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Relationship of specific language impairment with perinatal risk factors and neurological soft signs

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Abstract

Objective: *The study aimed to analyze the relationship of Specific Language Impairment (SLI) with Perinatal Risk Factors (PRFs) and Neurological Soft Signs (NSS) by sex in pre-school children.* **Methods:** *A non-experimental, transversal, comparative design with 216 girls and boys. Sociodemographic data and PRFs were documented with a Clinical History. The Screening for Language Problems was applied, and NSS were evaluated with the subtest of the Neuropsychological Battery for Pre-schoolers.* **Results:** *In 70%, the socioeconomic level was low; 51% were classified without SLI; and 27% with moderate articulation difficulties. The parents indicated that 40% had pronunciation difficulties and 71% had comprehension difficulties. A moderate significant correlation was observed with SLI and NSS: walk, asteroagnosis, and articulation difficulties.* **Conclusions:** *Screening evaluations were relevant tools to identify neurodevelopmental difficulties in pre-schoolers since they allow rapid and early attention to communication disorders, such as SLI in relation to PRFs and the presence of NSS. Furthermore, linguistic stimulation programs with extensive coverage should be undertaken in low-income communities, which were frecuent among in 70% of participants.*

Keywords: *Specific language impairment. Risk factors. Neurological soft signs. Pre-schoolers.*

Relación de los trastornos específicos de lenguaje con factores de riesgo perinatal y signos neurológicos blandos

Resumen

Objetivo: *Analizar la relación de los Trastornos Específicos de Lenguaje con los Factores de Riesgo Perinatal y los Signos Neurológicos Blandos por sexo en niños preescolares.* **Métodos:** *Diseño no experimental, transversal, comparativo con 216 niños y niñas. Se documentaron los datos sociodemográficos y de Factores de Riesgo Perinatal con una Historia Clínica. Se aplicó la evaluación Tamiz de problemas del Lenguaje (TPL) y se evaluaron los Signos Neurológicos Blandos con la subprueba de la Batería Neuropsicológica para Preescolares (BANPE).* **Resultados:** *En 70% el nivel socioeconómico fue bajo; se calificó 51% sin sospecha de Trastornos Específicos de Lenguaje; se observaron dificultades moderadas de articulación en 27%; los padres señalaron que 40% presentaban dificultades de pronunciación y 71% de comprensión. Se observó correlación significativa moderada de los Trastornos Específicos de Lenguaje con los Signos Neurológicos Blandos: marcha, asteroagnosia, y dificultades de articulación.* **Conclusiones:** *Las evaluaciones de tamizaje son herramientas relevantes para identificar dificultades del neurodesarrollo en los preescolares ya que permiten la atención rápida y temprana de los tras-*

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tornos de la comunicación, como los Trastornos Específicos del Lenguaje, los Factores de Riesgo Perinatal y los Signos Neurológicos Blandos. Además, los programas de estimulación lingüística deberían de extenderse a las comunidades de nivel socioeconómico bajo, el cual fue común en 70% de los participantes.

Palabras clave: *Trastornos específicos del lenguaje. Factores de riesgo. Signos neurológicos blandos. Preescolares.*

Introduction

In Mexico, 19.3% of children aged 24-59 months are reported to have development below the expected level for their age. Hence, it is essential to invest in educational initiatives during the initial phases[1]. According to the National Institute of Public Health[2] in the state of Sonora, México, 14.1% of boys and girls from birth to 4 years received an early childhood development evaluation.

Respecting the prevalence of language disorders, these difficulties correspond to 8.5% of boys and girls from 4 to 6 years, 11 months of age. However, in countries with fewer resources, underdiagnosis of these disorders is observed, for this reason, asking parents of children from 4 to 6 years about language acquisition, biological and environmental factors, has provided relevant information for the detection of signs of language disorders[3-5].

On the other hand, the analysis of language development difficulties has been associated with auditory processing difficulties and many cognitive processes, such as working, procedural, and declarative memories[6-8]. In contrast, language development promotes interaction, effective conflict resolution between children, self-regulation, and social and emotional skills[9].

