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Speech disorders in students in Belo Horizonte

Alterações de fala em escolares na cidade de Belo Horizonte

ABSTRACT

Purpose: To describe speech disorders in students from 1st to 4th grades, and to investigate possible associations between these disorders and stomatognathic system and auditory processing disorders. **Methods:** Cross-sectional study with stratified random sample composed of 288 students, calculated based on an universe of 1,189 children enrolled in public schools from the area covered by a health center in Belo Horizonte. The median age was 8.9 years, and 49.7% were male. Assessment used a stomatognathic system protocol adapted from the Myofunctional Evaluation Guidelines, the Phonology task of the ABFW – Child Language Test, and a simplified auditory processing evaluation. Data were statistically analyzed. **Results:** From the subjects studied, 31.9% had speech disorder. From these, 18% presented phonetic deviation, 9.7% phonological deviation, and 4.2% phonetic and phonological deviation. Linguistic variation was observed in 38.5% of the children. There was a higher proportion of children with phonetic deviation in 1st grade, and a higher proportion of children younger than 8 years old with both phonetic and phonological deviations. Phonetic deviation was associated to stomatognathic system disorder, and phonological deviation was associated to auditory processing disorder. **Conclusion:** The prevalence of speech disorders in 1st to 4th grade students is considered high. Moreover, these disorders are associated to other Speech-Language Pathology and Audiology alterations, which suggest that one disorder may be a consequence of the other, indicating the need for early diagnosis and intervention.

RESUMO

Objetivo: Descrever alterações de fala em escolares de 1^a a 4^a série e investigar a existência de associação entre essas alterações e os distúrbios de motricidade orofacial (MO) e de processamento auditivo. **Métodos:** Estudo transversal com amostra aleatória e estratificada composta por 288 escolares, calculada com base num universo de 1.189 crianças matriculadas em escolas públicas da área de abrangência de um centro de saúde de Belo Horizonte. A idade mediana foi de 8,9 anos, sendo 49,7% meninos. Foram utilizados: protocolo de MO adaptado do Roteiro para Avaliação Miofuncional; prova de Fonologia do Teste de Linguagem Infantil ABFW; e avaliação simplificada do processamento auditivo. Os dados foram analisados estatisticamente. **Resultados:** Das crianças avaliadas, 31,9% apresentaram alteração de fala. Destas, 18% apresentaram desvio fonético, 9,7% desvio fonológico e 4,2% fonético e fonológico. Observou-se variação linguística na fala de 38,5% das crianças. Houve maior proporção de crianças com desvio fonético isolado na 1^a série e de crianças menores de 8 anos com desvio fonético e fonológico. Verificou-se associação entre desvio fonético e alterações de motricidade orofacial e entre desvio fonológico e alterações de processamento auditivo. **Conclusão:** A prevalência de alterações de fala em escolares de 1^a a 4^a série é considerada alta. Além disso, estas são associadas a outras alterações fonoaudiológicas, o que sugere que uma pode ser consequência de outra, apontando para a necessidade de diagnóstico e intervenções precoces.

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INTRODUCTION

Human communication involves aspects of reception and transmission. The individual develops the ability to receive, develop and transmit structured messages for social interaction.

The word *communication* comes from the Latin *communi-care*, meaning to make common. For communication to occur there must be a sender, an information channel, and a receiver, with a system of signs with information between them. The message must be encoded in order to become common and understood. One form of message transmission occurs through speech, which can be defined as the emission of the voice and the mechanism of word formation⁽¹⁾.

Speech is the motor action which expresses language. It's a complex process that involves the neuromuscular system, the structures responsible for movement, and also aspects such as the volume flow and pressure of air and resonance⁽²⁾.

The development of speech occurs from the integration of the motor, sensory and auditory systems. For this to occur, sounds produced by the vocal folds are molded and articulated by their passage through the larynx, pharynx, soft palate, hard palate, tongue, teeth, cheeks, lips and nasal passage⁽²⁾.

For proper speech development, it's necessary for the child to not only learn the physical movements of speech production, which are the phonetic aspects, but also the organizational and structural aspects of the language's sound system, that are part of phonology^(2,3).

