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Risk for language delay in healthy preterm and full-term children

A longitudinal study from 22 to 60 months

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This study analysed the *Risk for Language Delay* (RLD) in a sample of healthy preterm children and a full-term control group. We collected direct and indirect measures of language development from 10 to 60 months, and we examined the influence of biomedical, cognitive and environmental variables over the RLD at 22, 30, and 60 months. While at the early ages there were not significant differences in the prevalence of RLD between preterm and full-term children, at 60 months receptive grammar delay was more frequent in the preterm group. Also, preterm children showed a higher instability in the prevalence of RLD over time. Lastly, cognitive development, maternal education and early expressive vocabulary were the most important factors to predict RLD.

Keywords: language delay, preterm children, lexical development, grammatical development

Introduction

A large number of previous studies show that preterm birth (< 37 weeks of gestational age) represents a risk condition for language development (Foster Cohen, Edgin, Champion & Woodward, 2007; Guarini et al., 2010; Stolt et al., 2007; Stolt et al., 2016). Some research focused on early lexical and grammatical development suggests that preterm children (PR) have a smaller and more immature lexicon, and significantly more reduced MLU's than full-term (FT) children. Those differences tend to be greater as gestational age (GA), and birth weight (BW) are lower (Adams-Chapman, Bann, Carter, & Stoll, 2015; Kern & Gayraud, 2007; Foster

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Cohen et al., 2007; Stolt et al., 2007). Similar results were obtained when longer-term language outcomes of PR and FT children were compared (Barre, Morgan, Doyly, & Anderson, 2011; Foster-Cohen, Friesen, Champion, & Woodward, 2010; Wolke & Meyer, 1999; Woodward et al., 2009).

However, these results are far from being conclusive. Some works did not find significant differences between FT and PR children's language development, at least at the early ages (Cattani et al., 2010; Pérez Pereira, Fernández, Resches, & Gómez Taibo, 2013; Pérez Pereira, Fernandez, Gómez Taibo, & Resches, 2014; Sansavini et al., 2006; Stolt et al., 2007). Sample selection issues may partially explain such discrepancies. Most of the studies carried out on the PR population have focused on very low BW (< 1000gr.) and/or extremely low GA (<28 weeks) children. Also, exclusion criteria have not been clearly established in many studies, some of them including some subjects with associated medical complications. Even though most of the PR children (around 80%) are over 32 weeks of GA and a mean BW of 2000 gr. (Blencowe et al., 2012), those research findings have been easily generalised to the whole PR population. There are some other factors which might also contribute to different results among studies. Some authors suggest that direct measures of language skills may be more sensitive than indirect measures in detecting language delays in moderate-to-late PR children (Stolt et al., 2009). However, given the wide variability and the context-dependent nature of very young children's linguistic behaviour, sensitivity remains a common issue both for direct and indirect approaches to language assessment at early ages (Law & Roy, 2008). Other sources of variation among results obtained with language development in PR children are differences both in the age of assessment and on the kind of language abilities evaluated (i.e. expressive/receptive; vocabulary/grammar).

Moreover, the relative scarcity of long-term, longitudinal studies about language development of healthy, moderate-to-late PT children from different approaches of assessment makes it difficult to conclude the stability of their results over time. Also, this lack of studies may hinder the identification of those factors influencing PR children's language outcomes at each stage of development.

Pérez-Pereira et al. (2014) assessed the early language and communicative development of an initial sample of 150 healthy PR children (mean *GA* = 32.62; mean *BW* = 1,727.57gr.), and 49 FT children between 10 and 30 months of age. They did not find significant differences between the PR and FT groups in communicative lexical or grammatical development at any of the age points analysed. They found that cognitive development at 22 months together with the lexical size at the same age were the most important variables for predicting language development at 30 months. More recently, Pérez-Pereira and Cruz (2018) analysed the vocabulary growth and composition of this same PR sample. Again, they found that when biomedical complications associated with prematurity are excluded, GA did not contribute to explaining the longitudinal changes in these variables.