These factors have been associated with difficulties in the development of neuropsychological processes and language of boys and girls from 3 to 6 years[10-17]. In this research examined them as Perinatal Risk Factors (PRF) and Neurological Soft Signs (NSS).

When we talk about NSS, we refer to nervous system dysfunctions due to disruptions in cortical-subcortical neuronal networks, without a specific location. NSS difficulties in the articulation and pronunciation of words were reported in 50% of Colombian children and Mexican children aged 6-11 years with low-medium socioeconomic status, oral and written language problems[18-21]. Therefore, the aim was to analyze the relationship of Specific Language Impairments (SLIs) with PRFs and NSS by sex in pre-school children.

Materials and methods

Participants

This was a non-experimental, cross-sectional, and comparative research. A sample of 216 children ranging in age from 38 to 77 months old (Mean = 60, SD = 8.1), 103 girls and 113 boys, were evaluated in 2016, in public pre-schools in the suburban areas of Xalapa, Veracruz, México.

Instruments

The clinical history of pre-schoolers was carried out, and the PRFs were documented as actual Parental perceptions of their child's: difficulties in pronunciation and comprehension. The Screening for Language Problems (TPL) and the NSS subtest of the Neuropsychological Battery for Pre-schoolers (BANPE) were applied.

PRFs documented with clinical history in pre-schoolers were birth weight, birth lenght, Apgar at 1 min and 5 min, newborn resuscitation, support of transition at birth, and in mothers were maternal age years, marital status, education, gestation time, fetal movements, threatened miscarriage, genital hemorrhage, intake of licit and illicit drugs during pregnancy, and socioeconomic status.

The TPL[22] is a screening evaluation for grammatical difficulties in children from 3 to 6 years and 11 months. It explores the language particles vulnerable in children likely to have SLI. It is done in 10 minutes on average.

The test is divided into morphology and repetition sections. In morphology, the use of articles, clitics, prepositions, and derivatives are explored; this scale consists of 13 items that are scored from 0 to 1 point; in the repetition test, 12 sentences of different complexity and length are presented and scored from 0 to 5 points depending on the sentences. TPL has a sensitivity and specificity of 0.80. The score is assigned with the percentiles of the test and is classified into three ranges according to age. In addition, the colors of the traffic light are used to indicate what was observed: no problem (green), suspected disorder (yellow), and probable disorder (red), and the percentage probability of the presence of SLI is calculated.

BANPE

BANPE[23] evaluates the normal and pathological course of the neuropsychological development of cognitive processes in pre-school, and includes tasks to evaluate 17 areas, orientation, attention and concentration,

memory, language comprehension, language expression, language articulation, motor coordination, academic skills, inhibition, working memory, flexibility, planning, abstraction, theory of mind, risk-benefit processing, emotion identification, and soft neurological signs; For this research, responses from the area of NSS were considered. In NSS, 10 areas are examined regarding the presence or absence of difficulties in language, balance, coordination, muscle tone, alternating sequences, gait, opposite finger-thumb sequences, graphesthesia, asteroagnosis, and choreiform signs.

The instrument is validated in the Mexican population, where the normalized total scores of each process have a mean of 100 and a standard deviation of 15; thus, the interpretation of the total score obtained classifies performance as: ≥ 116 high normal, 85-115 normal, 70-84 mild alteration, ≤ 69 severe alteration.

Procedure

We invited three official pre-schools from Xalapa, Veracruz, México. First, permission was requested from the school principals and children's parents. Subsequently, written informed consent was requested and obtained from all parents interested in having their children participate. All the children were evaluated with TPL and NSS, and parents answered the Clinical History.

Statistical analysis

Descriptive and inferential analysis was carried out with the JASP, 19.3.0 program. The descriptive analysis showed the distribution of cases by sex, scores on the SLI, articulation difficulties, PRF, and NSS.

In the inferential analysis, using the Kolmogorov-Smirnov test, a normal distribution of the data was observed, so in the inferential analysis, the Pearson correlation coefficient was calculated for continuous data, and the variable of SLI was correlated with NSS, PRF, and actual parental perceptions of their language child's.

