



## Impact of neonatal risk and temperament on behavioral problems in toddlers born preterm



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### ABSTRACT

Children born preterm are at risk for later developmental disorders. The present study examined the predictive effects of neonatal, sociodemographic, and temperament characteristics on behavioral outcomes at toddlerhood, in children born preterm. The sample included 100 toddlers born preterm and with very-low-birth-weight, and their mothers. Neonatal characteristics were evaluated using medical records. The mothers were interviewed using the Early Childhood Behavior Questionnaire for temperament assessment, and the Child Behavior Checklist for behavioral assessment. Multiple linear regression analyses were performed. Predictors of 39% of the variability of the total behavioral problems in toddlers born prematurely were: temperament with more Negative Affectivity and less Effortful Control, lower family socioeconomic status, and younger mothers at childbirth. Temperament with more Negative Affectivity and less Effortful Control and lower family socioeconomic status were predictors of 23% of the variability of internalizing behavioral problems. Additionally, 37% of the variability of externalizing behavioral problems was explained by temperament with more Negative Affectivity and less Effortful Control, and younger mothers at childbirth. The neonatal characteristics and stressful events in the neonatal intensive care unit did not predict behavioral problems at toddlerhood. However, temperament was a consistent predictor of behavioral problems in toddlers born preterm. Preventive follow-up programs could assess dispositional traits of temperament to provide early identification of preterm infants at high-risk for behavioral problems.

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### 1. Introduction

Preterm birth complications caused the most neonatal deaths in 2000–2013 and were the second-leading cause of death in children under five years of age. Estimates indicate that in 2030, the proportion of deaths that are caused by neonatal preterm birth complications will increase from 15% to 18% [1]. Children who survive preterm birth have been shown to have a high risk of developing morbidities and disabilities that affect development, such as cerebral palsy, learning impairments, visual disorders, and psychiatric disorders [2,3]. Children

*Abbreviations:* CAPES, Coordination for the Improvement of Higher Level 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; ECBQ, Early Childhood Behavior Questionnaire; FAPESP, São Paulo Research Foundation; HCRPMS-USP, Hospital of Clinics Ribeirão Preto Medical School, University of São Paulo; NICU, Neonatal Intensive Care Unit; NISS, Neonatal Infant Stressor Scale; CAPES, Coordination for the Improvement of Higher Level Personnel; VIF, variance inflation factor.

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born at low gestational age and birthweight presented a higher risk for these developmental problems, because of the organism's immaturity [4,5]. A recent review of literature showed that prematurity, combined with neonatal risk factors, increased the risk for behavioral and/or emotional problems in children [6].

Children born preterm are immediately thrust after birth into a chaotic developmental microsystem because of the need for hospitalization in the neonatal intensive care unit (NICU). These chaotic environments are characterized by frenetic activity, a lack of structure, unpredictable daily activities, and high levels of environmental stimuli [7]. Thus, NICUs provide for the survival of preterm infants but are also stressful environments [8]. The medical care of infants born preterm, especially those with a very low birthweight, involves repeated invasive and painful interventions that occur in the context of chronic stress, and can cause damage to the developing nervous system of the newborn [8,9]. According to Newnham, Inder, and Milgrom [10], an average of 44 acute stressful events and 24 chronic stressful events occur in premature newborns during their stay in the NICU. These preterm newborns are immature and disorganized in coping with these aversive stimuli [9].

With regard to neonatal stress that is suffered by infants born preterm, a recent systematic review [11] found that neonatal pain-related

stress was associated with alterations in both early and later developmental outcomes. Neonatal pain was associated with internalizing behaviors at 18 months of age [12], and total behavioral problems at seven years old [13], in children born very prematurely. Additionally, higher biobehavioral reactivity to pain and distress predicted a higher Negative Affectivity temperament in toddlerhood among children born preterm [14]. However, few longitudinal studies have examined the impact of neonatal pain and stress on the long-term development of children born preterm [11].

Regarding the environmental context of these infants, low socioeconomic status was consistently associated with preterm birth [15–17]. In addition, low socioeconomic status was associated with a wide array of health, cognitive, and socioemotional outcomes in children, with effects noted from the prenatal stage through adulthood [18–20]. Therefore, a low socioeconomic context constitutes a multiple risk factor for adaptive child development.

To our knowledge, there are no studies evaluating the impact of premature biological risk, environmental stress in the NICU, and dispositional traits (i.e., temperament) on behavioral problems in toddlerhood. The present study sought to advance our understanding of the longitudinal impact of neonatal clinical risks that are suffered by preterm children, and characteristics of child temperament, on behavior in toddlerhood in a sample of children with high biological and social risk. Overall, we examined the predictor effects of neonatal, sociodemographic, and temperament characteristics on behavioral outcomes in toddlerhood in children born preterm.

