Research Paper

Speech and Reading Disorders Screening, and Problems in Structure and Function of Articulation Organs in Children in Mashhad City, Iran

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ABSTRACT

Objectives: Investigating the prevalence of speech and language disorders and the contributing factors can help determine the best treatment options suited to the needs of these patients. So far, no comprehensive study has been conducted on screening speech and reading disorders and Problems in the Structure and Function of Articulation Organs (PSFAOs) in children in Mashhad City, Iran. This study aims to screen for these disorders and investigate the effects of demographic factors on such disorders.

Methods: Via the stratified-cluster sampling method, 2770 native Persian-speaking children participated in this study, of whom 1381 were girls and 1389 were boys, ranging from preschool to the third grade (3 to 9 years old). After obtaining the demographic information, the PSFAOs screening was performed for all participants using a semi-structured questionnaire taken from Paul et al.'s report (2017). Screening for a grade of dysphonia was then carried out for children with suspected voice disorders using the grade, roughness, breathiness, asthenia, and strain test. Fluency of speech screening for children with suspected fluency disorders was performed using the stuttering severity instrument – fourth edition test, and screening of reading skills for school children was performed using the screening inventory reading test. Analytical analysis was performed via the Chi-square test between study variables, including disorders and other variables. Two types of logistic regression models were used. The data were analyzed using survey data analysis of the Stata software, version 14.1, and $P<0.05$ was considered significant.

Results: The prevalence of articulation disorders, voice disorders, stuttering, PSFAOs, reading disorders, and multiple disorders (presence of two or more disorders per person) was 1.62%, 1.99%, 1.69%, 1.1%, 8.21%, and 14.89%, respectively. Descriptive analysis showed that the prevalence of articulation disorders, voice disorders, stuttering, and multiple disorders

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was higher in boys compared to girls (P=0.000), while the prevalence of reading disorders and PSFAOs was higher in girls (P=0.000). Furthermore, articulation disorders and reading disorders were more common in first-graders. The prevalence of voice disorders, stuttering, and PSFAOs were higher in the third graders. The logistic regression analysis showed that boys were more likely to develop speech and language disorders compared to girls (OR=1.3, P=0.01), and first-, second-, and third-graders were less likely to have such disorders when compared to preschoolers (OR=0.8, P=0.03).

Discussion: Compared to previous studies, the different rates of prevalence of the disorders studied in this investigation are related to differences in their methodology, the number of samples, age, linguistic and cultural characteristics of the subjects, and individual factors. In this study, the prevalence of the studied disorders was higher in boys, first-graders, and children with families of 4 or more. The development of speech and language skills is different between genders; slower maturation of male brains seems to predispose them to slower development of speech skills. The lower prevalence in school-age children may be because these disorders gradually resolve during the early years of childhood. Moreover, low family socioeconomic status and family size may be the contributing factors to speech and language disorders.

Highlights

• The prevalence of voice disorders, articulation disorders, stuttering, and multiple disorders was higher in boys, and the prevalence of reading disorders and Problems in the Structure and Function of Articulation Organs (PSFAOs) was higher in girls.

• The prevalence of articulation disorders and reading disorders was higher in first graders, the prevalence of voice disorders, stuttering, and PSFAOs was higher in third graders, and the prevalence of multiple disorders was the highest in preschoolers.

• The prevalence of articulation disorders, reading disorders, and multiple disorders were higher in children with families of more than 4 children, and the prevalence of voice disorders and stuttering was higher in children with a family of 2 children. The prevalence of PSFAOs was higher in children with a family of 3 children.

• Boys had a higher chance of developing these disorders compared to girls, and there was a lower chance in first, second, and third graders.

Plain Language Summary

Speech and language skills are important tools for assessing communication development during childhood. Cultural and psychosocial differences can affect the prevalence of speech and language disorders in children. This study showed that the prevalence of the studied disorders was higher in boys, first graders, and children with families of 4 or more children. Boys were more likely to develop such disorders, and first-, second-, and third-grade students were least likely. The prevalence of speech and language disorders in children is crucial for planning treatment interventions. It is hoped that the results of this study can help therapists and families reduce the effects of these disorders in the shortest possible time and reduce rehabilitation costs.

