**Original Article**

***Artigo Original***

Camila da Costa Ribeiro[1]
Mariane Regina de Oliveira Pachelli[2]
Natalie Camillo de Oliveira Amaral[1,3,4,5]
Dionísia Aparecida Cusin Lamônica[1]

# Development skills of children born premature with low and very low birth weight

## *Habilidades do desenvolvimento de crianças prematuras de baixo peso e muito baixo peso*

**Keywords**

Premature Infant
Development
Language, Child Development
Assessment

## ABSTRACT

**Purpose:** To compare the performance of children born premature with low birth weight (LBW) and very low birth-weight (VLBW) with that of children born at term, within the age range of one to three years, regarding child development in the gross motor, fine motor-adaptive, personal-social and language domains. **Methods:** This is a cross-sectional study in a cohort of 150 infants born premature (experimental group) and at term (control group) divided into eight groups with respect to weight (low birth weight: <2500 grams and very low birth weight: <1500 grams) and age range (aged 12 to 24 and 25 to 36 months). The control groups were paired with the experimental groups as for gender, chronological age, and socioeconomic level. Assessment comprised the application of anamnesis protocol, socioeconomic classification, and Denver Developmental Screening Test (DDST-II). Corrected age was calculated for premature children up to 24 months of age. Descriptive statistical analysis and the Student's t-test were used. **Results:** No statistically significant difference was found in the comparison between the groups of infants born premature and at term for all domains evaluated. **Conclusion:** The performance of infants born premature was lower than that of infants born at term regarding the gross motor, fine motor-adaptive, personal-social and language domains. In this study, the preterm groups presented different performances, i.e., normative, average, and below average performances were observed within the same group.

**Descritores**

Prematuro
Desenvolvimento
Linguagem, Desenvolvimento Infantil
Avaliação

## RESUMO

**Objetivo:** Comparar o desempenho de crianças nascidas prematuras de baixo peso (BP) e muito baixo peso (MBP) com crianças nascidas a termo na faixa etária de um a três anos, quanto ao desenvolvimento infantil, nos domínios motor grosso; motor fino adaptativo; pessoal-social; e linguagem. **Método:** Estudo de coorte transversal. A amostra foi constituída por 150 crianças nascidas prematuras (grupo experimental) e a termo (grupo comparativo), divididas em oito grupos, quanto ao peso (baixo peso: abaixo de 2500 gramas e muito baixo peso: abaixo de 1500 gramas) e faixa etária (de 12 a 24 e de 25 a 36 meses). Os grupos comparativos foram pareados aos experimentais quanto ao gênero, idade cronológica e nível socioeconômico. A avaliação constou da aplicação do protocolo de anamnese, classificação socioeconômica e do Teste de Screening de Desenvolvimento Denver-II (TSDD-II). Foi realizado o cálculo da idade corrigida para as crianças prematuras de idade até 24 meses. Utilizou-se análise estatística descritiva e o Teste "t" *Student*. **Resultados:** Na comparação entre os grupos de prematuros e nascidos a termo, houve diferença estatisticamente significante para todos os domínios avaliados. **Conclusão:** O desempenho de crianças nascidas prematuras foi inferior quando comparado ao desempenho de crianças nascidas a termo, nos domínios motor grosso, motor fino adaptativo, pessoal-social e linguagem. Neste estudo, os grupos de prematuros obtiveram desempenho distintos, ou seja, no mesmo grupo existiram desempenhos normativo, na média e abaixo.

**Correspondence address:**
Dionísia Aparecida Cusin Lamônica
Al. Octávio Pinheiro Brisolla, 9-75,
Vila Universitária, Bauru (SP), Brazil,
CEP: 17012-901.
E-mail: dionelam@uol.com.br

**Received:** March 02, 2016

**Accepted:** May 23, 2016

Study carried out at Clínica de Fonoaudiologia, Faculdade de Odontologia de Bauru, Universidade de São Paulo – USP - Bauru (SP), Brazil.

[1] Universidade de São Paulo – USP - Bauru (SP), Brazil.

[2] Associação de Pais e Amigos dos Excepcionais de Agudos - Agudos (SP), Brazil.

[3] Hospital de Reabilitação de Anomalias Craniofaciais - Bauru (SP), Brazil.