## 2. Methods

### 2.1. Participants

The convenience sample was composed of 100 children (18–36 months old) who were born prematurely. 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 enrolled in a follow-up preventive multidisciplinary intervention program. Inclusion criteria were: gestational age < 37 weeks, very-low-birth-weight < 1500 g, and history of admission to a NICU. Children with congenital malformation, intracranial hemorrhage grade III or IV, mothers and children with apparent cognitive impairment or who were under the use of medications that could alter their level of consciousness, and children who were on oxygen at 18–36 months of age were excluded.

During the period of data collection, 134 children (18–36 months of age) born prematurely with a very-low-birth-weight attended the follow-up preventive intervention program. Of these 134 children, 22 (16.5%) were excluded for the following reasons: 18 children presented intracranial hemorrhage grade III or IV, two children were on oxygen at 18–36 months of age, and two mothers presented apparent cognitive impairment. Of the eligible sample of 112 children, one mother refused to participate, and 11 mothers did not understand the instrument that evaluated the child's temperament.

The study was approved by the HCRPMS-USP Research Ethics Committee, and the mothers signed informed consent forms prior to inclusion in the study.

## 3. Instruments and measures

### 3.1. Neonatal phase

#### 3.1.1. Medical records

A retrospective review of medical charts was conducted independently by two medical students who were blinded to the developmental assessment. The children were characterized according to the following neonatal clinical variables: sex, gestational age evaluated by New Ballard method, birthweight, five-

minute Apgar score, Clinical Risk Index for Babies (CRIB) [21], length of stay in the NICU, total length of stay in the hospital, and neonatal diseases.

#### 3.1.2. Neonatal Infant Stressor Scale [10] Brazilian version [22]

The Neonatal Infant Stressor Scale (NISS) assesses the measurement, monitoring, and management of stress that accumulates during procedures in an intensive care environment. This instrument comprises a list of acute events and chronic living conditions. The acute stressful events are organized into four blocks, according to the intensity of stress: extremely stressful, very stressful, moderately stressful, and slightly stressful. In the present study, we used only these classifications of acute stressful events in the NICU.

### 3.2. Toddlerhood phase

#### 3.2.1. Early Childhood Behavior Questionnaire [23] Brazilian version [24]

The Early Childhood Behavior Questionnaire (ECBQ) is composed of 201 items that assess 18 dimensions of temperament in children who are 18–36 months old. The ECBQ was administered to parents to indicate how often their children had emitted reactions in specific contexts during the previous two weeks, assigning a value on a Likert scale that ranged from 1 (never) to 7 (always). The dimensions of temperament were grouped by factorial analysis into a three-factor structure: Negative Affectivity (discomfort, fear, frustration, sadness, motor activation, shyness, perceptual sensitivity, and inverted score of soothability), Surgency/Extraversion (activity level, high-intensity pleasure, positive anticipation, impulsivity, and sociability), and Effortful Control (inhibitory control, low-intensity pleasure, cuddliness, attentional shifting, and attention focusing). The internal consistency of the scales varies from 0.57 to 0.90 (mean = 0.81), and inter-responder agreement varies from 0.33 to 0.57 (mean  $r = 0.39$ ) [15]. The internal consistency of the scales in a Brazilian population varies from 0.43 to 0.88 (mean = 0.72) [24].

#### 3.3. Child Behavior Checklist 1½-5 [25], Brazilian version

The Child Behavior Checklist 1½-5 (CBCL1½-5) evaluates behavioral and emotional problems in children who are 18 months to five years of age by parental report. The CBCL is comprised of 99 items and includes two axes (externalizing and internalizing problems) and seven scales (emotionally reactive, anxious/depressed, somatic complaints, withdrawn, attention problems, aggressive behavior, and sleep problems). The CBCL1½-5 also includes Diagnostic and Statistical Manual of Mental Disorders-oriented scales. The results are expressed as normalized T-scores, with classifications of normal ( $T < 65$ ), borderline ( $T = 65–69$ ), and clinical ( $T \geq 70$ ). High scores indicate more disruptive behavior. This instrument has been shown to have adequate content, construct, criterion, and discriminant validity [25].

#### 3.4. Criteria for Economic Classification in Brazil (Critério de Classificação Econômica Brasil of the Brazilian Association of Market Research Companies [26])

The Criteria for Economic Classification in Brazil (Critério de Classificação Econômica Brasil [CCEB]) questionnaire assesses the socioeconomic level of Brazilian families, according to the following ordinal scale: A1 (score = 42–46), A2 (score = 35–41), B1 (score = 29–34), B2 (score = 23–28), C1 (score = 18–22), C2 (score = 14–17), D (score = 8–13), and E (score = 0–7). Higher scores indicate higher socioeconomic status.

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