The greatest expansion of the phonological system occurs between 1 year and 6 months and 4 years. During this period, errors in expected age-specific speech behaviors can occur. By 5 years, most children with normal speech development adequately produce the language sounds within the permitted sequences⁽⁴⁾. The acquisition of language, which involves the recognition of its sounds and organizational system, usually is completed by the end of preschool⁽⁵⁾.

During the process of speech acquisition, some difficulties may occur, such as the exchange of sounds or difficulties in the performance of articulatory movements. These deviations may have origins in phonological, neurological, muscular or skeletal structure alterations in orofacial functions⁽²⁾. In this study we focus on speech disorders that occur due to difficulties in articulation (phonetics), and those arising from language modifications (phonological deviations).

Phonetic deviations are characterized by inadequate articulation of the sounds involving the motor component. This is related to problems in position and mobility of the tongue, lips, cheeks and jaw, such as the presence and the position of teeth⁽²⁾. An example of such is the frontal lisp (the interposition of the tongue between the teeth, while producing the phoneme /s/).

On the other hand, phonological disorders are characterized by difficulties in the perception, production or organization of the rules of the phonological system, causing substitutions or omissions in speech sounds after a certain age (ex: saying "tapo" /'tapU/ instead of "sapo" /'sapU/ after 2 years and 6 months, or "suva" /'suva/ instead of "chuva" /'juva/ after 4 years and 6 months); or atypical exchanges (such as switch-

ing "jacaré" /ʒaka'rɛ/ with "chacaré" /ʃaka'rɛ/, a phonological process unexpected at any developmental phase)⁽⁶⁾.

The repercussions of speech disorders can influence the individual's relationship with his or her environment, self-image and learning⁽⁴⁾. Speech disorders can also negatively affect the child's life, for example in his or her academic development. This occurs because speech is a basic pre-requisite for the literacy process and, for this reason, errors in speech may also manifest themselves in the child's writing⁽⁷⁾. In addition, discrimination from classmates faced by the child due to the inability to speak properly may furtheracerbate his/her schooling experience. Such factors can interfere in communication and social integration.

It can also be noted that other issues can be related to speech disorders. Among these are hearing impairments, otitis media, and respiratory difficulties. In addition, cultural deprivation or lack of auditory stimuli and difficulties in auditory processing may relate to speech disorders⁽⁸⁾.

It is necessary to pay greater attention to healthy communication during infancy. There are few studies^(4,9-11) on the prevalence of speech disorders among children without complaints and on early diagnosis. Despite the need for more studies, existing research points to a large proportion of children with such disorders.

Once speech disorders negatively impact the health and quality of life of children, early diagnosis and intervention become essential to prevent further improvement of the disorder and the appearance of other alterations, such as social, psychological or cognitive impairments.

Thus, it is important to collect data on the prevalence of speech disorders in order to better understand the profile of this population and their needs. From such data, appropriate proposals for the control and prevention of speech disorders are possible, contributing to the healthy development of children.

This study had the aim to describe speech disorders in students from 1st to 4th grade, and to investigate possible associations between these disorders and variables related to age, gender, grade, inadequate age/grade, orofacial motor (OM) disorders, and auditory processing disorders.

METHODS

This study was approved by the Research Ethics Committee of Universidade Federal de Minas Gerais – UFMG (protocol ETIC 263/08). The responsible parties for the institutions involved signed letters of consent and willingness to participate in the study, and parents signed a term of informed consent (TCLE).

This is an observational, cross-sectional study with a stratified random sample consisting of children enrolled in four public elementary schools from the area covered by a health center in northeastern Belo Horizonte (MG), Brazil. The health center covers about 12,500 people. The area is classified by the Municipal Health Department of Belo Horizonte as having a medium to high risk of illness and death. At this center, internships, outreach projects and research occurs with the participation of professors and students from an institution

of higher education and health professionals. Public schools are associated with the health center, which monitors the cases evaluated.