[4] Unimed Bauru - Bauru (SP), Brazil.

[5] Fundação para o Desenvolvimento Médico Hospitalar - Bauru (SP), Brazil.

**Financial support:** Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP, process: 2011/04114-5; 2011/08768-9 and 2013/09017-3. CNPq: 476003/2013-0.

**Conflict of interests:** nothing to declare.

## INTRODUCTION

According to the World Health Organization (WHO)[1], preterm birth is characterized when infants are born alive with gestational age (GA) of less than 37 weeks. Preterm infants are classified as low birth weight (LBW) and very low birth weight (VLBW) when born with weight <2500 grams and <1500 grams, respectively.

LBW and VLBW preterm newborns are considered a biological risk to global developmental delay[2-10]. However, the nature of these deficits is not yet fully understood[11,12] considering the multiple variables involved as a result of pre-, peri- and post-natal intercurrences, GA, birth weight, intensive care management, socioeconomic and environmental factors, and the complex process subsequent to the maturational development of the infant's brain, interfering with the trajectory of typical development[3-5,13,14].

Child development is based on domains of functions related to motor, cognitive and linguistic aspects, influenced by biological, psychosocial and environmental factors[15].

Children born premature may present delays in the motor[2,3,6,10,16-21], adaptive[22], cognitive[2,5,6,8,10,18,19] and language[2,4,6,9,14,18-20] domains, even if the deficits in these areas are subtle[2]. These domains are interdependent, that is, each one influences and is influenced by the others.

Motor behavior favors children's experiences in acting and interacting, providing them with concrete opportunities that enable their repertoire and favor the development of their perceptual, cognitive, linguistic, adaptive and social areas. According to Amaral et al.[23], action generates and elicits cognition through praxes based on a mental planning that regulates, controls, integrates, develops, and executes the child's intention. In this context, development occurs through actions of the organism integrated to psychomotor dispositions, which influence the maturational process and, consequently, the processing of information, with important reflexes on all the areas of child development[24].

The adaptive function is considered an integrated ability of cognitive and motor skills, as well as an emotional regulation that reflects functional performance[22].

Language development in infants born premature may occur at a slower pace, with interference in lexical, morphosyntactic and pragmatic performance, even in the absence of neurological damage[4,5,9,14,19,24], as a result of the numerous factors that interfere in this process.

An understanding of risk factors, as well as early identification of prognostic factors for neurodevelopmental outcomes can assist in strategizing a prevention plan[17,22]. Thus there is the need for screening programs for the development of premature infants, even of those with no evidence of neurological damage[2-5,15,25].

In view of the foregoing information, the aim of the present study was to compare the performance of children born premature with low birth weight (LBW) and very low birth weight (VLBW) with that of infants born at term, within the age range of one to three years, with respect to child development in the gross motor, fine motor-adaptive, personal-social and language domains.

## METHODS

The study was approved by the Ethics Research Committee of the aforementioned institution under protocol numbers 2011/035 and CAAE: 15646414.1.0000.5417. The parents/legal guardians of the participating children signed an Informed Consent Form (ICF) prior to study start.

This is a cross-sectional study in a cohort of 150 infants born premature (experimental groups) - EG) and at term (control groups - CG) divided into eight groups: EG-I (20 preterm infants born with LBW) and CG-I (20 term infants); EG-II (19 preterm infants born with VLBW) and CG-II (19 term infants) - all children in these four groups were aged one to two years; EG-III (20 preterm infants born with LBW) and CG-III (20 term infants); EG-IV (16 preterm infants born with VLBW) and CG-IV (16 term infants) - all children in these four groups were aged two to three years.

All children in the control groups were born at term, with weight >2500 grams, presented typical development, and were paired with the children in their respective experimental groups regarding chronological age (in months), socioeconomic level, and gender.

Inclusion criteria for the experimental groups comprised the following: infants born premature with chronological age from 12 to 24 months (EG-I and EG-II) and from 25 to 36 months (EG-III and EG-IV); no evidence of neurological damage (intraventricular hemorrhage or periventricular leukomalacia), bronchopulmonary dysplasia, and retinopathy of prematurity; normal results in neonatal hearing, visual and metabolic screening (Guthrie test).