The correlation values considered were ≤ 0.09, null; from 0.10 to 0.29, weak; 0.30 to 0.49, moderate, and 0.50 to 1, strong[24]. The distribution of SLI due to articulation difficulties was compared with the Chi-square test.

Results

From the data, 47% of pre-schoolers were 60-71 months old; 55% were full-term birth, Apgar at 1 and 5 min were from 8 to 10, none required newborn resuscitation, even support of transition at birth. Regarding the mother's average age was 29 years, 15% had threatened miscarriage, 37% were not married, 28% were married, genital hemorrhage, 72% had no genital hemorrhage, 125 minimal and none reported intake of licit and illicit drugs during pregnancy and 70% had a low socioeconomic level.

Regarding language, 51% of pre-schoolers have no SLI; about NSS in March 38% present difficulties, in coordination 63% and 27% had moderate articulation difficulties. The parents' report indicated that 40% had pronunciation difficulties and 71% had comprehension difficulties (Table 1). In the distribution of participants by SLI and sex, we observed that 49% of boys and 53% of girls did not present SLI, while 31% of boys and 25% of girls present suspected SLI, and 20% had a probable SLI in boys and in girls 22% (Fig. 1). When performing the Pearson correlation coefficient of SLI with PRF were not statistically significant correlations while with NSS, we observed a significant moderate correlation with articulation difficulties ($r = 0.311$, $p = 0.001$); and weak correlation with asteroagnosis ($r = 0.289$, $p = 0.001$), and March ($r = 0.282$, $p = 0.001$) (Table 2). When comparing Morphology and Sentence Repetition, we observed significant moderate correlations of asteroagnosis ($r = -0.353$, $p = 0.001$), and articulation difficulties ($r = -0.414$, $p = 0.001$). Regarding sentence repetition, there were significant moderate correlations with March ($r = -367$, $p = 0.001$), asteroagnosis ($r = -0.433$, $p = 0.001$), and articulation difficulties ($r = -0.380$, $p = 0.001$) (Table 3).

Correlations between Morphology with SNB agreed to had no difficulties in March 64%, coordination 53%, asteroagnosis 63%, and articulation difficulties 40%, while Repetition of sentences in March 83%, coordination 72%, asteroagnosis 83%, and articulation difficulties 47% (Table 4).

Regarding comparison of the SLI and articulation difficulties, both instruments agreed that 23% had no problems, 6% had mild, and 9-13% had moderate to severe difficulties ($\chi^2 = 28.086$, $p = 0.001$) (Table 5).

Discussion

Many difficulties in early childhood development as language were observed upon returning to school following the pandemic, because of conditions in which children continued school learning from their homes. For that reason, the communication disorders in Mexican pre-schools were the focus of this analysis[21,25,26].

In this research, we analyze data collected in evaluations before the COVID-19 pandemic period, where

Table 1. Descriptive variables of the sample

Variables	Criteria	Frequency	%
Children's data			
Age (months)	38-47	18	8
	48-59	79	37
	60-71	102	47
	72-77	17	8
Sex	Female	103	48
	Male	113	52
Specific language impairment	Absent	110	51
	Suspect	61	28
	Probable	45	20
Neurological soft signs			
March	Present	83	38
	Absent	132	61
Coordination	Present	136	63
	Absent	79	36
Asteroagnosis	Present	51	24
	Absent	164	76
Articulation difficulties	Absent	74	34
	Mild	30	14
	Moderate	59	27
	Severe	51	24
	No data	2	1
Mother's data			
Perinatal risk factors			
Gestation time	No data	47	21
	Ful term	118	55
	Preterm	51	24
Socioeconomic level	Low	152	70
	Medium	33	15
	No data	31	14
Parental perceptions of their child's			
Pronunciation difficulties	Present	86	40
	Absent	93	43
	No data	37	17
Comprehension difficulties	Present	154	71
	Absent	20	9
	No data	42	19

Table 2. Correlations of specific language impairment with neurological soft signs