Based on a more immature, although healthy PR sample (mean $GA = 30.4$; BW ≥1200 gr.), Sansavini et al. (2006) pointed to partially similar results. These authors did not find a lower lexical or grammatical development in the PR group, as compared to a FT sample at 30 months. Nevertheless, they observed a wider range of individual variability within the PR group, showing a tendency for a higher incidence of *Risk for Language Delay* (RLD; Language outcomes ≤10th percentile or ≤ −1.25 SD in the absence of sensorial or neurological impairment). Interestingly, those preterms at RLD were males with a $BW \leq 1000$ gr and ≤ 31 weeks GA. Therefore, for this subgroup of PR children other biological factors, like gender, might interact with prematurity to amplify the risk for language difficulties. In contrast, contextual variables such as low maternal education did not represent a risk factor, at least at 30 months of age. In a later study, Sansavini et al. (2010) analysed the evolution of RLD in this same PR sample. They compared the percentage of children at RLD at 30 months with that found one year later, at 42 months of age. At 30 months, the incidence of children at RLD was not significantly higher for the PR than for the FT group. At 42 months, in turn, there was a significant increase in the number of PR children at RLD, with more than 30% of them at −1.25 SD in morphosyntactic production, compared with a 7.5% for the FT children. This rate of RLD among the PR children was similar to findings from other studies (Briscoe, Gathercole & Marlow, 2001; Singer et al., 2001; Woodward et al., 2009). Sansavini et al. (2010) also showed that both poorer language and cognitive skills at 30 months were the best candidates for predicting a preterm's risk status one year later. Also, this time, maternal education contributed increasing the prediction of RLD. This last finding agrees with others suggesting that, as development progresses, for immature but healthy PR children, biomedical risk factors tend to lose strength in favour of environmental variables.

A few studies have provided information about the later evolution of the RLD in PR children. Stolt et al. (2014), for example, analysed the prevalence of *weak language skills* (defined as language scores under the 10th percentile of the control group) between 2 and 5 years old in a group of very low birth weight (VLBW mean $BW = 1066$ gr.) children. They found that, despite being a VLBW sample, when children with neurological impairment (NI) were excluded from this group, the percentage of PR children with weak expressive language skills at 2 years of age was not significantly different from the full-term controls (15% vs 9% respectively). However, at 5 years of age, the prevalence of weak language skills among the VLBW group increased by as much as 23%, even after excluding children with NI. In contrast, this percentage remained stable in the FT group. Stolt et al. (2014) also showed that low expressive language scores at 2 years predicted a poor performance on a group of measures of complex language abilities at 5 years of age. In sum, both Sansavini et al.(2010) and Stolt et al. (2014, 2016) informed that the rate of PR children at RLD increased significantly throughout time. These findings contradict some others suggesting that very preterm children catch up to their peers regarding their language development (Luu, Vohr, Allan, Schneider & Ment, 2011; Ment et al., 2003). These discrepancies may be related to different factors affecting the stability of results over time.

Recently, Putnick, Bornstein, Eryigit-Madzwamuze & Wolke (2017) compared the long-term stability of language performance of PR children. Their results revealed a stronger stability in very PR children than in moderate-to-late PR and term children, although those differences are attenuated when the effect of family SES and non-verbal intelligence were controlled. Other studies suggest that the stability of language outcomes depends on the assessed language functions. According to a recent meta-analysis (van Noort-van der Spek, Franken & Weisglas-Kuperus, 2012), while for simple language functions (vocabulary and short sentence processing) differences between PR and FT children remained stable over time, for complex language functions (understanding and production of complex grammatical structures), group differences increased significantly from 3 to 12 years of age.

Furthermore, several other factors may increase the PR children's probability of being at RLD. First, there are a number of biomedical risk factors: low APGAR score (Pérez-Pereira et al., 2013), length of stay in Neonatal Intensive Care Unit (NICU) (Marston et al., 2007; Perez Pereira et al., 2013;), and some medical complications derived from brain or lung immaturity (Foster Cohen et al., 2010; Singer et al., 2001). Second, a good number of previous studies indicate that RLD in PR children does not seem to be specific but rather associated to more general cognitive difficulties (Adams-Chapman et al., 2015; Foster Cohen et al., 2010; Sansavini et al., 2010; Putnik et al., 2017). Finally, these and other studies also point out that certain environmental variables may increase the RLD among these children: low SES (Wolke & Meyer, 1999), low maternal education (Sansavini et al., 2010) and other variables which may affect communicative interactions: risk for maternal depression (McManus & Poehlmann, 2012) or a low quality of the social and material stimuli coming from the home environment (Molfese, Holcomb & Helwig, 1994).