Inclusion criteria for the control groups were as follows: infants born at term with chronological age from 12 to 24 months (CG-I and CG-II) and from 25 to 36 months (CG-III and CG-IV); weight at birth >2500 grams; typical neuropsychomotor development; normal results in neonatal hearing, visual and metabolic screening (Guthrie test).

Assessment consisted in the application of anamnesis protocol, socioeconomic classification[26], and Denver Developmental Screening Test (DDST-II)[27]. Corrected age was calculated for premature children up to 24 months of age.

### Sample characterization

Chart 1 shows the sample characterization regarding gender (%), chronological age (in months), gestational age (weeks), weight (in grams), socioeconomic classification, and schooling of participants.

Descriptive statistical analysis and the Student's t-test were used at a significance level of 5% ($p \leq 0.05$).

## RESULTS

The mean, median, maximum and minimum values, standard deviation, and *p* value obtained in the DDST-II, for comparison between the groups, are described in Table 1 (gross motor skills), Table 2 (fine motor-adaptive skills), Table 3 (personal-social skills), and Table 4 (language skills).

**Chart 1.** Sample characterization

| Group | Gender | CA (months) | GA (weeks) | Weight (grams) | SEC | Schooling |
|---|---|---|---|---|---|---|
| EG-I CG-I | 55% F 45% M | 17.8 m (13-24) | EG-I: 33.95 (30-36) CG-I:38.05 (38 a 41) | EG-I:1895g (1570-2440) CG-I: 3048g (2630-3780) | A2: 25% B1:20% B2:50% C1: 5% | EG-I: 20% CG-I:60% |
| EG-II CG-II | 53% F 47% M | 17.8 m (13-24) | EG-II: 28.68 (26-34) CG-II:38.15 (38-41) | EG-II: 1178g (895-1490) CG-II: 2983g (2600-3660) | A2: 15.78% B1: 26.33% B2: 36.84% C1: 21.05% | EG-II: 11% CG-II:63% |
| EG-III CG-II | 40% F 60% M | 30.3 m (25-36) | EG-III: 34.05 (31-36) CG-III:38.09 (37-41) | EG-III: 2247g (1590-2500) CG-III: 3274g (1570-2440) | A2: 8.78% B1: 24.73% B2: 31.84% C1: 34.65% | EG-III: 40% CG-III:70% |
| EG-IV CG-IV | 56% F 44% M | 29.1 m (25-36) | EG-IV: 28.02 (26 - 30) CG-IV:38.09 (37-41) | EG-IV:1240g (590 - 1500) CG-IV:3432g (2830-4800) | A2: 7.58% B1: 26.53% B2: 29.84% C1: 36.05% | EG-IV: 45% CG-IV:50% |

**Caption:** F: Female; M: Male; CA: Chronological Age; m: months; GA: Gestational Age; g: grams; SEC: Socioeconomic Classification

**Table 1.** Results of the DDST-II regarding gross motor skill for the experimental and control groups

| Denver-II | Group | Mean | Median | Minimum | Maximum | Standard Deviation | p value |
|---|---|---|---|---|---|---|---|
| Gross Motor | EC-I | 15.15 | 14 | 11 | 23 | 3.26 | 0.00* |
| | CG-I | 20.7 | 20 | 16 | 26 | 2.77 | |
| | EG-II | 14.21 | 12 | 9 | 23 | 3.88 | 0.00* |
| | CG-II | 19.78 | 20 | 14 | 26 | 2.99 | |
| | EG-III | 23.15 | 28.5 | 0 | 35 | 10.83 | 0.00* |
| | CG-III | 30.3 | 30 | 24 | 36 | 3.77 | |
| | EG-IV | 21 | 23 | 1 | 33 | 10.54 | 0.00* |
| | CG-IV | 29.19 | 29 | 24 | 34 | 2.61 | |

