Original Article

Artigo Original

Comparative analysis of initial vocalizations of preterm and full-term infants with and without risk for development

Análise comparativa das vocalizações iniciais de bebês prematuros e a termo, com e sem risco ao desenvolvimento

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Keywords

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Preterm Infant
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Language Development
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ABSTRACT

Purpose: To compare the evolution of vocalization in preterm and full-term infants, with and without risk for development, analyzing the possible association of sociodemographic, obstetric and psychosocial variables with vocalization. **Methods:** The study sample consisted of 30 infants, aged 3 months and 1 day to 4 months and 29 days (Phase 1) and 6 months and 1 day to 7 months and 29 days (Phase 2), of both genders, with gestational age <37 weeks (preterm group) and >37 weeks (full-term group). The following instruments were used for data collection: Child Development Risk Indicators (IRDl), the Denver II Test, an interview on the experience of motherhood with sociodemographic, obstetric and psychosocial data, as well as filming of the mother-infant dyad at the two phases of the research. Footage was analyzed using the EUDICO Linguistic Annotator (ELAN) software and the results were statistically analyzed on the STATISTICA 9.0 software. **Results:** The larger the total number of Phase II infants' and mothers' vocalizations using motherese, the greater the number of IRDls present. Significant increase in vocalizations without motherese was also observed in Phase 2. Sociodemographic variables, gestational age, weight at birth, maternal schooling, and the Brazil Criterion did not directly affect the infants' vocalization level. **Conclusion:** Analysis of the infants' vocalizations was sensitive to risk development and Child Development Risk Indicators in Phase 1; the Denver-language test was more effective in Phase 2. No influence of the sociodemographic variables was observed in the phases studied.

Descritores

Linguagem Infantil
Prematuro
Nascimento a Termo
Desenvolvimento da Linguagem
Relação Mãe-Filho

RESUMO

Objetivo: Comparar a evolução das vocalizações em bebês prematuros e a termo, com e sem risco ao desenvolvimento, analisando as possíveis relações entre variáveis sociodemográficas, obstétricas e psicossociais com as vocalizações. **Método:** A amostra foi composta por 30 bebês com idade entre os 3 meses e 1 dia aos 4 meses e 29 dias (fase 1) e 6 meses e 1 dia aos 7 meses e 29 dias (fase 2), de ambos os gêneros, com idade gestacional inferior a 37 semanas (grupo de prematuros) e superior a 37 semanas (grupo a termo). Para a coleta de dados, utilizaram-se os protocolos Indicadores de Risco ao Desenvolvimento Infantil, o teste Denver II e entrevista sobre a experiência da maternidade com dados sociodemográficos, obstétricos e psicossociais, além de filmagem da díade mãe-bebê nas duas fases da pesquisa. Os dados das filmagens foram analisados no *software* EUDICO Linguistic Anotador (ELAN) e os resultados analisados estatisticamente no *software* STATISTICA 9.0. **Resultados:** Quanto maior o número total de vocalizações do bebê e quanto mais vocalizações das mães com manhês, maior o número de Indicadores de Risco ao Desenvolvimento Infantil presentes. Também se percebeu aumento significativo de vocalizações sem manhês na fase 2 pesquisada. As variáveis sociodemográficas, idade gestacional, peso ao nascer, escolaridade materna e o Critério Brasil não incidiram diretamente no nível de vocalizações dos bebês. **Conclusão:** A análise das vocalizações dos bebês associou-se ao risco ao desenvolvimento, assim como os Indicadores de Risco ao Desenvolvimento Infantil, na fase 1 pesquisada, o teste Denver-Linguagem é mais efetivo na fase 2. Não houve influência das variáveis sociodemográficas na fase estudada.

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INTRODUCTION

Increased survival of preterm infants owing to medical advances[1] demands early identification of risk for developmental disorders arising both from biological structural limitations and environmental and psychic constraints. Infants born with Gestational Age (GA) <37 weeks are considered premature[2]. In this group, neonates are classified as follows: Late Preterm (GA between 34 and 36 weeks), Moderately Preterm (GA between 30 and 33 weeks), and Extreme Preterm (GA <30 weeks). This biological risk factor can interfere with brain maturation, resulting in important functional impairments such as delays in motor, cognitive, personal-social and language development, which present high rates of occurrence[3]. Premature infants may also present delays in receptive and/or expressive language, with less communicative ability compared with that of infants born at term[3,4].