The sample size was calculated considering the 40% prevalence of speech-language disorders based on other works^(4,10,11), with a 5% margin of error, 95% confidence interval and an additional 10% loss. The children were randomly stratified by school and grade. A sample of 309 children was obtained based on a population of 1,189 students enrolled in 1st to 4th grades, in 2008, in four public schools.

From the original sample of 309 children, the results of 288 1st to 4th grade children were analyzed, of which 49.7% were males. There was a loss of 21 children (7.29%) in the study. Of these, 12 did not participate due to lack of parental consent and nine due to absence of cochleopalpebral reflex. The age of the children ranged from 6 years and 1 month to 12 years and 5 months, with a median age of 8.9 years and an average of 9.0 years (± 1.3).

The presence of obvious physical or cognitive limitations observed by the researchers or reported by schools that limited the child's ability to complete all of the required tests, such as visual or motor disabilities, was used as an exclusion criterion.

Children were submitted to phonological assessment at a classroom made available by the school. The appropriate age/grade scale, as recommended by the State and Municipal Department of Education, in accordance with Resolution CNE/CEB No. 3/3005 and Joint Resolution SEE/MG- SMED/BH No. 1 of May 21, 2007, was used to indicate academic delay. Of the children evaluated, 29.5% (n=85) presented ages above expected for the grade level, considered an inadequate value, suggesting discrepancies among the ages of children in the same grade level.

Speech was evaluated using the ABFW Phonology Test⁽⁶⁾, consisting of 34 figures for naming and 39 words for repetition, was utilized. A digital recorder was used. Results were analyzed according to the protocols of the test, which has already been validated and standardized for Brazilian Portuguese.

The children were also evaluated regarding orofacial myology and auditory processing. For the orofacial myology assessment, the Myofunctional Evaluation Guidelines⁽¹²⁾ were adapted. The myofunctional aspects of the stomatognathic system were evaluated. For the evaluation of tension and mobility of the orofacial structures the following aspects were assessed: tongue strength in counter resistance with a wooden spatula and gloved finger; smile to pout movements; tongue movements to the cardinal points; inflation and deflation of cheeks; retraction, protrusion, raising and lowering of the tongue. An orofacial myofunctional disorder was classified clinically case by case by four speech-language pathologists, considering the repercussions of the impairment on the child's health. Diagnosis was based on a consensus among the speech-language pathologists that analyzed all the cases.

Auditory processing assessments were conducted using simplified standard evaluation techniques^(13,14) consisting of the following tests: 1) Sequential Memory Test for non-verbal sounds, 2) Sequential Memory Test for verbal sounds, 3) Sound Localization Test. The application and analysis of the results were in compliance with the standards of the test^(13,14). Previous

tests for cochleopalpebral reflex were done to exclude children with moderate to serious hearing loss. In cases with absence of reflex (n=9), the child was excluded from the sample and referred to an audiological assessment.

After the evaluations, parents received the results and any appropriate referrals to regional health services. All data was electronically stored. A descriptive analysis of the frequency distribution of the categorical variables, and analysis of the measures of central tendency and dispersion of the continuous variables were done. The Chi-square test was used to study the association between speech disorders and variables related to age, gender, grade, appropriate age/grade, auditory processing disorders and orofacial myofunctional disorders. The level of statistical significance was 5% ($p \leq 0.05$).

RESULTS

Among the children evaluated, 31.9% (n=92) presented some type of speech disorder. The prevalence of phonetic deviations was 18.0% and phonological deviations was 9.7%. In addition to these, 4.2% of the children presented both phonetic and phonological deviations. Furthermore 17.7% of the children had auditory processing disorders and 14.9% orofacial myofunctional disorders.

It was decided to analyze the speech disorders considering both phonetic and phonological deviations. Children who presented speech patterns related to linguistic variations, with specific exchanges, were analyzed separately and not included in the classification of phonetic or phonological deviations.

Of the 92 children with speech disorders, 56.6% had phonetic deviations, 30.4% phonological deviations, and 13.0% presented both phonetic and phonological deviations (Table 1).

Among the phonological deviations, the most common phonological process was simplification. Of the phonetic deviations, the most prevalent was the presence of a lisp when producing the phoneme /s/.