1. Introduction

Language is the most important means of communication [1]. Any disorder that affects speech, particularly fluency, articulation, and voice, or any disorder that affects language components, such as phonology, morphology, syntax, semantics, and pragmatics, can severely damage children's communication, academic, and social skills [2]. The issue of screening Speech and Language Disorders (SLDs) in children requires more attention, as treatment plans to solve their educational and social problems and their rehabilitation needs are based on the prevalence of such disorders in the community and related research [2-5].

Several local and international studies have reported the prevalence of SLDs. The prevalence of SLDs is between 0.2%-41.2% [6-15], speech disorders 3.4% to 14.7% [8, 16-20], reading disorders 3.5%-22% [16-18, 20-23], voice disorders 2.1%-4.8% [9, 12, 15, 16, 20, 22, 24, 25], stuttering 1%-13% [9, 10, 12, 15, 16, 20, 22, 26-29], articulation disorders 7.06%-90% [7, 9, 12, 15, 16, 20, 22, 24, 27, 30] and impairment in skills orofacial motor is reported to be between 16.2%-87% [22, 30].

There has been no comprehensive report on screening for speech and reading disorders and problems in the structure and function of articulation organs (PSFAOs) in Persian-speaking children in Mashhad City, Iran. Such studies can provide useful information for therapists to provide the best rehabilitation services and increase their awareness of the factors affecting these disorders. In addition, the findings of this study could reduce the cost of rehabilitation for families in the future. Therefore, this study aims to screen for stuttering, voice disorders, articulation disorders, and PSFAOs in preschool and school children in the first to third grade and screening for reading disorders in school children in the first to the third grade of primary school. Factors related to demographic information that affect these disorders were also examined.

2. Materials and Methods

Study samples

The present cross-sectional study was conducted from 2018 to 2020. Through the stratified-cluster sampling method, 2770 children in the age range of 3-9 years, from preschool to the third grade of primary school, participated in this study. Gender and educational background were considered as strata and school as a cluster. The inclusion criterion for this study was to be a monolingual Persian speaker, and there were no exclusion criteria. This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (Code: IR.MUMS.REC.1395. 566). Before the study, a training session was held for the research team. The session was on performing and scoring each test.

Before commencing the study, a written consent form was signed by the parents of the participating children. After obtaining the demographic information via a researcher-made questionnaire, the children were asked to sit in a specific position. First, a short interview was conducted to communicate with the children, and then examinations were performed to analyze the speech articulatory organs, voice, speech fluency, speech articulation, and reading skills. The sequence of steps was the same for all children and took approximately 30 min. As this study was conducted during the COVID-19 pandemic, all relevant health protocols were obsereved.

Study measures

Demographic information questionnaire

We designed a demographic information questionnaire that included the following information: gender, age, educational background, parents' education and occupation, order of birth, and the number of children.

Examining the articulation organs

All children were screened for structural and or functional dysfunctions of the mandible, throat, lips, tongue, palate, and pharyngeal sphincter using a semi-structured questionnaire taken from Paul et al.'s report [31].

Evaluating the articulation status

To investigate articulation disorders, the phonetic information test was used, the validity and reliability of which were obtained by Ghasisin et al. [32]. The correct articulation of the Persian consonants except the /Ɵ/ at the beginning of each syllable, the beginning or end of the middle syllable, and the end of the final syllable of 66 words were evaluated using this test. An image was shown to the student and they were asked to name it. If the child could not name the image using secondary stimuli, the examiner was allowed to present the articulation pattern to the student to imitate.

Perceptual evaluation of the voice

Each child was asked to say the vowel / a / for 3 s while their voice was being recorded. According to the grade, roughness, breathiness, asthenia, strain (GRBAS) test instructions, which is a tool for auditory perceptual assessment of voice [33], the severity of dysphonia was rated by six speech and language pathologists, and it was determined whether it was normal. All pathologists were trained before sampling.