This study has two goals: (1) To analyse the prevalence of RLD in a group of healthy, low-risk PR children, at 22, 30 and 60 months of age, as compared to a FT control group, and (2) To identify which biomedical, contextual or individual variables may increase the probability of RLD on this sample, and whether their predictive value changes over time. Results are intended to provide a non-biased perspective about the evolution, stability, and change in some factors influencing the RLD in a PR sample probably more representative than others from previous studies.

Methodology

Participants

This study is part of a follow-up, longitudinal study where the effects of numerous variables on preterms' language development were examined. The initial sample was recruited just after birth from four different hospitals in Galicia (Spain). There were 150 PR children (79 boys, 71 girls; mean *GA* = 32.60, *SD* = 2.43; range 26–36) and 49 FT children (25 boys, 24 girls; mean *GA* = 39.84; *SD* = 1.44; range 37–42). Parents' consent and approval by the Galician Ethics Committee of Clinical Research were obtained before the beginning of the research.

To distinguish between the effect of premature birth and other confounding variables, the following exclusion criteria were applied: cerebral palsy (as diagnosed up until 9 months of age), periventricular leukomalacia, intraventricular hemorrhage < grade II, hydrocephalus, encephalopathy, genetic malformations, chromosomal syndromes, metabolic syndromes associated to mental retardation, or important motor or sensorial impairments. Newborn children with Apgar scores below 6 at 5 min were also excluded.

Children were assessed at 10, 22, 30, 48 and 60 months old. Given that the prevalence of RLD will be examined at 22, 30 and 60 months, the main biomedical and demographic characteristics of the sample at 22 and 60 months are presented (Table 1). As can be observed, both at 22 and 60 months PR and FT children were not different regarding gender distribution, Apgar score, or maternal education. Also, if we consider their general characteristics and composition regarding GA and BW (with a 70% of moderate-to late PR children), this sample may be considered a low risk, representative PR sample.

Both at 22 and 30 months, children were identified as presenting RLD if their language outcomes were below the 10th percentile of the normative sample from indirect, parent report measures (IDHC). At 60 months, when direct measures of morphosyntactic development were applied, children at RLD were those whose language scores were lower than 1.25 SD of the mean for the FT sample.

Measures and instruments

Given the complex and multivariate nature of this study, it was not reasonable to collect repeated measures of all of the variables at all age points. Instead, some ages were selected as more proper than others to measure the different linguistic, cognitive and environmental variables.

Table 1. Biomedical and demographic data of the PR and FT groups at 22 and 60 months

Variable	PR		FT	
	22 m	**60 m**	**22 m**	**60 m**
	Mean (SD)		**Mean (SD)**	
GA (weeks)	32.62 (2.41)	32.57 (2.29)	39.70 (1.48)	39.70 (1.53)
BW (gr.)	1,721 (435)	1,708 (427)	3,373 (433)	3,340 (440)
Apgar score (1′)	7.94 (1.30)	7.90 (1.31)	8.13 (1.20)	8.18 (1.31)
	n (%)		**n (%)**	
Gender (girls)	65 (47.1)	44 (42.3)	20 (46.9)	15 (45.5)
Stay in NICU				
No stay	36 (26.2)	28 (26.9)	40 (93.1)	30 (90.9)
1–15 days	58 (42.3)	42 (40.4)	2 (4.6)	2 (6.1)
> 15 days	43 (31.3)	34 (32.7)	1 (2.3)	1 (3.0)
Mother's Education				
Basic Educ.	34 (24.8)	23 (22.1)	17 (39.5)	12 (36.4)
High sch./Tech.	56 (40.8)	46 (44.2)	10 (23.2)	10 (30.3)
Higher Ed.	47 (34.3)	35 (33.7)	16 (37.2)	11 (33.3)

Note: *GA* = Gestational Age; *BW* = Birth Weight; NICU = Neonatal Intensive Care Unit; *m* = months

Linguistic measures

Ten months (corrected age for PR children) was selected as a crucial point to observe the emergence of the first pre-linguistic abilities. Early receptive vocabulary and communicative development were assessed through the *Inventario do Desenvolvemento de Habilidades Comunicativas*, Form I: *Palabras e Xestos*, "Words and Gestures" (IDHC; Perez Pereira & García Soto, 2003). The IDHC is the Galician version of the Mac Arthur-Bates Communicative Development Inventory, CDI (Fenson et al., 2007). Two measurements were considered: Total receptive vocabulary (From the section "Vocabulary understanding") and Total Gestures (From the section "Gestures and actions").