Also in relation to speech, the linguistic variation of simplification of consonant clusters, was observed in specific word of the test in 38.5% (n=111) of the 288 children. What occurred in these cases was the substitution of phonemes in the words /'plātə/ and /'blusə/ ("planta" and "blusa") for /'prātə/ and /'brusə/ ("pranta" and "brusa"), and also the omission of phonemes in the words /tã'boh/ and /tra'toh/ ("tambor" and "trator") where /tã'bo/ and /tra'to/ ("tambô" and "tratô") were said, yet these substitutions or omissions were not seen in other words which require the articulation of the same phonemes. The linguistic variations are differences in speech which do not compromise the ability to understand the intended message, are usually culturally acceptable and vary according to the region. In the local dialect of Belo Horizonte, region of the present study, it is frequently observed a reduction in consonant clusters and final consonants in the speech of adults. Since children tend to model their speech according to the norms of their social groups, they may learn to use such variations. These cases were analyzed separately and were not considered speech disorders, but linguistic variations typical of the population studied.

Table 1. Distribution of types of speech disorders in 92 students from 1st to 4th grade

Type of speech disorders	n	%
Phonetic deviation	52	56.6
Distortion phoneme /s/ (lisp)	19	20.7
Distortion other phonemes	17	18.5
Distortion phoneme /s/ (lisp) + Distortion other phonemes	16	17.4
Phonological deviation	28	30.4
Simplification	23	25.0
Substitution	2	2.2
Unusual	0	0.0
Simplification + Substitution	2	2.2
Simplification + Substitution + Unusual	1	1.1
Phonetic deviation + Phonological deviation	12	13.0
Distortion + Simplification	9	9.7
Distortion + Simplification + Substitution	1	1.1
Distortion + Unusual	2	2.2

* The categories are not mutually exclusive. The same child could have more than one disorder.

When speech disorders were analyzed generally, without specifying the type of deviation, differences between age groups, gender, grade and appropriate grade/age were not observed. However, when the analysis was conducted separately for phonetic and phonological deviations, an association was found between phonetic deviation and grade ($p < 0.05$), and also between phonetic and phonological deviations and age

($p = 0.04$), which can be related to developmental chronicity. These disorders were more prevalent in children in younger age groups and early grade levels. In this developmental phase, dental exchanges and reorganization of the intraoral space can lead to difficulties in articulation (Table 2).

There was an association between the presence of a phonetic deviation and orofacial motor alterations ($p < 0.001$), and between the presence of phonological deviations and alterations in the auditory processing ($p < 0.001$) (Tables 3 and 4).

In most cases, phonetic deviations appear simultaneously with orofacial myofunctional disorders, as consequences of such alterations. However, with increasing age, facial growth, arrival of permanent teeth, orthodontic interventions, among other factors, the orofacial structures can reorganize, resulting in the correction of orofacial myofunctional disorders.

As for the association between phonological deviations and auditory processing disorders, it is observed that children with difficulties in auditory processing can be limited in their ability to differentiate sounds during the phases of speech acquisition, resulting in substitutions and/or omissions of phonemes in words.

DISCUSSION

Speech disorders were highly prevalent among the school children included in this study. Phonetic deviation as the only speech disorder was more frequent than isolated phonological deviation.

The elevated prevalence of speech disorders found in this study are similar to the finding of other national studies^(4,9,10,11). In Minas Gerais⁽¹⁰⁾, the prevalence of speech disorders found

Table 2. Speech disorders in schoolchildren and their relation to age, gender, grade and appropriate grade/age

