

Original articles

Spontaneous language of preterm children aged 4 and 5 years

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ABSTRACT

Purposes: to evaluate spontaneous language development through the Mean Length of Utterance in words (MLU-w) of children with gestational age between 28 and 36 weeks. This research also aims to study if the gestational age, birth weight, gender, and parents' level of formal education can influence that measurement.

Methods: nineteen premature children (9 males, 10 females), in the age range 4-5 years old, enrolled on Lisbon area kindergartens, and considered as having typical development, participated in this research. Spontaneous speech of each child was recorded for 30 minutes and transcribed afterwards.

Results: mean values of MLU-w of Portuguese premature children were significantly lower than those with typical development. A positive and significant correlation between the gestational age and the birth weight with the MLU-w was also found. The gender of the children and the parents' level of formal education showed no influence on the results.

Conclusion: these results reinforce the need to identify, on these children, possible deficits, in order to prevent negative impacts in school education, and stimulate their psychosocial development.

Keywords: Preterm Birth; Language Development; Gestational Age; Birth Weight

INTRODUCTION

Prematurity and language development

World Health Organization (WHO) defines “prematurity” as all babies born alive before 37 weeks of pregnancy are completed, establishing three categories of preterm birth: (a) extremely preterm, with less than 28 gestational weeks, (b) very preterm, between 28 and 31 gestational weeks, (c) moderate to late preterm, between 32 and 36 gestational weeks. Preterm birth is the leading cause of death for new-born babies and the second leading cause of death in children under five years of age. In general, preterm infants have an increased risk of illness, disability and death¹. Even slight delays in development resulting from prematurity can have consequences, from school difficulties to the inability to lead a totally independent life².

Several studies have focussed on the effects of preterm birth on the language development. It is presently known that up to the age of 2 the most affected language component is speech³⁻⁵ and that, between 3 and 12 years old, the language development of all preterm born children (regardless the prematurity category) is delayed or compromised⁶. This delay seems to be caused by the lack of neuronal maturation, which limits the auditory discrimination of speech sounds on the first stages of language acquisition⁶, although the results may vary between the expected values for that age and lower values⁷. This delay seems to be due to the lack of neuronal maturation that these children present at birth, which will limit their ability to auditory speech discrimination in the first stages of language acquisition⁸. Therefore, considering that the auditory system of premature babies is more immature to process the phonetic representations, the language development does not benefit from an additional exposure to speech interaction⁹. The deficit on expressive vocabulary of premature children implicates all semantic categories, showing a correlation between low weight, the gestational age, the birth conditions and the number of words produced⁴. Other authors¹⁰ have inclusively studied healthy late premature children, concluding that, when compared with term born children, they still face a bigger risk of development delays and of having problems related to school.

Low birth-weight (hypotrophy) is a very common situation, since there is a statistic correlation between the weight and the level of prematurity¹¹. Moreover, some authors have confirmed that low birth-weight (between 1,000kg and 1,500Kg)¹² always has a

negative impact on language and cognition and that this problem increases on children with very low birth-weight (<1,500Kg), being also responsible for school learning difficulties^{13,16}.

Factors as the sociocultural background and gender can have some influence on language development, although results in this regard are contradictory. Several studies refer to the parents' level of formal education as an important variable, influencing seriously the language development of premature children, but other studies do not confirm this correlation of factors^{14,16-19}. Some authors underline the female advantage²⁰⁻²², though this distinction loses relevance when studying children born with more than 27 gestational weeks.

Mean Length of Utterance

The Mean Length of Utterance in words (MLU-w) is a measure of expressive language development in children frequently used in clinical practice²³, calculated through dividing the number of words produced by a child by the total of intelligible utterances²⁴. In a school-age child, a higher MLU-w value means a more sophisticated linguistic proficiency and, consequently, a better language development²⁵. MLU-w is considered a reliable measure of language acquisition, as well as a good marker to identify speech-language pathology^{26,27}. Some authors recognize a strong correlation between this measure and the semantic and morphosyntactic competences of children with typical development²⁸.

The present study investigates if very preterm born children to late preterm born children (28 to 36 weeks) present lower MLU-w values than the reference values for the population of children with the same age. In this context, it were established the following research goals: (1) To evaluate spontaneous speech of preterm children through the MLU-w, comparing the reference values for the European Portuguese; (2) verify if the gestational age is related to the MLU-w; (3) verify if the birth-weight is related to MLU-w; (4) verify if the parents' formal education level interferes in the MLU-w and also (5) verify if gender influences MLU-w.

METHODS

Participants and sampling process

After approval of the project and confirmed all the ethical norms and the terms of confidentiality by the Instituto de Ciências da Saúde - Universidade Católica Portuguesa, children attending public kindergartens in

the Lisbon Metropolitan Area were recruited to participate in this study.