A study[5] which investigated the effects of prematurity on language development suggested that preterm birth has a direct effect on infants' ability to produce the first language sounds and practice them in order to evolve into more complex constructions. These authors classify babbling utterances into three levels of increasing complexity: at level I, vocalizations occur with a vowel or syllable containing a glottal stop, or even a glide; at level II, vocalizations emerge containing a true single or replicated consonant; and at level III, vocalizations can be composed of two or more different consonants[5]. Considering these levels, the authors concluded that preterm infants may have smaller capacity to develop babbling than full-term infants. They also state that the frequency of vocalizations produced at six months of age is associated with the rate of vocabulary acquisition, whereas babbling complexity can be related to the rapid acquisition of words. This suggests that the communicative ability exhibited by infants in the prelinguistic period is a reliable predictor of their subsequent linguistic development[5].

Such communicative skills, including babbling, are developed through social interaction, which is an essential component in the process of language acquisition in both premature and full-term infants. Acquisitions of intentional communication skills undergo gradual development from interactive processes, evolving and becoming more complex[6]. Since birth, infants are enveloped in a language network that precedes them, in which and by which any manifestation of their body - babbling, laughing, crying, moving, silence - is interpreted by their mothers or caregivers[7]. At the beginning, infants' communication occurs through gestures, facial expressions, and eye contact. As infants develop and maturate, communication evolves to the production of vocalizations with marked intonation, which compose the protoconversation[6,8]. These exchanges, which occur through protoconversation, allow the infant to be captured by the person with the greatest bond - usually the one who performs the maternal role - by the joy carried in her voice[9] manifested in the production of infant-directed speech (IDS), or motherese. This is a higher-than-usual voice record with restricted intonation range, but with exaggerated variations in modulation and pitch, long and sweet melodic forms with wide variations, which are accentuated by the infants' response to their mothers' speech[10]. These exchanges culminate in the establishment of the drive circuit, from which, at four months of age, most babies are able to seek others, or call them when they stop paying attention. As of this moment, infants are able to psychically constitute themselves, and perceive and listen to language[11].

Thus, language development follows a somewhat constant sequence and depends, in part, on genetic programming, as well as on listening to the speech of other people, especially those to whom they are more closely bound[12]. Therefore, motherese supports the affective and verbal communication of developing infants and can arouse the attention to speech that is directed specifically to them, with content and form that are adapted to them[13]. These continuous adjustments of mothers to their babies can result in facilitation of exchanges and interactions, with positive consequences for the sharing of emotions and language acquisition[14].

Importance of the early relationships in the context of child development is evident; therefore, the monitoring of infants and their parents is essential for early risk detection. Application of Child Development Risk Indicators (IRDI) (Annex A)[13] allows Speech-language Pathologists to detect and differentiate psychic risk from developmental risk, and the risk for language acquisition is one of the developmental aspects assessed by IRDIs[15-17]. Such studies have demonstrated the importance of intervention, in a timely manner, in cases of risk for language acquisition[15-17].

In this context, the objectives of this article are to compare the evolution of vocalization in preterm and full-term infants, with and without risk for language development, in the first year of life in two chronological phases; analyze possible correlations between infants' vocalization and maternal language productions with and without the use of motherese; and investigate the possible association of sociodemographic, obstetric and psychosocial variables with vocalization.

METHODS

The present study originated from a larger project titled "Comparative Analysis of the Development of Term and Preterm Infants and its Relationship with Psychic Risk: From detection to intervention" approved, according to the norms regulated by Resolution 466/96 (BRASIL Resolução MS/CNS/CNEP no. 466/2012), by the Health Research and Ethics Committee of the Universidade Federal de Santa Maria, Rio Grande do Sul state, Brazil, under no. CAE: 28586914.0.0000.5346.

The research individuals were recruited in two locations in the municipality of Santa Maria, countryside of Rio Grande do Sul state: the University Hospital and a Basic Health Unit. All mothers and/or caregivers were invited to participate and received detailed explanations on the objectives and procedures of the study, their rights as volunteers, and identity secrecy. All participants signed an Informed Consent Form prior to study commencement.

