Cognitive and language development in preterm infants

Desenvolvimento cognitivo e linguagem em prematuros

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ABSTRACT

Purpose: To correlate aspects of cognitive and language development in preterm infants of 24 and 42 months of chronological age. **Methods:** A quantitative, analytical, and cross-sectional study was conducted between February and December 2012. The sample comprised ten preterm infants with a chronological age ranging between 24 and 42 months. These children were subjected to the Bayley Scales of Infant Development – III and evaluated according to cognitive, receptive, and expressive language subscales. **Results:** A statistical significance was observed when correlating chronological and corrected age with the age of cognitive and language development. In the correlation of chronological age with cognitive and language abilities, a statistical significance was observed regarding the ability to grasp and handle objects, and in the construction and object permanence capacity. In the correlation of developmental age with cognition and language abilities, a statistical significance was observed in all cognitive abilities. A significant correlation was not observed between ages of expressive language development and receptive language ability. **Conclusion:** A correlation between chronological and corrected ages with the ages of cognitive and language development was confirmed. Receptive and expressive language abilities showed a distinct development; however, they were dependent on the cognition.

Keywords: Infant, Premature; Child development; Cognition; Language; Child health

RESUMO

Objetivo: Correlacionar os aspectos do desenvolvimento cognitivo e de linguagem em prematuros de 24 a 42 meses de idade cronológica. **Métodos:** Estudo quantitativo, de caráter analítico e transversal, realizado no período de fevereiro a dezembro de 2012. A amostra foi constituída por dez crianças prematuras, na faixa etária cronológica de 24 a 42 meses. As crianças foram submetidas à aplicação da Escala de Desenvolvimento Infantil de Bayley – III e avaliadas mediante as subescalas de cognição, linguagem receptiva e expressiva. **Resultados:** Observou-se significância estatística na correlação das idades cronológica e corrigida com as idades do desenvolvimento cognitivo e de linguagem. Na correlação da idade cronológica com as habilidades cognitiva e de linguagem, houve significância estatística quanto à capacidade de apreensão e manipulação de objetos e na construção e habilidade de permanência dos objetos. Na correlação da idade do desenvolvimento com as habilidades de cognição e linguagem, constatou-se significância estatística em todas as habilidades cognitivas. Não houve correlação significativa entre idade do desenvolvimento de linguagem expressiva e habilidades de linguagem receptiva. **Conclusão:** Confirmou-se correlação das idades cronológica e corrigida com a idade do desenvolvimento cognitivo e de linguagem. As habilidades de linguagem receptiva e expressiva mostraram-se com desenvolvimento distinto, todavia, dependentes da cognição.

Descritores: Prematuro; Desenvolvimento infantil; Cognição; Linguagem; Saúde da criança

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INTRODUCTION

In Brazil, premature birth is still the primary cause for neonatal mortality. In addition to long-term risk of sequelae, it is higher when the gestational age of the preterm infant is lower. The intercurrences resulting from different clinical complications of preterm birth may contribute to re-hospitalizations and lead to growth deficit, neurodevelopment delays, and higher morbidity rates[1].

According to the World Health Organization (WHO), prematurity may be classified as one of the following: borderline preterm, 35 to 36 weeks of gestational age; moderate preterm, 31 to 34 weeks of gestational age; and extreme preterm, gestational age ≤ 30 weeks. Newborns who are considered to have low birth weight may be classified as very low weight (less than 1.5 kg) or extremely low weight (less than 1.0 kg)[2].

Preterm infants born with less than 1.5 kg and/or 32 weeks of gestational age are considered to be at a higher risk for neurological development impairments. They may develop numerous complications, such as breathing difficulties, intracranial bleeding, infections, faster heat loss, and difficulties in feeding themselves, among other intercurrences that may negatively affect brain development[3]. In addition to stressful environmental conditions, these factors include inherent cerebral vulnerability of the preterm infant during the critical period of development and multiple clinical complications.