**Caption:** *statistically significant; Student's t-test; 5% significance level ($p \leq 0.05$)

**Table 2.** Results of the DDST-II regarding fine motor-adaptive skill for the experimental and control groups

| Denver-II | Group | Mean | Median | Minimum | Maximum | Standard Deviation | p value |
|---|---|---|---|---|---|---|---|
| Fine Motor-Adaptive | EG-I | 15.8 | 14 | 11 | 23 | 3.51 | 0.00* |
| | CG-I | 20.8 | 21 | 14 | 26 | 3.03 | |
| | EG-II | 14.05 | 12 | 10 | 23 | 3.99 | 0.00* |
| | CG-II | 19.73 | 20 | 14 | 26 | 3.50 | |
| | EG-III | 24.25 | 29 | 0 | 35 | 9.91 | 0.01* |
| | CG-III | 30.3 | 30.5 | 24 | 36 | 3.77 | |
| | EG-IV | 22.31 | 25 | 0 | 34 | 10.14 | 0.01* |
| | CG-IV | 29.19 | 29 | 24 | 33 | 2.61 | |

**Caption:** *statistically significant; Student's t-test; 5% significance level ($p \leq 0.05$)

**Table 3.** Results of the DDST-II regarding personal-social skill for the experimental and control groups

| Denver-II | Group | Mean | Median | Minimum | Maximum | Standard Deviation | p value |
|---|---|---|---|---|---|---|---|
| Personal-Social | EG-I | 15.05 | 15 | 10 | 23 | 4.18 | 0.00* |
| | CG-I | 20.5 | 20.5 | 16 | 24 | 2.76 | |
| | EG-II | 14.36 | 12 | 10 | 23 | 4.34 | 0.00* |
| | CG-II | 19.78 | 20 | 14 | 26 | 3.39 | |
| | EG-III | 25.55 | 29 | 4 | 35 | 8.47 | 0.02* |
| | CG-III | 30.3 | 30.5 | 24 | 36 | 3.77 | |
| | EG-IV | 23.31 | 25 | 3 | 33 | 9.48 | 0.02* |
| | CG-IV | 29.19 | 29 | 24 | 34 | 2.61 | |

**Caption:** *statistically significant; Student's t-test; 5% significance level ($p \leq 0.05$)

**Table 4.** Results of the DDST-II regarding language skill for the experimental and control groups

| Denver-II | Group | Mean | Median | Minimum | Maximum | Standard Deviation | p value |
|---|---|---|---|---|---|---|---|
| Language | EG-I | 12.2 | 12 | 9 | 18 | 2.52 | 0.00* |
| | CG-I | 18.15 | 19 | 12 | 24 | 3.54 | |
| | EG-II | 12.31 | 12 | 9 | 18 | 3.09 | 0.00* |
| | CG-II | 17.84 | 18 | 12 | 24 | 3.76 | |
| | EG-III | 24.85 | 25.5 | 0 | 35 | 8.05 | 0.00* |
| | CG-III | 30.3 | 30.5 | 24 | 36 | 3.77 | |
| | EG-IV | 24.5 | 25.5 | 4 | 34 | 7.78 | 0.00* |
| | CG-IV | 29.19 | 29 | 24 | 33 | 2.61 | |

**Caption:** *statistically significant; Student's t-test; 5% significance level ($p \leq 0.05$)

In the comparison between the preterm groups and their respective control groups, statistically significant difference was observed for all skills: gross motor, fine motor-adaptive, social-personal, and language. The experimental groups did not behave homogeneously.

## DISCUSSION

Children born premature with low birth weight (LBW) and very low birth weight (VLBW) may present developmental delay[3,5-7,10,17,18] even in the absence of neurological damage.

Infants in the experimental groups presented statistically significant difference in behavior compared with those in the control groups, which may indicate that development in these children is occurring more slowly. This fact has already been described in the literature[3,5-7,21].

Weight and gestational age (GA) have been reported as relevant variables for motor delay and/or sequelae[2,5,18].

The sequence in which motor skills are acquired does not vary in early childhood, but the pace of acquisition differs from child to child. This fact suggests that the onset of motor development, even in the absence of lesions and/or structural malformations in the motor centers, can be affected as a consequence of the aggravations that occurred during prematurity. Motor performance occurs through a self-organized system that congregates the task, the environment, and the individual, and it is influenced by brain maturation and plasticity[14].

A decreasing prevalence of severe motor impairment has been observed in infants born premature due to advances in prenatal and neonatal medicine. However, subtle deficits of neurodevelopment may remain, as dominant problems for these children, during preschool[22].