Considering that the project from which this research originated is still in progress, only a part of the sample was used in this study. Thus the sample was composed of 30 individuals of both genders: 15 preterm infants and 15 full-term infants

with gestational ages of 26 to 34 weeks and 37 to 38 weeks, respectively. The parents and the infants were monitored since infants were one month old using the Child Development Risk Indicators (IRDIs)[13] according to the age ranges of the protocol: 0 to 4 and 4 to 8 months. This instrument presents predictive value for developmental problems, but not for psychic risk; however, four individually flagged indicators and three groups of indicators were sensitive to indicate a trend towards a risk for obstacles in the constitution process of the individual, and are therefore indicative of psychic risk[13]. In this study, a predictive factor for psychic risk is constituted by the first five indicators of Phase 1 as a group, namely, 1. "Mothers know what infants want when they cry or scream"; 2. "Mothers speak to their children in a style particularly directed to them (motherese)"; 3. "Infants react to motherese"; 4. "Mothers propose something to their children and await their reaction"; 5. "There is expressive eye contact between mothers and infants"; and the sixth indicator of Phase 2 separately, 6. "Infants use different signs to express different needs"[13]. In addition to the IRDI protocol, data were collected through interviews on the experience of motherhood and on sociodemographic, obstetric, psychosocial aspects, among others, as well as through the application of a translated version of the Denver II test[18] using its four skill analysis groups: personal-social, fine motor, gross motor, and language. All 125 items of the test were observed by trained staff during actions produced by the infants and their requests to their mothers, who informed whether the infants performed or not a certain task. The final score of the test showed normal, suspect or altered results, indicating low, medium or high risk for developmental delay. Only two groups of analysis were used in this study: personal-social and language.

The Brazil Economic Classification Criterion (2013) was used to verify the socioeconomic profile of the families that participated in the study. This criterion is not based exclusively on family income for economic classification; it also estimates personal and family purchasing power, abandoning the concept of classifying the population into social classes. It considers the schooling level of the head of family, as well as the number of televisions, radios, refrigerators, toilets, freezers, automobiles, washing machines, housemaids, and VRC/DVD players in the household. The socioeconomic class of each family is defined by the sum of the values of the items family members own. Social classes are as follows: A1, A2, B1, B2, C1, C2, D, and E[19].

Language was analyzed by filming the interaction of mothers with their children at two different age ranges of the infants: from three months to four months and 29 days and from six months to seven months and 29 days. The filming was performed at two different angles, front and side, with duration of nine minutes each. Filming at the frontal angle was performed by positioning the camcorder on an easel distant two meters from the scene so as to catch the infant facing the camera and the mother projected in a mirror placed behind the infant. Filming at the lateral angle was performed with the camcorder positioned one meter away from the scene seeking to capture the mother-child, face-to-face interaction and a full view of the infant sitting on a comfort seat:

3-4 months and 29 days: The infant is sitting on a comfort seat (9 minutes). The mother was instructed to sing (3 minutes), speak (3 minutes), and offer an object to the infant - a rubber dog that produced no noise (3 minutes).

6-7 months and 29 days: The infant is sitting on a comfort seat (9 minutes). The mother was instructed to sing (3 minutes), speak (3 minutes), and offer an object to the infant - a rubber dog that produced no noise (3 minutes).

Footage data were analyzed using the ELAN (EUDICO Linguistic Annotator) software - an annotation tool that allows you to create, edit, visualize, and search annotations for video and audio data. Infants were assessed with regard to the vocalizations produced and were classified into the following levels: level I, vocalizations with a vowel or syllable containing a glottal stop, or even a glide; level II, vocalizations containing a true single or replicated consonant; and level III, vocalizations composed of two or more different consonants[5]. These vocalizations were annotated during the analysis of the last six minutes of footage (mother speaking and offering an object to infant). From this analysis, descriptive statistics were obtained for each infant with quantification of the vocalization subtypes for each age range. Regarding the mothers' behaviors, their vocalizations were analyzed according to the presence or absence of Infant-directed Speech (IDS), or motherese (Infant caregiver behavior scale, ICSB)[20]. Motherese was classified based on the convening speech of the mothers, with peculiar properties such as form of communication characterized by the use of shorter statements, isolated words, first names, and constant questions, in addition to slow and repetitive prosody with high pitch[10-13], which were identified by the researchers and, later, by referees.

Subsequently, a database was created in an Excel spreadsheet containing the number of infants' vocalizations at levels L I, L II, and L III, and the number of total vocalizations in the two phases: three months and one day to four months and 29 days (Phase 1) and six months and one day to seven months and 29 days (Phase 2). Analysis of the preterm infants considered their corrected age. In addition to the infants' data, the number of productions of the mothers, with and without the use of IDS, was recorded in the two phases of the study. Moreover, for each individual, the study analyzed the results of the IRDI protocol and of the Denver II test - personal/social and language aspects, and the sociodemographic (Brazil Criterion, mother's schooling and infant's number of siblings) and obstetric (gestational age and birth weight) variables.