Studies that compare children born as preterm infants with very low weight with children born as full-term infants with weight equal to or higher than 2,500 g indicate that those in the first group are more prone to cognitive deficiencies[4,5], school performance problems[6], behavioral difficulties[7], and language problems[8].

This observation justifies the need for monitoring the development of preterm babies and/or very low weight babies.

The prognosis of the development of preterm children depends on the complex interaction of biological, environmental, and socio-economic factors that act on their immature and vulnerable brains[9].

Considering the neurological maturation, formation of affective bonds, and knowledge elaboration, it should be noted that the first months of life are crucial for infant development. Preterm children are subject to higher risk of alterations in their cognitive and, consequently, language development.

It is, therefore, necessary to monitor the development of preterm children with the aim of detecting, preventing, or minimizing possible impairments in these neurodevelopmental aspects. The literature contains various protocols for following infant development, among which the Bayley Scales of Infant Development – III (BSID – III) stands out.

The Bayley Scales of Infant Development – III is considered the gold standard for evaluating infant development through quantitative and qualitative analyses of different developmental aspects. It is divided into five subtests: Cognition, Language (receptive and expressive), Motor (gross and fine), Social, and Emotional and Adaptive[10-12].

This study aims to correlate the aspects of cognitive and language development in preterm infants between 24 and 42 months of age, considering chronological and corrected ages using the Bayley Scales of Infant Development III.

METHODS

This was a quantitative, analytical, and cross-sectional study. It was performed between February and December 2012 at the Occupational Therapy Practice of *Núcleo de Atenção Médica Integrada* (NAMI) (in English: Center for Integrated Medical Attention) of the Universidade de Fortaleza (UNIFOR).

The studied population comprised preterm children born with less than 37 weeks of gestational age, belonging to both genders, and with no restrictions regarding delivery type or weight at birth. Children between 24 and 42 months of age who were under observation by the Early Stimulation Service from the abovementioned institution were considered eligible. Exclusion criteria were cerebral palsy diagnosis, syndromes, congenital malformations, and presence of hearing and/or visual impairment. The study sample included ten children.

The data collection, which occurred individually over a period of one hour, was conducted by researchers responsible for the study. Initially, relevant data regarding the child's history were collected, such as gestational background; gestational age; weight at birth; and prenatal, perinatal, and postnatal intercurrences. Subsequently, the correction of age was performed, taking into account 40 weeks as a reference, and was calculated by subtracting from the 40th week the number of gestational weeks at birth (i.e., corrected age = chronological age – [40 weeks – gestational age in weeks]).

Subsequently, the Bayley Scale, developed by Nancy Bayley and collaborators in 1933, was applied and presented in three versions: BSID I, published in 1969; BSID II, published in 1983; and the most actualized BSID III, could be accessed by the public in 2006. The BSID III is recommended to evaluate the development of children between 1 and 42 months of age. It is divided into the following development aspects: gross motor, fine motor, receptive and expressive language, cognition, and behavioral aspects. In this study, the Cognitive and the Receptive and Expressive Language Scales were prioritized.

The Cognitive Scale is composed of 91 items with abilities that determine how the child thinks, reacts, and learns about the world. The Language Scale is divided into two subtypes: Receptive Language, composed of 49 items, with abilities that indicate how the child reorganizes sounds and understands and directs words, and Expressive Language, with abilities that establish how the child communicates using sounds, gestures, and words and is composed of 48 items.

The application of the scale was initiated by performing

the correction of age of the child with the aim of establishing the first item of the test. In order to continue, the child had to obtain a score of one in the first three consecutive items. If the child obtained a score of zero in any of the first three items, he or she would go back to the initial point of the previous age stipulated by the scale. The test was finished when the child obtained a score of zero in five consecutive items.