At 22 and 30 months (corrected age for the PR group), the IDHC, Form II: *Palabras e Oracións*, "Words and Sentences" was applied (Perez Pereira & Resches, 2011). This range of ages is especially important to establish the point at which the rapid growth of the first vocabulary begins. The section "Word production" was used as a measure of expressive vocabulary both at 22 and 30 months. At 30 months, when the first combination of words in most toddlers is expected, parent responses to the section "Sentence Complexity" were taken as a measure of children's early grammatical development.

At 60 months, when basic language abilities are expected to be consolidated, two measures of expressive and receptive grammar were applied. These measures represent what some authors called *complex language functions* (see van Noort-van der Spek et al., 2012). Both the production and understanding of complex sentences involve the integration across multiple language components and other basic processes for language development, like memory. So, they were considered proper and reliable measurements of a 5-year-old's language skills.

Morphosyntactic production was evaluated through the expressive subscale of the *Test de desarrollo de la morfosintaxis en el niño* (TSA; Aguado, 2000). The TSA-expressive has 34 items. In the first 29 items, the child is shown a card with two drawings, and the examiner says one sentence for each of the drawings. Then, the child is asked to say the sentence matching the picture the examiner points to (i.e., *La chica mira a los perros*; "The girl looks at the dogs"). The last five items the child is asked to conclude a sentence started by the examiner (i.e *Cuando hace frío*…; "When it's cold…"; max. Score = 68).

Grammatical comprehension was assessed through the *Test de Comprensión de Estructuras Gramaticales* (CEG; Mendoza, Carballo, Muñoz & Fresneda, 2005). The CEG consists of 80 items displaying the most representative Spanish grammatical structures. A card presents each item with four drawings. The child is asked to choose the drawing representing the sentence said by the examiner (i.e. *El ratón persigue al gato;* "The mouse chases the cat"; max. Score = 80).

Cognitive and other contextual measures

At 22 and 60 months the Spanish version of the *Battelle Developmental Inventory* (BDI; Newborg, Stock, & Wnek, 1996) was applied. The BDI is composed of five subscales: adaptive, personal-social, communication, motor, and cognitive. At 22 months, the sum of the raw scores in four of the five subscales was considered as a good measure of early cognitive development, which is non-symbolic but mainly practical at the first ages. The score from the communication subscale was excluded to avoid spurious associations with the language measures taken as dependent variables (DV). At 60 months, only the raw score from the cognitive scale was used, since at this age that scale represents a proper measurement of non-verbal intelligence.

As for environmental variables, besides the maternal education, the risk for maternal depression was assessed. Maternal depression might affect the first mother-infant interactions, as well as the quality of family linguistic input and experiences at the preschool age. The Spanish version of the CES-D scale (Radloff, 1977) was applied both at children's 10 months and 60 months. CES-D is a 20-item screening questionnaire aimed to evaluate the presence of symptoms associated with depression among caregivers (max score = 60). Scores ≥16 denote risk for clinical depression. Also, the quality of the stimulation provided by the home environment was assessed through the Spanish adaptation of *The Home Observation for the Measurement of the Environment* scale (HOME; Caldwell & Bradley, 1984). The HOME scale has different versions depending on the child's age since the resources and experiences required for identifying a stimulating environment are different for toddlers than preschoolers. When the children were 22 months, the infant and toddlers' scale was applied (max score: 45). At 48 months children's home environment was reassessed through the version for preschoolers (max. Score: 50).

Procedure

When participants entered the study (15 days), their mothers participated in an interview to gather data on the family's sociodemographic characteristics and children's health. At 10 months, mothers filled out checklists both on child's language development (IDHC-Form I) and her risk for depression (CES-D). Completed forms were sent by mail within the first week after receiving them. At 22 months, the children's cognitive development (BDI), and the quality of their home environments (HOME) were directly assessed by a trained psychologist, who visited their homes. We were informed of their linguistic abilities through the IDHC-Form II, which the mothers filled out a few days before the visit, or sent within the first week after the visit. At 30 months, the IDHC-Form II was completed and mailed again. At 48 and 60 months, the former trained evaluator made two home visits. At 48 months she collected information about the home environment (HOME), and at 60 months, children's cognitive (BDI) and receptive and expressive morphosyntactic abilities (CEG and TSA) were assessed through direct testing. Children were individually evaluated in a quiet room of their homes.