The results were statistically analyzed using the STATISTICA 9.0 software. Parametric and nonparametric tests were applied to verify the significance of the relationship between the variables investigated. A significance level of 5% was adopted for all statistical analyses ($p \leq 0.05$).

RESULTS

Table 1 shows the comparison between the infants' levels of vocalization L I, L II, and L III and the total number of mothers' vocalizations, with and without the use of motherese, in the analysis of Phases 1 and 2. The results demonstrated that the variable number of vocalizations with Infant-directed speech (IDS) had a statistically significant result in Phase 2 ($p<0.05$),

which means that the mothers presented a significant increase in vocalizations with IDS in this phase.

In the comparison between the sociodemographic data and the levels of vocalization L I and L II in Phases 1 and 2, no statistically significant correlation was observed between the sociodemographic variables, the variables Gestational Age (GA), birth weight, Brazil Criterion data and mothers' schooling and the infants' vocalizations. Therefore, such variables do not directly affect the infants' level of vocalization.

As none of the infants presented level of vocalization L III in Phase 1, no comparison was possible for this level. As all of the infants presented level of vocalization L II in Phase 2, it was not possible to conduct the test.

Table 2 compares the infants' levels of vocalization L I and L II in Phase 1 and L II in Phase 2 with the results of the IRDI protocol in Phases 1 and 2, respectively, and of the Denver II test for the personal/social and language aspects. Statistically significant result ($p<0.05$) was found for the IRDIs present compared with the presence of level of vocalization L I in Phase 1. Therefore, it was evinced that the number of IRDIs present was significantly larger in the group of children who vocalized more in Phase 1. Regarding the same comparison in Phase 2, no statistically significant result was observed. There was also no statistical relevance in the comparison between the IRDIs and the results of the Denver II test and the vocalizations. Although the number of vocalizations at L II did not differ statistically between Phases 1 and 2, it is worth noting that the number of vocalizations at L II was larger in Phase 2 compared with that of Phase 1.

Application of the Spearman correlation test showed that the higher the total number of IRDIs present, the higher the total number of vocalizations at L I; this result was in agreement with that found in the Mann-Whitney test (Table 2).

No statistically significant correlation was found in the comparison between the number of IRDIs present in Phase 2 and the total number of vocalizations at the different levels in Phase 2; this result had been previously observed in both statistical tests (Spearman correlation test and Mann-Whitney "U" test).

Table 3 shows the total number of infants' vocalizations correlated to the IRDIs of Phase 1 individually. Significant correlation was found between the total number of infants' vocalizations and the third and fourth IRDIs (3. "Infants react to motherese" and 4. "Mothers offer something to their children and await their reaction"). Therefore, the higher the incidence of infants' vocalizations, the greater the presence of indicators 3 and 4 in the sample.

In Phase 2, no correlation between the sixth, seventh and eighth IRDIs (6. "Infants use different signs to express different needs"; 7. "Infants react, smile, or vocalize when their mothers or other people is addressing them"; 8. "Infants actively seek their mothers' gaze"), analyzed individually in comparison with the infants' vocalizations.

Table 3 also shows, from the Spearman correlation, that the larger the number of total IRDIs present in Phase 1, the larger the total number of mothers' vocalizations in the same phase.

In Phase 2, no significant correlation was observed between the IRDIs of Phase 2, infants' vocalizations, and mothers' vocalizations, with and without the use of IDS.

With respect to vocalizations with IDS and the IRDIs analyzed individually in Phase 1, statistical significance was observed between the second IRDI (2. "Mothers speak to their children in a style particularly directed to them (motherese)") and vocalization using IDS, according to the results described in Table 3.

Table 1. Comparison between infants' and mothers' vocalizations in phases 1 and 2

	N valid	*p* level
L I - Phases 1 and 2	30	0.462225
L II – Phases 1 and 2	30	0.116665
L III – Phases 1 and 2	30	____
Total for L I, II, and III - Phases 1 and 2	30	0.368402
MVIDS – Phases 1 and 2	30	0.169731
MV – Phases 1 and 2	30	0.002585*

LI = Level I of infants' vocalization; LII = Level I of infants' vocalization; LIII = Level III of infants' vocalization; MVIDS = mothers' vocalizations with IDS (Infant-directed speech); MV = mothers' vocalizations without IDS; * Significant values by the Wilcoxon non-parametric test