The interpretation of the results referring to Cognitive and Language Scales was performed through quantitative analysis of responses. The final result of the evaluation was expressed in Developmental Quotient (DQ); the minimum quotient was equal to 100 points with a standard deviation of 15% and might have varied between 85 and 115 percentage points. Developmental aspects were classified as: very superior behavior (index ≥ 130th percentile), superior behavior (index between 120th and 129th percentile), medium-high behavior (index between 110th and 119th percentile), medium behavior (index between 90th and 109th percentile), medium-low behavior (index between 80th and 89th percentile), and borderline behavior (index ≤ 79th percentile).

The selection of variables pertinent to the study prioritized aspects associated with gestational age; chronological and corrected age; and evaluation of receptive, expressive, and cognitive language of preterm infants between 24 and 42 months.

For data analysis, we used the following software: SPSS V17, Minitab 16, and Excel Office 2010. Non-parametric tests were applied, since the dataset comprised a low sample size (ten children). Descriptive statistics were used to characterize the sample in relation to all the variables.

The tests used were the correlation test and the p-value test. A confidence interval of 95% and significance level of 5% were considered to verify the reliability.

All the parents or people responsible for the children signed an Informed Consent Form in accordance with Resolution 196/96 of the National Committee of Ethics in Research (CONEP). This study was submitted and approved at the Brazil Platform, process CAAE 05302312.9.0000.5052, under the registration number 148.651.

RESULTS

A significant correlation between the chronological age and all the development ages was observed. When correlating the chronological age with the age of receptive language development, we noticed a tendency for statistical significance (p=0.085). This also occurred when the correlation referred to expressive language (p=0.044). The correlation with age of cognitive development was also significant (p=0.030) (Table 1).

A significant correlation between the corrected age and all the development ages was observed. When correlating the corrected age with the age of receptive language development, a tendency for statistical significance (p=0.083) was observed. This also occurred when the correlation was referring to expressive language (p=0.010). The correlation with age of cognitive development was also significant (p=0.002) (Table 2).

When correlating the chronological age with the percentage of correct cognitive abilities and receptive and expressive language, a statistically significant correlation was observed in the ability to grasp and handle objects (p=0.035) as well as in construction and object permanence (p=0.031) (Table 3).

When correlating the age of cognitive development, a tendency for statistical significance was observed in all the correlated abilities.

In the correlation between age of receptive language development and the abilities of cognitive, receptive, and expressive language scales, a statistical significance was only obtained for the ability to grasp and handle objects (p=0.003).

Table 1. Correlation between the chronological age and the age of cognitive, receptive, and expressive language development

	Chronological age	
	Corr (%)	p-value
Age of cognitive development	68.1	0.030*
Age of receptive language development	57.0	0.085*
Age of expressive language development	64.4	0.044*

*Significant values (p<0.05) – Correlation test
Note: Corr = correlation

Table 2. Correlation between the corrected age and the age of cognitive, receptive, and expressive language development

	Corrected age	
	Corr (%)	p-value
Age of cognitive development	84.1	0.002*
Age of receptive language development	57.3	0.083*
Age of expressive language development	76.2	0.010*

* Significant values (p<0.05) – Correlation test
Note: Corr = correlation

Table 3. Correlation between the chronological age and cognition and language abilities.

		Chronological age	
		Corr (%)	p-value
Cognitive abilities	Ability to grasp and handle objects	66.7	0.035*
	Construction and object permanence ability	67.8	0.031*
	Memory	52.2	0.150
Receptive language abilities	Identification of objects and referenced images	17.0	0.639
	Development of receptive vocabulary	-28.2	0.431
	Morphological development	25.0	0.550
Expressive language abilities	Joint referential	-51.1	0.131
	Development of expressive vocabulary (nomination)	0.3	0.992
	Morphosyntactic development	-38.7	0.344

* Significant values (p<0.05) – Correlation test
Note: Corr = correlation

Table 4. Correlation between the developmental age and the abilities of the cognitive, receptive, and expressive language scale