In the fine motor-adaptive behavior[27], it is possible to verify the child's ability as for organization of stimuli, perception of relationships, and decomposition of the whole into parts. In the personal-social skill, the personal reactions to the social environment experienced by the child are verified in the accomplishment of the daily tasks involving the organization of stimuli, handling of social ability, and understanding of context. In these skills, the experimental groups also behaved statistically differently from the control groups.

It is estimated that 40-70% of children born prematurely are identified as presenting minor disabilities such as mild motor problems and poor adaptive behaviors during preschool and school[22]. School children born with extreme prematurity, without any significant neurological problem or developmental impairment, achieved worse performances in sensory-motor and visuospatial competencies, as well as on attention and executive functioning, compared with children born at term[8].

The experimental groups also presented statistically significant difference in behavior compared with the control groups in the language area, with marked losses for the groups of preterm children. Some studies have reported that infants born premature present significantly lower scores on language tests compared with those of children born full term[2,4,9,13,18,20,22,24] and that there is correlation between GA and birth weight and altered language development[2,4,9]. A study did not find differences in the performance of infants born preterm and full term regarding language, cognition, and motor development[12]. It is worth noting that the studies that addressed the development of language skills in preterm infants emphasized that although delay in language development is a frequent condition, variability is observed even in the absence of deficiencies and interference of socioeconomic status[12,14,28].

Individuals born preterm with LBW and VLBW, despite the high probability of changes in development, do not constitute a homogeneous group. It is clear that the relation of prematurity and birth weight with commitment to global development cannot be understood as a direct relation of cause and effect, but instead it demonstrates the need to identify the protective mechanisms capable of minimizing or even neutralizing the potential effects of risk to development[14]. Although participants present no evidence of neurological damage, a drawback of this study is not correlated with other risk factors, such as the risk of prematurity.

Socioeconomic status, cultural level, and environmental conditions have effects on the domains of development, mainly regarding cognitive and language performance[4,5,13,21,24,28], and may constitute risk factors for developmental delays. The pairing of groups included children of similar socioeconomic status. In this study, the participants were paired as to socioeconomic level, which considered the material assets of families and the mothers' schooling[26].

An important difference between the groups is the participation in activities at schools or day care centers, which may have influenced the results. In preschool, many activities are conducted

on manual control, organization of stimuli, perception of relations, social interactions, etc. In fact, the basis for gross and fine motor skills and social and communicative relationships is established during preschool, where children considerably increase their motor repertoire and acquire models of movement coordination and of social and communicative interactions that are essential for their independence[8,11]. It should be considered that children learn through the interactions they establish with people, events, and objects and that time of exposure to directed and interactive activities favors global development and performance in language tasks[24].

The preterm birth condition is another important aspect to be considered. Infants born premature are deprived of a critical period of intrauterine growth[29]. From a structural point of view, premature birth may interfere particularly in the phases of glial multiplication and neuronal migration and organization, indicating the possibility of alteration in the cerebral organization[15,30]. Therefore, prematurity offers the possibility of interfering in the brain maturational processes, leading to anatomical and structural interferences, which lead to functional deficits[29]. Evidence on the cerebral development of premature infants supports the argument that physiological immaturity explains the risks, but environmental and social factors should not be neglected[13]. Early brain immaturity associated with preterm birth and weight at birth may be important determinants of child development[14,29,30].

The functioning of neural plasticity in response to the insult of prematurity has shown that the plasticity of a developing brain may be limited, influencing the pace of acquisition of skills, even in the absence of neurological damage[15,29].

An aspect that may have contributed to the results found refers to the formation of the experimental groups in this study. The experimental groups were formed according to the weight at birth (LBW or VLBW) criterion. The groups were not classified according to GA (extreme, very, or moderate to late preterm). GA of children in the EG-I varied from 30 to 36 weeks, that is, infants with moderate to late prematurity, whereas GA in the EG-II varied from 26 to 36 weeks, that is, infants with extreme and moderate to late prematurity.

Another aspect worth considering refers to the corrected age of prematurity. Despite the indication that age correction, in preterm infants, occurs up to 24 months, there is controversy regarding its use. Correcting GA up to the first two years of life, the developmental sequences of preterm infants become similar to those presented by term-born infants[16]. Correction of age for motor assessment of children born premature is a consensus, but the same does not occur for other domains of development[20]. Some authors have reported that, with corrected age, some children may present normative scores, at level with full-term children, and preventive measures may be postponed, causing harm to these individuals[20]. Professionals who work with these children should be alert to the development of preterm infants, because developmental problems may become more evident at preschool and school age[8,14,22].