Table 2. Analysis of the Denver II test, IRDIs, and infants' vocalizations

L I – Phase 1	**N**	***p* value**
Phase 1 – IRDIs	23	0.0416*
Denver – Personal/Social - Phase 1	23	____
Denver - Language - Phase 1	23	0.462
L II – Phase 2	**N**	***p* value**
Phase 1 - IRDIs	23	0.128
Denver – Personal/Social - Phase 1	22	____
Denver - Language - Phase 1	22	0.417
L II - Phase 2	**N**	***p* value**
Phase 2 – IRDIs	22	0.373826
Denver – Personal/Social - Phase 1	21	0.25684
Denver - Language - Phase 2	21	0.111028

LI = Vocalization Level I; LII = Vocalization Level II; IRDIs = Child Development Risk Indicators; * Significant values by the Mann-Whitney "U" test

Table 3. Analysis of the infants' and mothers' vocalizations compared with the IRDIs - phase 1

	Valid	Spearman	*p* value
IV and IRDI 1	30	0.276	0.139
IV and IRDI 2	30	0.019	0.918
IV and IRDI 3	30	0.359	0.050*
IV and IRDI 4	30	0.39	0.032*
IV and IRDI 5	30	0.232	0.216
MIDS and IRDI 1	30	0.236	0.209
MIDS and IRDI 2	30	0.353	0.050*
MIDS and IRDI 3	30	0.204	0.279
MIDS and IRDI 4	30	0.039	0.833
MIDS and IRDI 5	30	0.1	0.598
Phase 1 IRDIs x MVIDS+MV	30	0.456	0.011*
Phase 1 IRDIs x MVIDS	30	0.346	0.06
Phase 1 IRDIs x MV	30	-0.232	0.216

IV = infants' vocalizations; MVIDS = mothers' vocalizations with IDS (Infant-directed speech); MV = mothers' vocalizations without IDS; IRDIs = Child Development Risk Indicators; * Significant values by the Spearman test

Table 4. infants' and mothers' vocalizations compared with the Denver II - Language

	N	*r* Spearman	*p* valor
Denver Language - Phase 2 and L I - Phase 2 – Total	30	0.054	0.789
Denver Language - Phase 2 and L II - Phase 2 – Total	30	0.309	0.115
Denver Language - Phase 2 and L III - Phase 2 - Total	30	–0.278	0.159
Denver Language - Phase 2 and Total MV - Phase 2	30	0.099	0.620
Denver Language – Phase 2 and MVIDS – Phase 2	30	0.306	0.120
Denver Language - Phase 2 and MV – Phase 2	30	–0.483	0.0105*

LI = Vocalization Level I; LII = Vocalization Level II; LIII = Vocalization Level III; MVIDS = mothers' vocalizations with IDS (Infant-directed speech); MV = mothers' vocalizations without IDS; * Significant values by the Spearman test

No statistical significance was found between the vocalizations with IDS and the IRDIs of this phase, when analyzed individually. The same result was observed in the total analysis of mothers' vocalizations in Phase 1 compared with each of the IRDIs of Phase 1.

In Phase 2, no statistical significance was observed between the total number of mothers' vocalizations and the IRDIs of this phase, when analyzed separately (indicators 6, 7, and 8). The same result was found when mothers' vocalizations, with and without the use of motherese, and such IRDIs were analyzed separately.

Analysis of the relationship between the Denver II test and the level of infants' vocalizations showed significant correlation between the Denver II - Language, in Phase 1, the levels of vocalization. In addition, no correlation was found between the Denver - Personal/Social, in Phase 1, and the vocalization levels, because all infants presented 100% positive results for this test item in this phase, not allowing the performance of statistical analysis.

Table 4 shows that there was significant correlation between the results of the Denver II - Language in Phase 2 and the mothers' vocalizations using IDS in the same phase. Therefore, the higher the score in the Denver II - Language, the lower the evidence of mothers' vocalizations without IDS. No significant correlation was observed regarding mothers' vocalizations using motherese in Phase 2.

No statistically significant results were observed regarding the scores in the Denver II - Personal/Social in Phase 2 and the total number of vocalizations at the different levels in the same phase, as well as the total number of mothers' vocalizations with and without the use of IDS..

No relevant statistical results were found between the number of mothers' and infants' vocalizations and the sociodemographic variables.