In a first stage, 150 kindergartens were selected according to a simple random sample, but only 11 have authorised the study. After obtaining parental informed consent, the sample included all premature children who attended those institutions, meeting the following criteria: (1) preterm born children with birth weight noninferior to 1,500Kg and minimal gestational age of 28 weeks, in order to avoid congenital anomalies on the development²⁹⁻³¹, (2) between the 4;00 and

the 5;05 years old, so that the linguistic performance could be compared with the available reference values for children in that age group³², (3) monolinguals of European Portuguese, (4) with no present or previous Speech Therapy treatment and (5) without motor, mental and/or sensory disorders diagnosed that could affect the language development. From the initial sample of 20 children, one boy was excluded, because he has refused to cooperate. Therefore, the sample comprised 19 children, 9 boys and 10 girls (Table 1).

Table 1. Characteristics of the sample per age range

	4.00 – 4.05 (n=5)	4.06 – 4.11 (n=5)	5.00 – 5.05 (n=9)	Total
Gender	2 boys 3 girls	4 boys 1 girls	3 boys 6 girls	9 boys 10 girls
GA (M + SD)	34 ± 2.92	33 ± 2.45	34.89 ± 2.62	34.16 ± 2.63
Birth weight (M + SD)	2.39 ± 0.52	2.03 ± 0.49	2.39 ± 0.45	2.30 ± 0.48

GA – gestational age; M – Means; SD – standard deviation

Since one of the research goals was analysing the effects of prematurity on language development, besides the data regarding each child, it was also necessary to control the sociocultural background, bearing in mind its possible impact on the development. From this point of view, the parents' level of formal education was considered a variable (of the father or mother, the highest): 9 had up to 9 years of formal education; 7 had between 10 to 12 years and 3 had higher education.

Data collection instruments

As well as in the research work developed to obtain reference values of MLUw³² for the Portuguese population, the spontaneous speech of each child was elicited through the interaction with the observer and the voice was digitally recorded (*Olympus Digital Voice Recorder VN-5500PC*, *Olympus - Digital Voice Recorder VN-711PC* and *Philips Voice Tracer Ith0615*). The game-like material used in the speech elicitation was similar to the material used in other studies to calculate the MLU-w^{26,32}: farm animals (cows, a bull, a sheep, a dog, a horse, a goat, a rooster) and wild animals (leopards, a rhinoceros, a lion, a dromedary, a giraffe, a tiger, a deer, a zebra and an elephant), food (corn, courgette and a bunch of grapes), kitchen accessories (a frying pan, pans, a stove and cutlery)

and medical material (a thermometer, a pillbox, an otoscope, scissors, an otoscope, scissors, a stethoscope and a medical bag). All children were able to identify the materials used and/or their function. The interaction was initiated by playing with the animals, and then the medical objects were introduced (“to treat some animals that were sick”) and at the end the set of kitchen objects (“to feed and give strength to animals”). The interaction using each set took about 10 minutes, with the observer interferences being limited to a minimum.

Procedures

The data collection was made by four speech and language therapists, properly trained to collect the specific data, and took place in the kindergarten of each child, in a schedule agreed on with the respective educator. All the collecting process was based on the stimulation of the spontaneous language production in a game-like context, with minimum interference of the observer and during about 30 minutes per child. After collecting all samples of the spontaneous language, the utterances were transcribed and codified by the first author, using ELAN software (*EUDICO Linguistic Annotator*, Max Planck Institute), a well-known tool used for speech transcription.

During the transcripts, in order to establish a reliable comparison between these values and the reference values, it were applied the same conventions and methodological standards to analyse each linguistic corpus. The definition of the utterances has also followed the criteria specified on the study to obtain the reference values: the prosodic curve defines the utterances; the end of a sentence corresponds to the end of the utterance; a pause of two seconds implies the end of the utterance; the expression “and then” (“*e depois*”) divides the utterances. The criteria for the exclusion of the utterances and for counting the number of words per utterance were also similar to the reference study methodology.

The counting of the number of utterances produced by each child did not follow all the rules established in the study to obtain the reference values of MLU-w, i.e., 100 utterances per child. Nonetheless, taking into account that large and small speech samples are not significantly different²³, and to avoid reducing drastically the size of the sample, we have decided to comprise all the participants in our study, including those who

produced more than 50 utterances necessary for the sampling, as Casby²³ mentions. This situation refers to 7 cases, having the children produced between 80 to 97 utterances.