Sample size could be considered a limitation of this study, because it interferes with the generalization of results. Replication of the study is recommended with larger samples.

Further studies should monitor the overall development of preterm infants longitudinally in order to contribute to the knowledge on acquisition of developmental skills in infants born premature with LBW and VLBW.

## CONCLUSION

Infants born premature presented lower development compared with that of infants born at term with statistically significant difference regarding the gross motor, fine motor-adaptive, personal-social and language domains. In this study, the preterm groups presented different performances, i.e., normative, average, and below average performances were observed within the same group.


## ACKNOWLEDGEMENTS

The authors are grateful to "Fundação de Amparo à Pesquisa do Estado de São Paulo" - FAPESP (process no. 2011/04114-5, 2011/08768-9, and 2013/09017-3) and to "Conselho Nacional de Desenvolvimento Científico e Tecnológico" - CNPq (process no. 476003/2013-0) for the funding received.


## REFERENCES


1. OMS: Organização Mundial da Saúde [Internet]. Classificação Estatística Internacional de Doenças e Problemas Relacionados à Saúde – CID-10. Genebra: OMS; 2015 [citado em 2015 Jan. 14]. Disponível em: www.datasus.gov.br/cid10/v2008/cid10.ht
2. Ross GS, Foran LM, Barbot B, Sossin KM, Perlman JM. Using cluster analysis to provide new insights into development of very low birthweight (VLBW) premature infants. Early Hum Dev. 2016;92:45-9. PMid:26651085.
3. Resch B, Resch E, Maurer U, Mueller W. Periventricular leukomalacia and neurodevelopmental outcome. J Pediatr. 2011;159(6):1049-50. PMid:21962604.
4. Barre N, Morgan A, Doyle LW, Anderson PJ. Language abilities in children who were very preterm and/or very low birth weight: a meta-analysis. J Pediatr. 2011;158(5):766-74. PMid:21146182.
5. Samra HA, McGrath JM, Wehbe M. An integrated review of developmental outcomes and late-preterm birth. J Obstet Gynecol Neonatal Nurs. 2011;40(4):399-411. PMid:21771069.
6. Ballot DE, Potterton J, Chirwa T, Hilburn N, Cooper PA. Developmental outcome of very low birth weight infants in a developing country. BMC Pediatr. 2012;12:11. PMid:22296705.
7. Glass HC, Costarino AT, Stayer AS, Brett CM, Cladis F, Davis PJ. Outcomes for extremely premature infants. Anesth Analg. 2015;120(6):1337-51. PMid:25988638.
8. Kallankari H, Kaukola T, Olsén P, Ojaniemi M, Hallman M. Very preterm birth and fetal growth restriction are associated with specific cognitive deficits in children attending mainstream school. Acta Paediatr. 2015;104(1):84-90. PMid:25272976.
9. Ortiz-Mantilla S, Choudhury N, Leevers H, Benasich AA. Understanding language and cognitive deficits in very low birth weight children. Dev Psychobiol. 2008;50(2):107-26. PMid:18286580.
10. Velikos K, Soubasi V, Michalettou I, Sarafidis K, Nakas C, Papadopoulou V, et al. Bayley-III scales at 12 months of corrected age in preterm infants: Patterns of developmental performance and correlations to environmental and biological influences. Res Dev Disabil. 2015;45-46:110-9. PMid:26232203.
11. Jong M, Verhoeven M, Lasham CA, Meijssen CB, van Baar AL. Behaviour and development in 24-month-old moderately preterm toddlers. Arch Dis Child. 2015;100(6):548-53. PMid:25589560.

12. Kara ÖK, Günel MK, Açikel C, Yiğit Sm Aeslan M. Is there any difference between high-risk infants with different birth weight and gestational age in neurodevelopmental characters? Turk Pediatri Aes. 2015;50(3):151-7. PMid:26568690.