	Speech disorder			Phonological deviation alone			Phonetic deviation alone			Phonetic + Phonological deviation			Linguistic variation alone		
	Yes (n=92)	No (n=196)	p-value	Yes (n=28)	No (n=260)	p-value	Yes (n=52)	No (n=236)	p-value	Yes (n=12)	No (n=276)	p-value	Yes (n=76)	No (n=212)	p-value
Age group (years)															
<8 years	22	58		8	72		8	72		6	74		27	53	
≥8 years e <9 years	29	41	0.22	8	62	0.85	16	54	0.16	5	65	0.04*	18	52	0.08
≥9 years e <10 years	22	46		7	61		14	54		1	67		20	48	
>10 years	19	51		5	65		14	56		0	70		11	59	
Gender															
Male	41	102	0.23	10	133	0.12	24	119	0.57	7	136	0.53	38	105	0.94
Female	51	94		18	127		28	117		5	140		38	107	
Grade															
1st	38	69	0.72	9	98	0.48	10	97	0.008*	19	88	0.93	31	76	0.49
2nd	22	47		10	59		1	68		11	58		19	50	
3rd	17	40		5	52		1	56		11	46		16	41	
4th	15	40		4	51		0	55		11	44		10	45	
Appropriate grade/age															
Adequate	67	136	0.55	23	180	0.15	33	170	0.21	11	192	0.10	55	148	0.67
Lagged	25	60		5	80		19	66		1	84		21	64	

* Significant values ($p \leq 0.05$) – Chi-square test

Table 3. Relationship between phonetic deviation and orofacial myofunctional disorders in students from 1st to 4th grade (n = 276 *)

	Without OMD	With OMD	Total
Without phonetic deviation	203	21	224
With phonetic deviation	35	17	52
Total	238	38	276

Chi-square test – p<0.001

* 12 children with both disorders were excluded

Note: OMD = orofacial myofunctional disorders**Table 4.** Relationship between phonological deviation and auditory processing disorders in students from 1st to 4th grade (n=276*)

	Without APD	With APD	Total
Without phonological deviation	217	31	248
With phonological deviation	14	14	28
Total	231	45	276

Chi-square test – p<0.001

* 12 children with both disorders were excluded

Note: APD = auditory processing disorders

in the age group between 5 and 9 years was 26.8%; in studies done in Rio Grande do Sul the prevalence was 20.8%⁽⁹⁾ and 24.6%⁽⁴⁾; in São Paulo the prevalence was 37.0%⁽¹¹⁾. No nationwide studies have been conducted. Brazilian studies typically include small populations and, due to the size and vast regional differences within Brazil, it is difficult to compare and generalize findings.

In contrast, international studies show a lower prevalence. In a Cuban study, the prevalence of speech disorders was 12%⁽¹⁵⁾. In Australia⁽¹⁶⁾, 13% of the children evaluated presented results lower than the expected for the age group.

As for phonetic deviations specifically, the prevalence was 18.0%. In other national studies^(9,11), there was great variation of prevalence – from 2.05% to 35.80%, with a tendency to decrease with increasing age of the children. After the age of 7, distortions are the most frequent phonetic deviation⁽¹¹⁾. Distortions may be caused by anatomical abnormalities of the face, mouth and its structures, in addition to the improper positioning of the organs responsible for articulation and phonation, especially the tongue, lips and teeth. In these cases, the individual seeks a more intelligible speech through adjustments and compensations, which in turn lead to distortions⁽²⁾. By analyzing the phonetic deviations by type, the most prevalent in the present study was the lisp at the /s/ phoneme. The literature cites that the most frequent phonetic deviations occur at the sibilant phonemes /s/, /z/, which are the most affected by occlusal changes⁽²⁾.

As for phonological deviations, the prevalence was 9.7%, which approximates the values obtained in other national studies^(5,9-11,17). American studies estimated prevalence of phonological disorders of between 3.8% and 10.0% in school children^(18,19).

According to type, the most common phonological process was simplification – consonant cluster reduction, gliding of liquids, weak syllable deletion and consonant harmony –, supporting data from Brazilian studies^(5,9,17,20).

Cluster reduction as a linguistic variation occurred in 38.5% of the evaluated children and was analyzed separately from other speech disorders, since it was considered a characteristic of the population. Linguistic variations are culturally accepted and can be found in the speech of adults and children⁽²¹⁾. Results from a previous study, also conducted in Belo Horizonte, show evidence of a relationship between the mother and child's phonological productions, and in the majority of the cases in which the mother presented cluster reductions in speech, the child also presented a similar tendency⁽²¹⁾.

In this study, these manifestations of linguistic variations occurred in specific words, perceived not as a difficulty of production of the specific sound, but as a habit of pronunciation. The data supported a previous study which showed a linguistic variation in 61.7% of children⁽²²⁾.