Evaluating the fluency of speech

A spontaneous speech sample was obtained to evaluate stuttering in suspected children using the stuttering severity instrument, 4th edition (SSI-4). This sample of spontaneous speech was used to assess the frequency of stuttering, its duration, and associated physical move-

ments. The reliability of this test was confirmed by Zolfaghari et al. in 2014 [34].

According to this tool, frequency includes the percentage of stuttered syllables (SS%) in colloquial speech and is determined with a score of 2-18. During the delay, 3 of the longest stuttering events were taken, the minimum of which is one-tenth of a second and is marked with a score scale of 4-18. Four types of physical behaviors are graded on a scale of 0-5 and were marked with a total score of 0-20. The overall score is 0-56. Images were provided to the child for verbal stimulation. The child's speech and physical movements were recorded by a video camera. During the sampling, the patients were asked questions and were interrupted to give the impression of a normal conversation. Speech fluency was scored by a single person, and it was determined whether a dysfunction was present.

Evaluating the reading skills

To screen for reading disorders, we used the "screening test for the diagnosis of reading disorders in the first to fifth grades of elementary school students" that is designed by Shafiei et al. (2008) in Isfahan City, Iran [35]. This test consists of 5 texts or story-reading assignments that have been extracted from first to fifth-grade Persian school books and are selected in such a way that at least 75% of the students in each grade can read the relevant text easily with minimal mistakes. The font size and line type used are designed in a way that words can be easily read. Students of each grade level were assessed by the appropriate text (they should have completed at least 6 months of that grade level). Based on this test, it was determined whether the child has a reading disorder or not.

Statistical analysis

Sampling was done via the stratified-cluster method. School grade was considered a cluster, while gender (boy, girl), educational level (1^{st}, 2^{nd} and 3^{rd}), and type of school (public, private) were considered the strata. This was done to make our population sample representative of the majority of students in Mashhad City, Iran.

The data were analyzed using the Stata software, v. 14.1. Statistical analysis was performed to calculate descriptive indicators, such as prevalence, mean, and so on, based on the inverse probability of participating in the study. In the descriptive analysis, the prevalence of SLDs, other qualitative variables, and their 95% confidence interval (CI) were calculated. Analytical analysis began with the Chi-square test between the studied disorders and other variables. Then, variables with a P value of less than 0.2, which included gender (girl=0, boy=1), school grade (preschool=0, 1^{st}=1, 2^{nd}=2, 3^{rd}=3), birth order (1^{st}=1, 2^{nd}=2, 3^{rd}=3, 4^{th} and higher=4), number of children in the family (one=1, two=2, three=3, four and more=4) were entered into the regression logistic model and their corresponding odds ratio (OR) values were calculated. We performed 2 types of logistic regression. In the binary logistics regression model, the variables of the studied disorders were identified as no (without the disorder) and yes (any type of disorder). In the multinomial model, the type of each disorder was specified. The significance level was considered α=0.05.

3. Results

Descriptive findings

The demographic characteristics of the subjects are provided in Table 1. Participants included 1381 girls with Mean±SD age of 7.46±1.015 years and 1389 boys with a Mean±SD age of 7.64±1.095. In addition, the prevalence of all disorders studied in this study by gender, educational level, order of birth, and the number of children are provided in Table 2.

The results showed that the prevalence of articulation disorders, voice disorders, stuttering, and multiple disorders was significantly higher in boys compared to girls, while the prevalence of reading disorders and PSFAOs were significantly higher in girls. Also, the prevalence of multiple disorders was significantly higher in preschoolers (P=0.000).

Articulation and reading disorders were significantly more common in first graders, while voice disorders, stuttering, and PSFAOs were significantly more common in third graders (P=0.000). In addition, the prevalence of articulation, reading, and multiple disorders were higher in children with families of 4 or more children.

Voice disorders and stuttering were higher in children with families of two children, and the prevalence of PSFAOs was higher in children with families of 3 children (P=0.03). The prevalence of the disorders studied did not show a significant difference in terms of birth order between groups (P>0.05).

The prevalence of the studied disorders was significantly higher in boys, first graders, and children with families of 4 or more children compared to other groups (P<0.05) (Table 3).

