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Receptive language and intellectual abilities in preterm children☆

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ABSTRACT

Objective: The aim of this study was to examine the association between receptive vocabulary performance and intellectual quotient (IQ) in preterm born children compared to children born at term.
Method: A total of 72 preschool-age children participated in the study. Participants were divided in four groups: EG-I, including 20 moderate to late preterm born children; EG-II, comprehending 16 extremely preterm born children; CG-I and CG-II with correspondingly 20 and 16 children born at term. EG-I and CG-I as well as EG-II and CG-II groups were matched according to gender, chronological age, and family SES. The mean age of children in each group was: EG-I and CG-I: 30.3 months; EG-II and CG-II: 29.1 months. The assessment information was collected using an anamnesis protocol, the Brazilian criterion of economic classification, the Peabody Picture Vocabulary Test, and the Stanford-Binet Intelligence Scale.
Results: Mean scores for receptive vocabulary were significantly lower in both preterm groups (EG-I and EG-II) than in the corresponding matched groups (CG-I and CG-II). However, no significant differences were found among the preterm groups. Moreover, high correlations between vocabulary and IQ scores were found in both preterm groups (EG-I and EG-II). In contrast, no significant correlations were found when analyses considered each group of full-term born children (CG-I and CG-II).
Conclusion: Our findings indicate that prematurity status has an impact on receptive language performance and on the pattern of relationships between receptive vocabulary and general intellectual functioning.

1. Introduction

Each year, an estimated number of 15 million babies are born prematurely all around the world [1]. A neonate is defined as preterm when birth occurs before 37 weeks of pregnancy are completed. Babies who are born with gestational age (GA) below 30 weeks are considered extremely preterm [2]. Occurring during a fundamental period of the neurodevelopmental process, the early interruption of the typical course of pregnancy can lead to structural and anatomic changes of the central nervous system. Furthermore, born too soon seems to increase the child vulnerability to several medical complications including brain injuries [3]. Thus, prematurity is considered a biological risk factor for atypical trajectories of development [4–9].

There is a considerable consensus about the fact that the course of language development, in both receptive and expressive aspects, is determined by complex interactions among biological, epigenetic, environmental and psychosocial factors [4,7]. Consequently, the functional architecture of language can be differently impaired according to the nature and the number of risk factors [9,10].

Children born preterm are more likely than full-term infants to present problems in linguistic development [9–26]. Actually, developmental language disorders have been reported in 3% to 10% of the babies born at term while for preterm babies such percentage is approximately 30% [27]. During the preschool years, difficulties of language are prevalent in premature children who may present poorer vocabulary and decreased morphosyntactic complexity [16,17,20,23–27]. At school age, preterm born children may also show increasing difficulties with complex language functions [5], which can affect social functioning as well as academic and communicative performance [2,12,22].

Receptive vocabulary is an important requirement for information processing. Hence, vocabulary extension may be conceived as an organizer of more general cognitive abilities [13,27]. Although not much is known concerning the potential impact of language learning

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on overall cognitive competence, linguistic development occurs alongside with cognitive development [25] and both processes seem to influence each other [27].

Having as reference the wider problem of prematurity impacts on linguistic and cognitive development, the current study compares receptive vocabulary performance and general intellectual functioning in young children born preterm or at term. Thus, two specific research questions were evaluated: (a) Are there differences between preterm and full-term children regarding vocabulary and IQ scores? (b) To what extent is vocabulary performance associated with general intellectual functioning either in preterm children or in children born at term?

In this study we compared extremely premature and moderate to late preterm born children with children who were born at term matching the groups in accordance to gender, chronological age, and socio-economic status.

2. Material and methods

The study project was approved by the Research Ethics Committee (Protocol: 035/2011) and all participants' caretakers signed the Informed Consent Form.

This is a cross-sectional study with 72 children divided in four groups: Two preterm groups, EG-I (20 moderate to late preterm born children) and EG-II (16 extremely preterm); two comparison groups, CG-I (20 children born at term) and CG-II (16 children born at term). EG-I and CG-I as well EG-II and CG-II groups were matched in relation to chronological age, gender, and family SES. Since children's age was above 24 months after birth, we did not use the corrected gestational age criterion.