There was no association between speech disorders and variables relating to gender, age, grade and appropriate grade/age in this study. There is some controversy over the influence of age and gender on speech disorders. Some studies refer to a greater prevalence among males, especially in relation to phonological deviations^(11,15,17,19,23,24) and others report similar prevalences between genders^(4,20).

When analyzing speech disorders by type, an association between phonetic deviation and grade and also between phonetic/phonological deviation and age. Speech disorders were more prevalent in children in the younger age groups and early grade levels. It is common for children to present greater speech alterations during the phase of dental exchanges and reorganization of the intraoral space, aspects which can interfere with articulation. The presence of these associations support previous studies with children in 1st to 4th grades in which the prevalence of speech disorders was greater than the prevalence among 7-year-olds⁽¹¹⁾.

No association was found between phonological deviation and inappropriate grade/age of the child. However, the literature points to negative repercussions of difficulties in speech on learning^(4,5,11,17,25). In a study with 28 children referred by a teacher with complaints of speech errors, of the 1st grade students, 85% presented with a phonological deviation and exchanges of sounds in reading and writing, followed by 75% of 2nd grade students and 57% of 3rd grade students. The 4th grade students presented alterations only in reading and writing⁽²⁶⁾. To verify this association in the present study, more comprehensive reading and writing tests are necessary. Furthermore it is important to note that inappropriate age/grade is not sufficient to characterize the academic delay.

An association between phonetic deviation and orofacial myofunctional disorders was found. A similar study conducted in Rio Grande do Sul⁽²⁵⁾ also noted an association between phonetic deviation and some aspects of orofacial myofunctional abilities, such as alterations in praxis of the tongue.

The present study confirmed an association between phonological deviations and auditory processing disorders. This

association was also found in previous studies^(8,27-29).

In an analysis of records of children diagnosed with phonological disorders⁽⁸⁾, authors found at least one subtype of auditory processing disorder in all of the subjects. In a similar study⁽²⁷⁾ undertaken at the São Paulo Hospital – UNIFESP, 20 children with phonological disorders underwent auditory processing screenings and 70% failed at least one of the trials. A study conducted in Rio Grande do Sul suggested that, compared to children with normal phonological development, children with atypical phonological development show worse performance in auditory processing and phonological awareness tasks⁽²⁸⁾.

The acquisition of oral language is intimately related to the conditions of hearing⁽²⁹⁾. The perception and production of speech are related events. The proper development of speech is influenced by the child's perceptual capabilities; in other words, the child can only produce the sounds of language when he is capable of integrating his perceptive base and language system. To produce intelligible speech, the received speech sounds must be adequately processed⁽³⁰⁾.

The present study shows a high prevalence of speech disorders in a population without complaints, showing the profile of speech acquisition. There exist few studies in the region which address prevalence data. Therefore, this study is relevant for the scientific community and for the development of public health interventions.

It is hoped that the results from this study will alert health professionals on the importance of taking a careful look at speech disorders and their implications. Preventive actions can reduce the damages in the lives of children. Moreover it is hoped that further research on speech disorders and their associations occur. This theme is still underexplored, and studies with large sample sizes covering different regions are essential.

CONCLUSION

This study shows the high prevalence of speech disorders among schoolchildren. The associations between speech and language disorders suggest that one may be a result of the other, with worsening of the initial presentation, pointing to the need for timely diagnosis and intervention. Moreover, since some speech disorders were more prevalent among young children in early grade levels, the importance of early detection of speech disorders is reinforced.

No association between speech disorders and gender and appropriate grade/age were found. Further research is needed to investigate these associations.

The high prevalence of speech disorders is of concern, as much for their interference with communication, but also due to the repercussions of such disorders in other developmental areas and social relations. It is hoped that the results presented here can raise awareness among not only Speech-Language Pathologists, but also among other health and education professionals. The collaboration of different professionals in the prevention, detection, diagnosis, treatment and monitoring of children with speech disorders is of utmost importance in providing these children with a healthy standard of communication and better quality of life.

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