Analyses performed

Firstly, to identify those children at RLD, cut-offs to language scores at 22, 30 and 60 months were applied. According to the previous literature about language delay in PR and non-PR populations, at 22 and 30 months, we used the 10th percentile from the normative sample of the IDHC "Word Production" and "Sentence complexity" sections. At 60 months, both for grammatical comprehension (CEG) and morphosyntactic production (TSA) a cut-point of ≤ −1.25 SD of the mean from the FT sample was used.

In response to the first of our goals, at each age mean scores and the percentage of children at RLD in the PR and FT groups were compared using independent-samples *t* test and *Chi*^{2} test. Also, for both groups, changes in the rate of prevalence of RLD throughout time were examined through the *McNemar's Chi*^{2} test for related samples. Considering previous results with this sample and the low number of individuals at RLD, comparisons were made with the whole PR sample instead of dividing it into groups of GA.

Regarding our second goal (see above), a series of stepwise logistic regression models were performed. The DV's were the 22, 30 and 60 month lexical and grammatical measures, dichotomised regarding the RLD. For each DV, four consecutive models were performed. A step forward method was applied to retain the previously selected independent variables. In the first model, the following biomedical risk-variables were entered: PR/FT birth; APGAR-risk (cut-point = ≤ 7); Stay in NICU (3 groups, see Table 1) and sex. For the second model, a number of environmental risk-variables were considered: Mother's education (3 groups, see Table 1); risk for maternal depression at 10 months for DV's at 22 and 30 months, or at 60 months for DV's at that age (cut-point = ≥ 16); HOME-risk at 22 months or at 48 months for DV's at 60 months (cut-point = ≤ 2nd Quartile according to norms). In a third model, scores from the BDI at 22 or 60 months were entered, together with the biomedical or environmental variables selected on the previous models. Finally, for the fourth model, earlier language scores were summed up to the selected variables from the former model.

Results

Descriptive language, cognitive and environmental measures in PR and FT children

First, PR and FT mean lexical and grammatical scores at 22, 30 and 60 months were compared (Table 2). As shown in previous studies, we did not find significant differences between PR and FT children in the IDHC language measurements up to 30 months of age. However, at 22 months PR children got significantly lower scores in cognitive abilities than the FT children (BDI; $PR = 215.20$ (16.08); $FT = 224.32$ (17.45); $t\ (117) = -3.13$, $p = .001$). In turn, contextual variables at early age – risk for maternal depression at 10 months or the quality of the family environment at 22 months – were not significantly different between groups (CES-D; $PR = 10.3$ (8.80); $FT = 11.1$ (7.54); $t\ (194) = -0.53$, $p = .58$; HOME Scale; $PR = 38.2$ (4.33); $FT = 38.7$ (3.97); $t\ (178) = -0.62$, $p = .53$).

At 60 months of age, grammatical comprehension abilities (CEG) were significantly lower among the PR children. In contrast, PR and FT mean scores in morphosyntactic production (TSA) were not significantly different (Table 2). There were no significant differences between PR and FT children's performance on

Table 2. Language outcomes of the PR and FT groups at 22, 30 and 60 months: Means (SD) and number (percentage) of children at RLD at each age

Outcome	PR	FT	t/X^2	p
22 months	***n* = 137**	***n* = 43**		
Expressive Vocabulary (M (SD))	158.6 (147.28)	173.8 (137.19)	−.59	.55
RLD (≤10th Perc.) (n (%))	37 (27.0)	8 (18.6)	1.23	.26
30 months	***n* = 115**	***n* = 37**		
Expressive Vocabulary (M (SD))	419.5 (175.44)	411.9 (173.76)	.23	.81
RLD (≤10th Perc.) (n (%))	19 (16.5)	7 (19.4)	.16	.68
Syntactic Complexity (M(SD))	20.9 (14.35)	20.5(13.32)	.16	.87
RLD (≤10th Perc.) (n (%))	22 (19.8)	5 (14.2)	.54	.46
60 months	***n* = 104**	***n* = 33**		
Receptive Grammar (M(SD))	47.8 (8.97)	52.1 (7.33)	2.23	.027*
RLD (−1.25 SD) (n (%))	27 (25.9)	4 (12.1)	2.74	.074§
Expressive Grammar (M (SD))	42.1(11.21)	43.6 (8.17)	.68	.49
RLD (−1.25 SD) (n (%))	12 (12)	2 (6.2)	.84	.35