After 240 hours of transcripts in the ELAN 4.1.2. software, all the quantitative data were analysed using SPSS (*Statistical Package for the Social Sciences*) software, version 20 for Windows

RESULTS

Comparing the MLU-w values of premature children with the reference values available for the European Portuguese (Table 2), we have observed that on the three subgroups of premature children there is not a clear increasing of MLU-w values with progressing age, as occurs in the reference values. Considering the small dimension of the sample of premature subgroups, it was made a global comparison, which has shown a significant distinction between the two groups ($t=3,97$, $df\ 109$, $p=0,000$), with minimum mean results of premature children.

Table 2. MLU-w values on premature children by age range and reference values

Age range	n	Minimum	Maximum	Mean \pm SD	Reference values
4.00 – 4.05	5	2.75	4.90	3.91 \pm 0.98	4.49 \pm 0.38
4.06 – 5.00	5	2.89	4.35	3.48 \pm 0.59	4.90 \pm 0.76
5.01 – 5.05	9	3.00	5.62	4.55 \pm 1.06	5.09 \pm 0.65
Total	-	-	-	4.10 \pm 1.01	4.83 \pm 0.66

SD – standard deviation

The Spearman’s nonparametric correlation coefficient has shown that there is a positive moderate and significant correlation between the number of gestational weeks and MLU-w ($\rho=0,615$; $p=0,005$) and between the birth-weight and MLU ($\rho=0,526$; $p=0,024$) (Table 3). At the contrary, it has not shown a significant correlation between MLU-w and the parents’ level of formal education ($\rho=0,403$; $p=0,087$).

The nonparametric Mann-Whitney test has not revealed differences between boys and girls (Table 4).

Table 3. Correlation between MLU-w scores, the number of gestational weeks, birth-weight and parents’ level of education ($n = 19$)

	Rho	p
No. of gestational weeks vs. MLU-w	0.62	0.00
Birth-weight vs. MLU-w	0.53	0.02
No. of years of the parents’ formal education vs. MLU-w	0.40	0.09

Rho = Spearman’s test

Table 4. Mean Length of Utterance in Words (MLU-w): comparison between boys and girls

Mann-Whitney U	25.000
Wilcoxon W	70.000
Z	-1.633
Asymp. Sig. (2-tailed)	0.102

DISCUSSION

Mean MLU-w values revealed by preterm children are, generally, significantly lower to the reference values obtained for the typically developing population, showing that the utterances produced are shorter. These results agree with those described by other studies, suggesting that premature children reveal a delay on language development^{3,4}. The inexistence of a clear increase in MLU values with age progression in the premature children evaluated can arise from different variables: the fact that subgroups were too small, which did not assured equivalent characteristics between them, for instance, birth conditions (suffering from peri/intraventricular haemorrhage, needing mechanical ventilation, hospitalisation time...), which could have serious repercussions on language development^{4,12}. Nonetheless, we have observed higher MLU values in the last age range, 5;00 to 5;05.

We have also verified a positive, moderate and significant correlation between the number of gestational weeks and MLU-w values, as well as between the birthweight and MLU-w. These results corroborate those indicated by other studies, which underline a correlation between the gestational age and the number of words produced³, as well as a delay on language development in premature children with birth weight between 1,500 Kg and 1,999 Kg¹².

According to the outcomes, the parents' level of formal education does not influence significantly the dimension of the utterances. This result may be due to the limitations on auditory speech sounds discrimination revealed by these children since their birth, which persist during the first stages of language development⁶⁹. These difficulties prevent premature babies from taking the most advantage of an additional exposure to speech⁹, and from acquiring a wider and richer vocabulary or more complex syntactic structures⁵.

We have also noticed that there are not significant differences according to gender, corroborating the reference values³². Nonetheless, the achieved results

may be explained by the fact that all children evaluated had a gestational age superior to 28 weeks, considering that the gender distinction loses relevance in neurological development after the 27 gestational weeks²².

CONCLUSIONS

In this research we have compared MLU-w values of 19 premature children with the reference values for the European Portuguese, in the age range of 4-5 years old and five months. The outcomes allowed us to reach some conclusions: (1) mean values of MLU-w of premature children are lower to the mean values of the typically developing population; (2) gestational time and birth-weight have a positive correlation with MLU-w, i.e., more gestational weeks and higher birth weight lead to an increase in the dimension of the utterances produced by the children; (3) the parents' level of formal education does not influence MLU-w; (4) there is not a gender distinction in the dimension of the utterances, confirming the assumptions of the reference study.

We believe that our results may contribute to a better understanding of how spontaneous language develops in preterm children born after 28 weeks of gestation. In spite of what is commonly assumed, these children may not recover completely from the language delay caused by preterm birth, a circumstance that may have a negative impact on their school performance and on formal education results. A midlong term monitoring, especially before attending school, may be an important measure to diagnose possible problems and to prevent the negative impact in school education.

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