Variables	Correlation	p
March	0.282	< 0.001
Coordination	0.064	0.352
Asteroagnosis	0.289	< 0.001
Articulation difficulties	0.311	< 0.001

Table 3. Correlations of morphology and sentence repetition with neurological soft signs

Variables	Morphology		Repetition	
	Correlation	p	Correlation	p
March	–0.323	< 0.001	–0.367	< 0.001
Coordination	–0.060	0.385	–0.041	0.547
Asteroagnosis	–0.353	< 0.001	–0.433	< 0.001
Articulation difficulties	–0.414	< 0.001	–0.380	< 0.001

Table 4. Percentage of morphology and sentences repetition and neurological soft signs

Variables	Morphology (%)		Sentences repetition (%)	
	Absent	Present	Absent	Present
March	64	7	83	5
Coordination	53	6	72	4
Asteroagnosis	63	7	83	5
Articulation difficulties	40	25	47	10

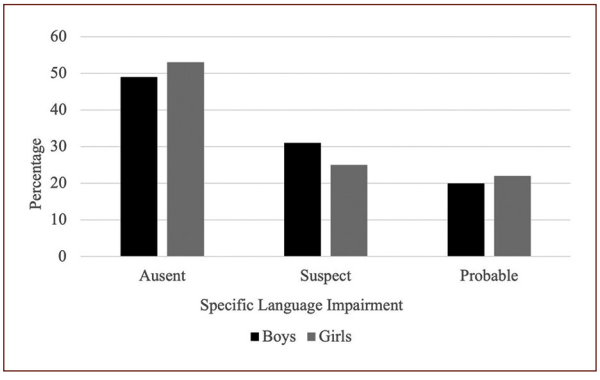

Figure 1. Percentage of children by language disorder and sex.

Table 5. Comparison of specific language impairment and articulation difficulties in pre-schoolers

Specific language impairment	Articulation difficulties (%)				Total (%)
	Ausent	Mild	Moderate	Severe	
Absent	49 (23)	13 (6)	28 (13)	18 (9)	108 (51)
Suspect	20 (9)	12 (6)	18 (9)	11 (5)	61 (29)
Probable	5 (2)	5 (2)	13 (6)	22 (10)	45 (20)
Total	74 (35)	30 (14)	59 (28)	51 (24)	214 (100)

$\chi^2 = 28.086$, $p = 0.001$.

we observed that a suspected or probable SLI was observed in 51% of pre-school boys and girls and 67% of articulation disorders, therefore that diagnostic evaluations are required to differentiate what is the primary difficulty in these cases because language is learning predictor of the acquisition of reading and writing, as mentioned by Bonifacci et al.[27,28], who found significant associations between language comprehension and reading comprehension; as well as between the morphosyntactic structures of the language with the reading speed in bilingual children who speak Italian and French.

Relevantly, we recommended diagnostic language assessments for the children we identified as having severe articulating difficulties and probable language abnormalities so that the specific communication impairment they presented could be determined. In this context, Georgan et al.[29] highlights the importance of determining whether linguistic traits are indicative of certain language disorders or articulation issues since this would have varying effects on academic performance and necessitate the provision of early help suitable for each condition.

About PRF, it is known that the presence of social and neurobiological risk factors from 22 weeks gestation to 7 days after birth has been shown to affect language, motor, and social development. Among these factors have been reported in children: Peri-intraventricular hemorrhage or bronchopulmonary, birth weight less than 1000g, and long hospital stay, and in mothers, maternal age < 18% and 70% had low socioeconomic level[13,30-32].

In this research, PRF documented with parental perceptions of their child's, this was a limitation because we did not have imaging or electrophysiological testing to confirm the presence of any neurological impairment related to language difficulties. However, in this research, we use standardized screening assessments as a first level in language difficulty detection[33]. Then we assigned children with suspected SLI and Articulation difficulties to diagnostic assessments to determine the certainty of findings and situable intervention.

Although we found no significant correlations between socioeconomic level, SLI, and articulation difficulties, there have been reports of the impact of poverty levels in poor communicative interactions since stimulation in those contexts is tipically limited[34,35].