DISCUSSION

Based on the results obtained, it is possible to conclude that the correlation between the decreased number of mothers' vocalizations without the use of Infant-directed Speech (IDS) in Phase 2 and the higher score in the Denver II - Language, coupled with the fact that mothers' vocalizations using IDS were not statistically correlated with the Denver II - Language in the same phase, indicates that greater language maturity of infants may not demand a particular language addressed to them by mothers. Perhaps, this is the reason the eighth IRDI did not present statistically significant correlation with the studied variables (Tables 1, 2, and 6).

This result was also observed in another study[15], in which no correlation was found between language development between 13 and 16 months and the IRDIs of Phase 2. This may have occurred due to advancement in the language skills of infants in Phase 2, as predicted by several studies[6-8].

Mothers tend to adjust the speech directed to their children according to their age, cognitive skills, and linguistic level[14]. In a recent study[21], the authors observed, based on the analysis of homemade videos, that the use of motherese reduces over time, more significantly between the first and second six months of life of infants. This fact was not observed in the present study, where the use of motherese increased in some cases and decreased in others. It can be hypothesized that they have varied from the enunciative context, which includes the willingness of mothers and infants at the time of filming.

Speech directed to infants depends on the psychological, social and cultural characteristics of the mothers/caregivers and on the infants' responsiveness to these adults. The prosodic contours of motherese, from their peculiar characteristics, are designed to facilitate the understanding by infants and assist in language acquisition, stimulating their responsive capacity[14]. Therefore, the fact that infants are increasing their language skills may explain the mothers' lesser focus on this support.

In Phase 1, it was possible to observe that the Denver II - Language was less sensitive regarding the comparison between the groups. On the contrary, the number of vocalizations presented difference in the comparison between the groups of infants with and without psychic risk (Table 2). A study[15] demonstrated high correlation between the presence of risk in the IRDIs between 0 and 4 months of age and smaller speech production between 13 and 16 months age, which was confirmed in this study with respect to vocalizations, since risk-free infants presented a larger number of vocalizations compared with that of infants at risk for language development. Therefore, the larger the total number of IRDIs present, the larger the total number of infants' vocalizations in Phase 1, which is directly associated with the observed results, the larger the number of total IRDIs present, the larger the total number of mothers' vocalizations in this phase (Table 3). Cohen et al.[21] observed that mothers' productions are significantly associated with expressive infants' responses.

Still on infants' vocalizations in Phase 2, it is worth emphasizing that, although they do not differ statistically from

those of Phase 1, vocalizations of the L II level emerge more often. These data suggest that increased complexity may be associated with decreased quantity, because infants are more involved in articulating more complex phonemes, which may decrease the total vocalization rate.

Another interesting fact arises from comparison of the indicators of Phase 1, with mothers' vocalizations with and without IDS. Statistically significant correlation was found between the use of IDS and the second IRDI. (2. Mothers speak with their infants in a style particularly direct to them - motherese) (Table 3). The total number of infants' vocalizations correlated with the IRDIs of Phase 1, individually, also showed significant correlation between the total number of infants' vocalizations and the third and fourth IRDIs (Table 3). Therefore, the higher the incidence of infants' vocalizations, the greater the infants' reaction to motherese, and the longer and more often mothers will use it, as well as will offer something to their infants, which shows how the basic principles of conversation emerging in protoconversation act between mothers and infants since in Phase 1.

This finding can be explained from the analysis of the indicators that compose Phase 1. These indices are related to the maternal function and to the initial protoconversations, such as the second IRDI, in which it is observed whether mothers use motherese with their infants, and the third IRDI, in which it is analyzed whether infants react to motherese; both indicators are essential for protoconversation because they capture the initial dialogue between mothers and infants. Children with typical development are active researchers of the dialogical relationship, because for them the dialogue represents an instinct as powerful as the drives of breathing, eating, or surviving[22]. According to the author, this innate drive for dialogue, called intersubjectivity, indicates a particular harmony between such facial, vocal and gestural expressions of infants and the facial expressions of their mothers during face-to-face communication, and which evinces an early interest of infants in other people. Still on this aspect, a recent study reported statistical significance between motherese and infants' responses as a whole, which involved orientation for people and receptive responses[23], corroborating the correlation between the second and third IRDIs observed in the present study.

Furthermore, the correlations between the second IRDI and the mothers' vocalizations using IDS and between the third IRDI and the total number of infants' vocalizations show that the contingency and synchrony of mothers with infants are crucial for the production and extension of motherese, because according to the infants' reaction, there is an increase in the use of IDS from the part of the mothers, and such contingent feedback from the infants makes them more attractive, which in turn increases the quality of motherese[14].Therefore, the use of motherese from the part of the mothers is as important as the infant's reaction to it.