Table 1. Demographic status of participants (N=2770)

Demographic Characteristics		Groups	No. (%)
Gender		Female	1381(49.9)
		Male	1389(50.1)
School grade		Preschooler	483(17.4)
		1st	830(30)
		2nd	865(31.2)
		3rd	592(21.4)
Education of parents	Father	Illiterate	0(0)
		No high school diploma	368(13.3)
		Diploma and associate	935(33.8)
		Bachelors	454(16.4)
		Master	135(4.9)
		Seminary	7(0.3)
	Mother	Illiterate	7(0.3)
		No high school diploma	300(10.8)
		Diploma and associate	1013(36.6)
		Bachelor	490(17.7)
		Master	85(3.1)
		Seminary	2(0.1)
Career of parents	Father	Jobless	13(0.5)
		Laborer	204(7.4)
		Employee	1120(40.4)
		Self-employed	1226(44.3)
	Mother	Housewife	1934(69.7)
		Laborer	8(0.3)
		Employee	605(21.8)
		Self-employed	121(4.4)
Rank of child		1st	1414(51)
		2nd	866(31.3)
		3rd	279(10.1)
		Fourth and more	112(4)
Number of children		1	674(24.3)
		2	1375(49.6)
		3	486(17.5)
		Four & more	158(11.4)

Table 2. Prevalence of studied disorders in children

Demographic Characteristics	Groups	No. (%)						P
		Articulation Disorders	Voice Disorders	Stuttering	(PSFAOs)	Reading Disorders	Multiple Disorders	
Gender	Female	8(0.59)	5(0.37)	5(0.37)	8(0.59)	62(4.54)	91(6.67)	0.000
	Male	14(1.03)	22(1.62)	18(1.32)	7(0.51)	50(3.67)	112(8.22)	
School grade	Preschool	2(0.43)	5(1.07)	5(1.07)	3(0.64)	0(0.00)	56(11.94)	0.000
	1st	14(1.07)	5(0.61)	3(0.36)	4(0.49)	71(8.63)	59(7.17)	
	2nd	2(0.23)	4(0.47)	5(0.58)	3(0.35)	20(2.34)	51(5.96)	
	3rd	4(0.69)	13(2.24)	10(1.72)	5(0.86)	21(3.62)	37(6.38)	
Birth order	1st	9(0.64)	16(1.15)	14(1.00)	9(0.64)	44(3.15)	100(7.16)	0.173
	2nd	7(0.82)	10(1.17)	5(0.58)	6(0.70)	42(4.91)	66(7.72)	
	3rd	2(0.72)	1(0.36)	3(1.09)	0(0.00)	12(4.35)	19(6.18)	
	Fourth and more	2(2.73)	0(0.00)	1(0.91)	0(0.00)	9(8.18)	11(10.00)	
Number of children	1	4(0.61)	6(0.91)	6(0.91)	5(0.76)	24(3.63)	50(7.56)	0.036
	2	10(0.74)	19(1.40)	13(0.96)	6(0.44)	47(3.46)	94(6.92)	
	3	4(0.84)	2(0.42)	3(0.63)	4(0.84)	20(4.18)	37(7.74)	
	Four and more	3(1.92)	0(0.00)	1(0.64)	0(0.00)	16(10.26)	15(9.62)	

PSFAOs: Problems in structure and function of articulation organs.

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Results of the logistic regression model

As shown in Table 4, the logistic regression analysis revealed an increased likelihood of SLDs risk in boys compared to girls with a 95% CI (OR=1.3, P=0.01), and reduced risk of SLDs were detected in the first, second, and third graders when compared to preschool children (OR=0.8, P=0.03).

4. Discussion

Language and speech skills are the most important tools for communication during childhood [1]. Investigating the prevalence of SLDs helps formulate treatment plans. The results of the present cross-sectional study showed that the prevalence of SLDs was higher in boys, first graders, and children with families of 4 or more children.

Being a boy increases the chances of developing SLDs. Language development is different between the genders. The evidence suggests that male brains mature slower and are thus more vulnerable to speech development disruptions during the first years of life [22].