* $p < .05$; § $p < .10$
Note: RLD = Risk for Language Delay;

the BDI's cognitive scale (*PR* = 84.0 (11.30); *FT* = 85.9 (3.18); *t* (136.25) = −1.56 *p* = .11). No significant differences were found neither for the HOME scale at 48 months (*PR* = 48.9 (3.57); *FT* = 49.9 (2.46); *t* (143) = −1.61, *p* = .10) nor for the risk for maternal depression at children's 60 months old (*PR* = 9.10 (6.32); *FT* = 10.73 (8.81), *t* (121) = −1.11, *p* = .268).

PR and FT children's RLD from 22 to 60 months

Second, the prevalence of RLD along time, both for PR and FT children, was compared. At 22 months, almost 30% of the PR children had an expressive vocabulary below the 10th percentile, compared to 18% from the FT group. Those differences, however, did not reach statistical significance (see Table 2). At 30 months, while the percentage of RLD remained stable for the FT group (*McNemar's* $X^2(1) = 1.00$), that percentage significantly decreased for the PR group, (McNemar's X^2 $(1) = .011$). At 60 months of age, in turn, PR children's prevalence of RLD in grammatical comprehension increased to 26%, while that percentage slightly decreased to 12% for the FT group. Between-group differences were marginally significant. Nevertheless, percentages of RLD from 30 to 60 months significantly increased for the PR children (*McNemar's* $X^2(1) = .021$) while not for the full terms (*McNemar's*

$X^2(1) = .453$). About the prevalence of RLD in morphosyntactic production (TSA), there were no significant differences between PR and FT groups, with percentages around the expected values for the general population.

Predicting RLD at 22, 30 and 60 months

To identify those factors predicting RLD for the whole sample, four stepwise logistic regression models were performed (see above). For the first model, among the biomedical variables, in this low-risk sample only being male was significantly related to a higher probability of RLD at 22 months ($OR = .432$, $p = .021$; *Nagelkerke's* $R^2 = .046$); and at 30 months for syntactic complexity ($OR = .338$, $p = .024$; *Nagelkerke's* $R^2 = .064$). The second model assessed the predictive value of some environmental variables on the RLD. Results showed that maternal education was a significant predictor of RLD at 22 months ($OR = 1.60$, $p = .037$; *Nagelkerke's* $R^2 = .079$), at 30 months for a poor performance in syntactic complexity ($OR = 1.90$, $p = .027$; *Nagelkerke's* $R^2 = .056$) and at 60 months of age for grammatical comprehension ($OR = 2.41$, $p = .006$; *Nagelkerke's* $R^2 = .108$). The third model assessed the predictive role of children's cognitive performance in interaction with the previously selected biomedical and contextual variables. While a lower level of cognitive development was a significant predictor of RLD at all ages and for all DV's, maternal education was the only variable which remained in the model increasing the total explained variance at 22 months (*Nagelkerke's* $R^2 = .320$), at 30 months for risk for delay in syntactic complexity (*Nagelkerke's* $R^2 = .250$), and at 60 months for grammatical comprehension (*Nagelkerke's* $R^2 = .212$). Finally, the fourth model evaluated the predictive capacity of the former linguistic variables, after considering the influence of cognitive development and maternal education on the corresponding DV's. Table 3 shows the model's selected variables at each age. As can be observed, at 22 months the risk for lexical delay increased not only because of a poor cognitive performance or a lower level of maternal studies, but children's prelinguistic abilities at 10 months (gestures and receptive vocabulary) contributed in a modest, although significant, way to increase the model's total explained variance (44.8%). In contrast, at 30 months, once former language abilities entered the model, expressive vocabulary at 22 months became the only significant predictor of both risk for lexical and syntactic delay, accounting for 36.5% and 42.7% of the variance. Last, at 60 months of age, non-verbal cognitive development, maternal education and early vocabulary size at 22 months were significant predictors of risk for delay in grammatical comprehension, accounting for 28.3% of explained variance. In turn, non-verbal cognitive skills and lexical development at 30 months explained only 13% of the variance in the prediction of risk for delay in morphosyntactic production.