In other studies about perception´s parents emphasize the importance to parental involvement in the assessment process because parents recognize the relevance to seeing the child's reactions, perceiving other aspects about their child´s development, and have a deeper understanding about child's problems[36]. We did not capture this component of the study, despite the fact that the child's parents were present for the assessments. Even though no correlations were observed between PRF and SLI, we can point out that 49% of pre-schoolers with suspected or probable SLI are considered to have delays in neuromaturational development, as pointed out by Rincon-Lozada et al.[20]. Therefore, timely follow-up and attention must be given, about which we cannot give any information, because results were delivered to the parents with suggestions for support and recommendations for care with language development professionals at the Rehabilitation and Social Center Inclusion of Veracruz, CRISVER, or with the support teachers of the Psychopedagogical Care Center for Pre-school Education, CAPEP. Although the significant correlations found between SLI and NSS were moderate, it is relevant to consider that NSS corresponded to difficulties in walking and articulation. Regarding risk factors, Chumacero-Calle et al.[18], and Rincon-Lozada et al.[20], mention that Colombian children of medium to low socioeconomic level, as in the case of the children evaluated in our research, encountered difficulties in language and writing, however, we

did not find significant correlations because it was a common condition in the majority of the pre-school families, with 70% at a low level and 14% at a medium level, with 15% without reporting the data. We thought to examine whether the TPL instrument's subtests revealed any associations with PRF and NSS and we observed de similar correlations with SLI; however, a higher percentage of children had difficulties in Morphology than in Sentence Repetition. On the other hand, although we did not find correlations with parental perceptions of their children about comprehension and expression language, these observations favored applying standardized screening instruments as the first level of evaluation. Regarding parental perceptions of their children, the findings of Auza et al.[3,4], mentioned that in low-income populations lacking access to evaluations like we conducted, parents' reports about their children's development are a crucial source of information for implementing intervention actions in addition to making reasonable adjustments in educational programs.

It was important to know in what percentage two variables coincided to find the presence or absence from difficulties. That's why, we observed that three NSS with SLI agreed that 23% did not present difficulties, while in articulation, 38% presented moderate or severe difficulties and suspected or probable SLI. It is important to increase the dissemination of SLI screening so that families have knowledge of it and will be detected earlier more children. It was necessary to determine whether difficulties observed in the pre-schoolers corresponded to the phonological disorders identified through the evaluation of NSS or to the SLI identified with TPL, or if there were pre-schoolers who presented both difficulties. Communication disorders are defined as language, phonological, verbal fluency, and pragmatic communication disorders in the Diagnostic and Statistical Manual of Mental Disorders[37]. In the two assessments that were conducted, we discovered that 23% of the pre-schoolers did not exhibit communication problems, 11% had grammar issues, and 28% had articulation issues. It was decided that 15% of respondents had moderate issues and 15% had severe difficulties when it came to the presence of both. In addition to directing parents and educators, the analysis allowed the suggestion of diagnostic tests to be carried out in severe situations with the purpose to confirm or not the indicators observed.

By considering the parameters, we were able to achieve the intended goal of examining the correlation between SLI with NSS in pre-schoolers. We discovered that the percentages were higher than those reported by Vázquez-Salas et al.[1]. However, as already mentioned, we did not follow-up how many children with severe problems were evaluated with diagnostic instruments and we also did not follow-up the subsequent children's development.

Conclusions

Since standardized screening evaluations permit rapid attention to communication disorders, such as SLI in relation to PRF and the presence of NSS, which are the guiding variables of this study, they are appropriate instruments to identify neurodevelopmental difficulties in pre-schoolers. Pre-schoolers' development should be closely monitored to prevent deficits in basic competencies, such as writing, reading, and logical math concepts. Furthermore, linguistic stimulation programs with extensive coverage should be undertaken in low-income communities, which are frecuent among in most participants.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of humans and animals. The authors declare that no experiments on humans or animals were performed for this research.

Confidentiality of data. The authors declare that they have followed their center's protocols on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

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