The inclusion criteria adopted for the groups EG-I and EG-II were: Being preterm, having chronological age between 24 and 36 months; not presenting a diagnosis of cerebral palsy or brain lesions and having normal results in the neonatal hearing, visual and metabolism screenings. For groups CG-I and CG-II, the following inclusion criteria were considered: being born at term with birth weight above 2500 g; chronological age between 24 and 36 months; presenting no signs of neuromotor developmental delay, and non-abnormal results in the neonatal hearing, visual and metabolism screenings.

All groups' assessment comprehended the administration of:

- The Peabody Picture Vocabulary Test – PPVT [28], aiming to assess the receptive vocabulary. With the obtained results for each individual we classified its performance level, using the confidence interval values in accordance with the instructions of the instrument's manual.
- The Stanford-Binet Scale, aiming to measure children's general intelligence. We used a translated and adapted version of the Terman-Merrill LM form [29]. The scale items are grouped in age levels. From two to five years old items range in six months intervals. From five years onwards, intervals range one year. Each interval corresponds to a level of performance of the child. There are six items for each level, besides a supplementary one to substitute any of the items of the same level, if necessary. The scale has verbal and nonverbal items; the latter predominate when testing very young children. The test administration starts with items corresponding to one level below the chronological age of the examinee; if the child fails, the items from an even lower level are applied until all items of one same level are solved, thereby determining the basal age. The items of the next higher level are then applied, until reaching the ceiling point in which no item is solved. For each item solved above the BA, a month is added to the basal age in order to obtain a mental age (MA) score. In this study, IQ scores were calculated using the classical ratio formula:

$$IQ = MA/CA \times 100$$

Characterization of the SES of children's families was accomplished using the Brazilian Economic Classification Criterion (BECC) [30]. The BECC considers the possession of items by the family (material goods) and the level of school instruction of the parents.

Table 1
Characterization of casuistry.

	EG-I	CG-I	EG-II	CG-II
Gender	40% F 60% M	40% F 60% M	56.3% F 43.7% M	56.3% F 43.7% M
CA mean	30.3	30.3	29.1	29.1
GA mean	34.5	38.9	28	38.9
Weight mean	2247 g	3274 g	1240 g	3432 g

Caption: CA: Chronological Age; GA: Gestational Age; F: Female; M: Male.

Table 1 presents both preterm and comparative groups casuistry regarding gender, mean chronological age (CA), mean gestational age (GA) in months and mean birth weight in grams.

All preterm children (EG-I and EG-II) did not have a diagnosis of brain lesion or cerebral palsy. Regarding language development, caretakers reported, in the anamnesis a delay in the appearance of the first words in 25% of the EG-I and in 43.75% of the EG-II participants. Concerning education, 60% of the EG-I, 30% of the CG-I, 56.25% of the EG-II and 50% of the CG-II did not attend preschool.

The participants were predominantly from urban middle-class socioeconomic backgrounds (30% were lower middle-class, 62.5% were middle and 7.5% were upper middle-class).

Data were analyzed using the Student's *t*-test for comparing mean scores between groups. The Spearman Correlation Test was used for examining relationships between results obtained on the PPVT and on the Stanford-Binet Scale.

3. Results

Table 2 presents the means of EG-I and CG-I regarding the performance in the receptive vocabulary assessed with the Peabody Picture Vocabulary Test (PPVT). Mean comparisons showed a big size effect significant difference between the groups, with CG-I children exhibiting a better performance.

Table 3 presents the comparison between EG-II and CG-II regarding the performance on receptive vocabulary in the Peabody Picture Vocabulary Test (PPVT), which showed, equally, a big effect size significant difference with the CG-II participants having a better performance.

Table 4 presents the comparison between EG-I and EG-II concerning the performance in receptive vocabulary with no statistically significant difference found between the groups.

Table 5 presents correlation coefficients between receptive vocabulary measures in the Peabody Picture Vocabulary Test and scores in the Stanford-Binet for each one of the groups. There was a strong correlation for groups EG-I and EG-II; No significant correlations were found for results of CG-I and CG-II groups.

Results of the Stanford-Binet test showed that 50% of the participants in GE-I and GE-II and all the participants in GC-I or GC-II groups obtained score values according to expectations for their chronological age.

Table 2
Results of the PPVT in the EG-I compared to the CG-I.

PPVT	GROUP	Mean	Minimum	Maximum	Standard Deviation	t d	
Language	EG-I: CG-I	3.4 5.4	0 4	6 8	2.4 1.1	−3.4*	1.07

$p < 0.01$ Student *t*-test.
* Significant at p 0.01.