Based on our findings, being in school (first to third grade) decreased the chances of developing SLDs. Special attention is usually paid to such disorders in preschools, and families at this age are usually concerned with their child's speech and language skills and seek treatment sooner if needed. The low prevalence of SLDs at school age may be because they gradually resolve in preschool [27].

The more families are aware of the importance of age under two years in language learning, the better the prognosis for their child's treatment [22].

There was a significant relationship between the number of family members of the child and the studied disorders, which is consistent with Obeid et al.'s findings. This factor seems to be related to the lower socioeconomic conditions of families with more children [27].

Table 3. Overall prevalence of studied disorders in children

Speech and Language Disorders		No. (%)	P
Sex	Female	179(13.11)	0.000
	Male	223(16.37	
School grade	Preschool	71(15.14)	0.000
	1st	156(18.96)	
	2nd	85(9.94)	
	3rd	90(15.52)	
Rank of child	1st	192(13.74)	0.173
	2nd	136(15.91)	
	3rd	37(13.41)	
	Forth and more	24(21.82)	
Number of children	1	95(14.37)	0.036
	2	189(13.91)	
	3	70(14.64)	
	Four and more	35(22.44)	

There have been several studies over the last two decades that have reported different rates of prevalence of SLDs. Among students, the prevalence of SLDs is reported to range from 11.5%-41.2% [2, 8, 20, 22, 36-39], while in this study, the prevalence of these disorders in the first to third grades was higher than these values (44.36%). This difference seems to be because of the differences in methodology and individual, cultural, and social factors [10, 17, 36]. In previous studies, the prevalence of articulation disorders was reported to range from 8% to 13.8% [9, 15, 29], while in this study, a lower value was obtained (Table 1). The prevalence of stuttering in previous studies was 1% to 2.06% [9, 15, 29], while in this study, it was slightly higher. Voice disorders in previous studies had a prevalence of 0.47% to 53.2% [15, 25, 40] and were consistent with the results of the present study. Hakim et al. reported a prevalence of reading disorders of 3.5% [21], whereas, in the present study, this rate was higher. The difference may be related to the number of participants and their age range.

In preschoolers, Tchoungui et al. reported a prevalence of SLDs of 17.1% [20], however, a lower rate was found in this study. The prevalence of some speech disorders in this study was lower than in previous stud-

Table 4. Variables associated with studied disorders using logistic regression

Variables	Odd Ratio	P	95% Confidence Interval
Sex	1.303756	0.017	(1.04, 1.62)
Grade	0.8867139	0.032	(0.79, 0.98)
Rank	1.017596	0.862	(0.83, 1.23)
Child	1.132971	0.231	(0.92, 1.38)
Constant	0.1357434	0.000	(0.09, 0.19)

ies, which included articulation disorders, voice disorders, and stuttering. Different methodologies, the age of subjects, linguistic and cultural characteristics of subjects, and individual factors affecting SLDs can be used as justifications for the differences between the study results [4, 10, 22, 36].

Investigating the prevalence of SLDs is important as it increases the awareness of health professionals and helps newer and more effective treatment and prevention methods [22]. In addition, there is a link between speech disorders and psychiatric disorders [27, 41]. Untreated speech and language problems can lead to behavioral and psychosocial problems [2-5]. Furthermore, children who are diagnosed or referred late may have difficulty reading and writing at school [2].

Limitations of our study included the reluctance of some educational institutions and schools to participate in the research. Another challenge we faced was school examinations and completing part of the study during the COVID-19 pandemic. It is recommended that screening for other SLDs be performed, especially among younger children. Considering the importance of early detection of speech and language disorders in providing effective and quicker interventions, it is better to screen children before the age of 3.

5. Conclusion

The prevalence of SLDs was higher in boys, first-graders, and children with families of four or more children compared to other groups. In addition, boys were more likely to develop such disorders, while first-, second-, and third-grade students were less likely to develop them.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (Code: IR.MUMS.REC.1395. 566).

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Authors' contributions

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Conflict of interest

The authors declared no conflict of interest.

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