible to identify neonatal clinical variables associated with higher risk for low regulation of temperament and behavioral problems in children born preterm, thus to support prevention programs for monitoring children with higher risk for developmental problems.

2. Methods

2.1. Participants

The sample was composed of 100 preterm toddlers (mean gestational age = 30 weeks [\pm 2.5; 22–35]), with a very low birth weight (1115 g [\pm 234; 560–1500]), from 18 to 36 months of age (mean = 25 [\pm 5.4]) of both sexes (52% boys), and their mothers. These children were born in a public university hospital in southeastern Brazil (Hospital of Clinics of Ribeirão Preto Medical School, University of São Paulo [HCRPMS-USP]) and were enrolled in a follow-up, preventive, multidisciplinary intervention program in the same hospital. The sample included children from predominantly medium-low socioeconomic level families, according to the Criteria for Economic Classification in Brazil [35]. The inclusion criteria were as follows: gestational age < 37 weeks, birth weight < 1500 g, and history of admission to a neonatal intensive care unit (NICU; mean = 24 days [\pm 25.5; 1–163]). Toddlers with a congenital malformation or grade III or IV intracranial hemorrhage, mothers and toddlers with apparent cognitive impairment, mothers who were using medications that could alter their level of consciousness, mothers who did not understand the instrument used to report toddler behavior or temperament, and toddlers with limited mobility at 18–36 months of age were excluded. This sample is part of a follow-up study [36].

During data collection, there were 134 toddlers between 18 and 36 months of age who were born preterm with a very low birth weight, who attended the follow-up preventive intervention program. Of these 134 toddlers, 22 (16.5%) were excluded for the following reasons: 18 toddlers presented with grade III or IV intracranial hemorrhage, two toddlers presented with limited mobility between 18 and 36 months of age, and two mothers presented with apparent cognitive impairment. Of the eligible sample of 112 toddlers, one mother refused to participate and 11 mothers did not understand the instrument used to evaluate temperament.

For data analysis, the sample of 100 toddlers born preterm was segregated into groups according to each of these variables: a) level of prematurity, with 75 toddlers born very preterm – VPT group (gestational age < 32 weeks) and 25 toddlers born moderate/late preterm – PT-M/T group (32–36 weeks gestational age); b) presence of bronchopulmonary dysplasia (BPD) (BPD group = 36, No-BPD group = 64); c)

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