The fourth IRDI is also related to dialogue with other people, because it refers to mothers proposing something to their children and awaiting their reaction. Some authors[14] have emphasized that motherese reflects an interactive loop between infants and caregivers, in such a way that the response of each person may increase the initial stimulation of the other partner, which may explain the correlation found between the larger number of infants' vocalizations and the fourth indicator. This interactive loop is supported by the emotional charge of the affective level, affecting the cognitive level, attention, learning, and the construction of intersubjective tools, such as joint attention and communicative skills[14,22].

Phase 1 indicators contemplate communication in the mother-infant dyad. Therefore, the reflection that emerges from the results of this study is that the age range of 0 to 4 months of the IRDIs, which was significantly correlated with the larger number of infants' vocalizations / the larger the number of IRDIs present, as well as with the larger number of mothers' vocalizations, especially using motherese, is one of the phases in which the characteristics of the infants' dependence on the relationship with the other person, especially in the dialogue, are observed. Indicators are clues enacted by and in the infant that can suggest events, and these clues are considered in the subjectivity of the mother-infant dyad, thus they seem to demonstrate predictive elements for language acquisition, as observed in recent studies[15-17]. Therefore, it is possible to observe that flaws in these indicators could lead to language functioning failure.

For a child, language acquisition requires an "other" who becomes an individual of that acquisition. The movements, gestures, gazes, cries, laughter, babblings, words of the infant are taken by this "other" as meaningful, and thus the structure of dialogue, which is essential for the constitution of the individual in the language, is established from the enunciation[17]. The transition from speaker to individual seems to be an effect of the appropriation process that occurs at the semiotic and semantic levels of language, that is, the individuals appropriate the linguistic system in a discursive instance and, therefore, are dependent both on the enunciative place that the other/adult offers them and on their biological possibilities to occupy that place. For this process to occur, it is necessary that the adult assume that the infant is an individual who still cannot speak[16], this seems to be confirmed by the results of this study, which show the correlation between infants' and mothers' vocalizations and the individual assumption axis of the IRDIs. In Phase 2, no correlation was observed between the IRDIs and the infants' and mothers' vocalizations, perhaps because the indicators between four and eight months of age are less sensitive to the analysis of the other, capture more the infants' characteristics and what they do than the mother-infant dialogue. This finding was also observed in a previously mentioned study, in which the authors reported no statistical association between the IRDIs of Phase 2 and initial speech production in children aged 13 to 16 months[15].

No statistically significant correlation was found in the analysis of the results of the Denver II - Personal/Social test for both phases (1 and 2). In fact, the test was less sensitive than the IRDIs of Phase 1, which may be explained by the fact that the items analyzed - recognize the face, respond to a smile, smile spontaneously, recognize their own hands - are more focused on the analysis of infants' basic reactions and little focused on the mother-infant dyad, that is, they do not

evaluate the protoconversation and initial interaction, which are two-way paths considering that they address both the adult and the child. Scales such as the Denver II Test are not based on infants' conception as part of an essentially symbolic world that requires a psychic structure to organize its functions, because they analyze only behaviors of the instrumental field; therefore, it is interesting to associate this test with the use of assessment tools such as IRDIs, which encompass the interface between functions and skills according to a place from where infants assign meaning to the world, and not only to verify behaviors resulting from genetically programmed skills[24].

Analysis of the obstetric and sociodemographic variables did not show significant results in the comparison with the infants' vocalizations. It is possible infer that, in the age range analyzed, these variables still present little influence, because vocalizations seem little sensitive to social factors. In this period, what seems to be more important is the support and investment that the other gives the infant, through dialogue and motherese, when the musical and poetic dimensions, which are bearers of affective values, are more important than the representation of words[10]. Therefore, this is not yet a time when the infants' linguistic productions are sensitive to broader social effects, such as when they reach the vocabulary acquisition period. With regards to the mothers' schooling, our findings corroborate those of a study[25] which found no statistical significance in the analysis of the influence of maternal schooling on the language acquisition of infants aged 0 to 2 years. As of this phase, this variable, as well as the variables social class and cultural environment, interfere more directly in the mastering of grammar and in the quality of the dialogue. Analysis of the variable prematurity did not present statistical difference in the comparison between the groups of preterm and full-term infants with respect to the number of vocalizations, which suggests that risk for development or psychic risk, which are elements capable of evincing possible environmental problems, more precisely associated with the relationship between infants and the others (mothers/caregivers), are more relevant than the prematurity itself in this period of life.