Table 3. Stepwise logistic regression analyses: Selected contextual, cognitive and linguistic variables as predictors of RLD at different ages

Dependent variables	Nagelkerke's R^2	OR	95% CI	p
RLD-Exp.Vocabulary-22 m.	.448			
BDI-Total score		.907	.871–.943	.000
Maternal education		2.14	1.21–3.78	.009
Total gestures-10 m.		.894	.833–.961	.002
Word understanding-10 m.		1.01	1.00–1.02	.005
RLD-Exp.Vocabulary-30 m.	.365			
Exp.Vocabulary-22 m		.979	.968–.990	.000
RLD- Sent. Complexity-30 m.	.427			
Exp.Vocabulary-22 m		.974	.960–.988	.000
RLD- Recep. Grammar- 60 m	.283			
BDI-Cognitive scale-60 m		.861	.767–.967	.011
Exp.Vocabulary-22 m		.995	.990–1.00	.037
Maternal education		1.88	.997–3.57	.051
RLD-Exp. Grammar-60 m	.135			
BDI-Cognitive scale-60 m		.868	.757–996	.044
Exp. Vocabulary- 30 m		.997	.993–1.00	.055

Notes: RLD = Risk for Language Delay; BDI = Battelle Developmental Inventory; OR = Odds Ratio; CI = Confidence Interval

Discussion

The first goal of this study was to examine the prevalence of RLD in a group of healthy, low-risk PR children from 22 to 60 months of age, as compared to a FT sample. As previous studies with healthy, and even more immature PR children have shown (Sansavini et al., 2010; Stolt et al., 2014), in this work we did not find significant differences between PR and FT children in the prevalence of RLD at 22 and 30 months old. Our results were similar to those informed by Sansavini et al. (2010), who found 16 to 24% of their PR children performing under the 10th percentile in lexical and grammatical development at 30 months. However, results from Stolt et al. (2014) showed that, when children with NI were excluded from their VLBW sample at 24 months, there were only 15% of PR children with weak language skills. Our study differs from Stolt et al. (2014) not only in the criteria for defining early language delay, but mainly because we collected measures of early expressive language at two age-points. When PR's vocabulary production at

22 and 30 months was compared to that of the FT group, PR children showed a higher prevalence of RLD before 24 months, and a significant reduction after eight months. In contrast, those percentages remained stable for the FT group and within the expected epidemiological values (Zubrick, Taylor, Rice, & Seglers, 2007).

At 5 years of age, for a more complex language function like grammatical comprehension, PR children performed significantly lower than FT children. Between-group differences in the prevalence of RLD were only marginally significant. Nevertheless, the percentage of PR children at risk for delay in grammatical comprehension at 5 years significantly increased regarding the observed at 30 months for expressive vocabulary. Our low-risk PR results showed similar values to those informed by Stolt and collaborators at 5 years old (Stolt et al., 2014, 2016). In their studies, language skills at 5 years of age were assessed through the language subscale from the NEPSY II test. When Stolt et al. (2016) analysed the scores from the five subtests conforming the NEPSY-Language score they found that the VLBW group only showed significant differences to controls on the "Comprehension of Instructions" subtest. This subtest requires an understanding of grammatically complex sentences and working memory, both the same abilities required for good performance in our Comprehension of Grammatical Structures Test (CEG).

As for morphosyntactic production (TSA), no significant differences were found between PR and FT groups. The prevalence of RLD on this measure was slightly lower than the observed for grammatical comprehension. On the one hand, these differences could be explained by differences in the complexity of the grammatical structures presented on each test. On the other hand, demands on working memory probably are higher for the CEG than for the TSA test.