			Age of cognitive development	Age of receptive language development	Age of expressive language development
Cognitive abilities	Ability to grasp and handle objects	Corr (%)	83.3	83.4	80.3
		p-value	0.003*	0.003*	0.005*
	Construction and object permanence ability	Corr (%)	62.7	42.1	61.2
		p-value	0.052*	0.225	0.060*
Receptive language abilities	Development of receptive vocabulary	Corr (%)	65.9	31.6	37.5
		p-value	0.038*	0.374	0.286
Expressive language abilities	Development of expressive vocabulary (nomination)	Corr (%)	66.9	52.3	75.4
		p-value	0.034*	0.121	0.012*

* Significant values (p<0.05) – Correlation test
Note: Corr = correlation

When correlating the age of expressive language development and the abilities of cognitive, receptive, and expressive language scales, a statistical significance was observed in the ability to grasp and handle objects (p=0.005), construction and object permanence (p=0.060), and the development of expressive vocabulary (nomination) (p=0.012) (Table 4).

DISCUSSION

Prematurity is one of the main biological risk factors for child development due to the immaturity and vulnerability of the developing brain[13]. Scientific advances emphasize that cerebral plasticity is more marked in the first years of age. It is susceptible to stimulation as well as to biological, genetic, and environmental factors[13,14]. Children who present alterations in their development and obtain early diagnosis and interventions will have higher progress possibilities[14,15]. However, when following preterm infants, it is necessary to correct the age with the aim of identifying possible development delays or deviations.

In this study, we performed the age correction that is necessary to delimitate the diagnosis of the development of preterm children[16].

The literature suggests that preterm newborns are more prone to exhibit development delays in motor, language, and cognitive areas[17-20]. In the study analyzed, we observed that the chronological and corrected age could influence the development of these areas. This notion was supported by the correlation obtained between the ages of cognitive and receptive development and expressive language abilities.

The age range of the analyzed children was within the representation or preoperational period - symbolic phase - characterized from 2 to 7 years of age, which is the stage when the child starts to develop the capacity to imitate and create elaborate games and symbols[20-22]. The cognitive abilities that have shown to be statistically significant were the ability to grasp and handle objects and construction and object permanence. This result supports the statement in the literature suggesting that one of the prerequisites for language development in the preoperational period is the ability of object handling and permanence[23-25].

This reality confirms the relation between language development and perceptive-motor reaction and cognition[26].

In the correlation between the age of expressive language development and receptive and cognitive language abilities, we observed a tendency for statistical significance in all the cognitive abilities.

Surveys describe differences in the development of receptive and expressive language[24-26]. We observed discrepancies in receptive language abilities when compared to the age of expressive development capacities, since in this phase children enhance expressive language by repeating sounds without understanding their meaning. First, they need to understand and then transform it into words[27,28]. They are able to perform two activities at the same time - for instance, to report, identify, and name objects and their functions; to reply and structure simple orders; and to tell stories[29,30], which are abilities that are well defined in full-term children and not observed in the preterm infants analyzed in this study.

We observed that prematurity may lead to important alterations in the stages of language development for which cognition was shown to be the primordial factor for the children to improve their capabilities. It is known that, as the age of cognitive development increases, the receptive and expressive language abilities also increase.

The deficits found in the abilities referring to cognitive and language development in preterm children underline the need for careful and standardized evaluations with the aim of early detection of impairments in the development of the children, which may improve their quality of life.

CONCLUSION

A correlation between chronological and corrected ages and the age of cognitive and language development was observed. Also noted was an influence of chronological age in the development of cognitive abilities.

It was known that the age of cognitive development influences the cognitive, receptive, and expressive language abilities, and a relationship exists between age of receptive and expressive language development with the ability to grasp and handle objects.

A relationship between the age of expressive language development and the development of expressive vocabulary was observed (nomination).

Receptive and expressive language abilities showed distinct development, although dependent on the cognition.

We suggest the use of larger samples to amplify our findings and follow the development of preterm infants beyond the ages addressed in this study.

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