13. Jensen SK, Bouhouch RR, Walson JL, Daelmans B, Bahl R, Darmstadt GL, et al. Enhancing the child survival agenda to promote, protect, and support early child development. Semin Perinatol. 2015;39(5):373-86. PMid:26234921.

14. van Noort-van der Spek IL, Franken MC, Weisglas-Kuperus N. Language functions in preterm-born children: a systematic review and meta-analysis. Pediatrics. 2012;129(4):745-54. PMid:22430458.

15. Moura-Ribeiro MVL. Primeiras experiências e consequências no neurodesenvolvimento de crianças. In: Riechi TIJS, Moura-Ribeiro MVL. Desenvolvimento de crianças nascidas pré-termo. Rio de Janeiro: Revinter; 2012. p. 3-7.

16. Formiga CKMR, Vieira MEB, Linhares MBM. Avaliação do desenvolvimento de bebês nascidos pré-termo: a comparação entre idades cronológica e corrigida. Ver Bras Crescimento Desenvolv Hum. 2015;25(2):230-6.

17. Brown HK, Speechley KN, Macnab J, Natale R, Campbell MK. Mild prematurity, proximal social processes and development. Pediatrics. 2014;134(3):814-24. PMid:25113289.

18. Guerra CC, Barros MC, Goulart AL, Fernandes LV, Kopelman BI, Santos AM. Premature infants with birth weights of 1500-1999 g exhibit considerable delays in several developmental areas. Acta Paediatr. 2014;103(1):e1-6. PMid:24117765.

19. Páez-Pineda OD, Valencia-Valencia D, Ortiz-Calderon MV. Evaluating language acquisition using the Early Language Milestone (ELM) and Munich Developmental Scales. Rev Salud Publica. 2014;16(3):453-61. PMid:25521959.

20. Lamônica DA, Carlino FC, Alvarenga KF. Avaliação da função auditiva receptiva, expressiva e visual em crianças prematuras. Pró-Fono Revista de Atualização Científica. 2010;22(1):19-24. PMid:20339803.

21. Duan Y, Sun FQ, Li YQ, Que SS, Yang SY, Xu WJ, et al. Prognosis of psychomotor and mental development in premature infants by early cranial ultrasound. Ital J Pediatr. 2015;41(9):30-7. PMid:25886733.

22. Howe TH, Sheu CF, Hsu YW, Wang TN, Wang LW. Predicting neurodevelopmental outcomes at preschool age for children with very low birth weight. Res Dev Disabil. 2016;48:231-41. PMid:26630614.

23. Gerber A. Problemas de aprendizagem relacionados à linguagem – sua natureza e tratamento. Porto Alegre: Artes Médicas; 1996.

24. Lamônica DAC, Picolini MM. Habilidades do desenvolvimento de prematuros. Rev CEFAC. 2009;11(2):145-53.

25. Pramana IA, Neumann RP. Follow up care of the preterm infant. Ther Umsch. 2013;70(11):648-52. PMid:24168798.

26. ABEP: Associação Brasileira de Empresas de Pesquisa [Internet]. Critério de Classificação Socioeconômica Brasil. São Paulo: ABEP; 2012. [citado em 2015 Jan. 2015]. Disponível em: www.abep.org

27. Frankenburg WK, Doods J, Archer P, Bresnick B, Maschka P, Edelman N, et al. Denver II training manual. Denver: Denver Developmental Materials; 1992.

28. Månsson J, Fellman V, Stjerngvist K. Extremely preterm birth affects boys more and socio-economic and neonatal variables pose sex-specific risks. Acta Paediatr. 2015;104(5):514-21. PMid:25620552.

29. Douglas-Escobar M, Weiss MD. Biomarkers of brain injury in the premature infant. Front Neurol. 2013;22(3):185-9. PMid:23346073.

30. Raybaud C, Ahmad T, Rastegar N, Shroff M, Al Nassar M. The premature brain: developmental and lesional anatomy. Neuroradiology. 2013;2(Suppl 2):23-40. PMid:23832006.

## Author contributions

*CCR was responsible for the study design, collection and analysis of data, and writing of the manuscript; MROP contributed with the study design, collection and analysis of data, and revision of the manuscript; NCOA contributed with collection and analysis of data, and revision of the manuscript; DACL was responsible for the study design, data analysis, and writing of the manuscript.*