In general, these results are in line with previous studies which highlight the importance of considering both the sample selection (Pérez Pereira et al., 2014; Pérez Pereira & Cruz, 2018) and the kind of assessed language abilities (van Noort-van der Spek et al., 2012). During the early ages, and when simple language functions like vocabulary or early grammar were assessed, the prevalence of RLD among PR children without associated medical complications was not significantly different from the FT children. In fact, the percentage of PR children at risk for lexical delay significantly decreased from 22 to 30 months. In contrast, when performance in grammatical comprehension at 5 years was assessed, the prevalence of PR children at RLD increased again. These results follow those obtained through meta-analysis by van Noort-van der Spek et al. (2012) who found that as PR children grow up, they may have increasing difficulties with complex language function.

Nevertheless, considering results from other studies (Stolt et al., 2009), the direct or indirect nature of the linguistic measures applied at different ages (parent report vs. standardised tests) might be a third, non negligible factor – besides the sample selection and the kind of language abilities – influencing results from the present study.

In any case, this pattern of results suggests that among healthy, moderate to late PR children, language growth could be quite unstable, with more children with poor vocabulary at the beginning, but who tend to catch up in a short time. In turn, language difficulties might reemerge at later ages because of the higher processing demands from more complex language abilities. Future studies should carefully analyse the individual pathways of those PR children with persistent language delay before those who recover either at middle or long-term.

The second goal of this study was to identify those biomedical, individual and environmental factors, which could be accurate predictors of RLD across time. As was referred to in previous studies analyzing the mean language performance of this healthy PR sample (Pérez Pereira et al., 2013; 2014), in the present study those biomedical variables associated with prematurity did not contribute to the prediction of RLD. In line with Sansavini et al. (2006; 2011), we found that male gender made a modest, although significant contribution to the prediction of RLD, but only up to 30 months. However, this association between gender and risk for early language difficulties disappeared when general cognitive abilities were taken into account. Therefore, this study confirms the importance of cognitive development as a predictor of RLD both at early and later ages, and even after considering maternal education and former language abilities. These results extend those previously obtained with this sample, and at the same time support findings from other studies with healthy, although more immature, PR children. RLD did not seem to be specific but associated to subtle, more general cognitive difficulties (Adams-Chapman et al. 2015; Foster Cohen et al., 2010; Putnik et al., 2017; Sansavini et al., 2010). Unlike previous studies assessing the predictive value of maternal education on PR children's early language abilities (Pérez-Pereira et al., 2014), we found that a low level in the mother's education made a unique contribution to predicting which children may be at RLD both at 22 and 5 years. It is probable that the maternal level of education is not a good predictor of the vocabulary growth from the PR group as a whole. However, it may become an important variable in predicting which children could fall in the lowest end of the distribution. At 22 months, perhaps more than at 30, the rapid growth of expressive vocabulary is an especially challenging task because it is affected by certain environmental risk factors, such as a low level of education in the mother.

With regards to the predictive value of former language abilities on later RLD, this study supports previous results with the until-30-months sample but also shows the important role of early expressive vocabulary for the long-term prediction of RLD. As in Pérez-Pereira et al. (2014), a low receptive vocabulary and a few gestures at 10 months were significant predictors of risk for expressive vocabulary delay only at 22 months. In turn, a poor lexical development at 22 months helped to predict the risk for a lexical and grammatical delay not only in the short term, at 30 months, but also at a longer-term, for grammatical comprehension at 5 years of age. Also, a low expressive vocabulary at 30 months increased the prediction of risk for morphosyntactic production delay two and a half years later. These results are in agreement with those found by Stolt et al. (2014) who highlighted the predictive value of VLBW children's expressive vocabulary at 2 years on their weak language skills at 5 years of age.

In sum, this study demonstrates the need for following the pathways of language development among healthy, low-risk PR children, beyond the early ages. As other previous studies suggest, this may be especially true in the case of those children with histories of late language emergence (Rice, Taylor, & Zubrick, 2008). Even though PR children's language delays may not become evident from the beginning, when demands on language processing are higher and involve other capacities, like working memory or cognitive control, subtler language difficulties may appear. Those difficulties, in turn, might affect other domains of later development, including scholarly learning abilities.

Among these low-risk PR children, even though the biomedical variables do not seem to help the early detection of those individuals at a higher RLD, the assessment of the first expressive vocabulary and the early cognitive development together with the evaluation of the familiar risk associated with a low educational level may be useful. Considering these other variables would allow us to implement early intervention strategies addressed to those most vulnerable PR children.

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