Furthermore, in this sample, composed mostly of late and healthy preterm infants and of only one extremely preterm infant, it was possible to observe that the variable prematurity had no effect on the infants' and mothers' language productions. Thus, these healthy preterm infants possibly presented innate intersubjectivity[26] which depends on the biological conditions of the infant to establish interaction with the other, a sort of orientation to the other that the authors of social cognition have defined very well[27].It is known that extremely preterm infants are more prone to developmental delays[28-30]. The fact that the sample had only one extremely preterm infant may have reflected in the results of the lack of statistical significance in the sample studied. However, the biological aspect is not sufficient, the investment and support of the other is necessary, representative of the "other", so that infants can be psychically formed. This process is defined by Golse[26] as secondary intersubjectivity, which is addressed by the IRDIs[13], essentially in the first six months of an infant's life. This was a relevant factor in the studied sample, considering that IRDIs are able to show possible environmental and biological problems that are reflected in intersubjectivity, more precisely associated with the relationship between the infant and the other (mother)[13]. This result testifies to the importance of observing the psychic conditions of all infants and not only that of preterms.

Still on prematurity, there are few studies on the vocal and communicative capacities of preterm infants in the literature, and these have produced contrasting results regarding the prelinguistic development of preterm infants[5].The same authors, in their study, work with comparisons between the groups of preterm and full-term infants, associating the infants' prelinguistic skills with the outcome at 12 and 18 months of age; that is, such differences in language skills in preterm infants may be observed later, in the beginning of vocabulary acquisition, when dialogue becomes more complex in the continuity of this study.

CONCLUSION

Considering the initial objectives of this study to compare the evolution of vocalizations in the two phases, an increase in Level II vocalizations was observed from Phase 1 to Phase 2. No statistically significant differences were found in the comparison between preterm and full-term infants, which indicates the importance of monitoring both of them, considering that the first are as vulnerable to developmental risk as the latter, as observed in the comparison between the two groups. Statistical relevance was observed for the presence of risk for language development, because infants and mothers with smaller number of IRDIs present vocalized less compared with those with larger number of IRDIs present. Furthermore, the number of infants' vocalizations is sensitive to developmental risk in Phase 1, and the Denver II - Language test is most effective in Phase 2. With respect to the IRDIs, they are also more sensitive in Phase 1, unlike the Denver II - Personal/Social in the same phase.

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Author contributions

IMF, RMU, and LDO were responsible for the collection and analysis of the data using ELAN and for the writing and editing of the manuscript; AMR was in charge of the statistical analysis; APRS was the study adviser and responsible for the study design and writing and revision of the manuscript.

Annex A. Child Development Risk Indicators (IRDIs)

0 A 4 MESES INCOMPLETOS	EIXOS
1. Quando a criança chora ou grita, a mãe sabe o que ela quer.	SS/ED
2. A mãe fala com a criança num estilo particularmente dirigido a ela (“manhês”).	SS
3. A criança reage ao “manhês”.	ED
4. A mãe propõe algo à criança e aguarda sua reação.	PA
5. Há trocas de olhares entre a criança e a mãe.	SS/PA
4 A 8 MESES INCOMPLETOS	
6. A criança utiliza sinais diferentes para expressar suas diferentes necessidades.	ED
7. A criança reage (sorri, vocaliza) quando a mãe ou outra pessoa está se dirigindo a ela.	ED
8. A criança procura ativamente o olhar da mãe.	ED/PA
8 A 12 MESES INCOMPLETOS	
9. A mãe percebe que alguns pedidos da criança podem ser uma forma de chamar sua atenção.	ED/SS
10. Durante os cuidados corporais, a criança busca ativamente jogos e brincadeiras amorosas com a mãe.	ED
11. Mãe e criança compartilham uma linguagem particular.	SS/PA
12. A criança estranha pessoas desconhecidas para ela.	FP
13. A criança faz gracinhas.	ED
14. A criança aceita alimentação semissólida, sólida e variada.	ED
12 A 18 MESES	
15. A mãe alterna momentos de dedicação à criança com outros interesses.	ED/FP
16. A criança suporta bem as breves ausências da mãe e reage às ausências prolongadas.	ED/FP
17. A mãe já não se sente mais obrigada a satisfazer tudo que a criança pede.	FP
18. Os pais colocam pequenas regras de comportamento para a criança.	FP