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ORIGINAL RESEARCH

Do Comorbid Psychiatric Disorders Affect Global Functioning in Children Diagnosed with Speech Sound Disorder?

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Abstract

Objective: Children with the speech sound disorder (SSD) had impairment in comprehensibility and SSD lead to significant problems in academic and social life especially with psychiatric comorbidities. The aim of the study was to assess the effects of comorbid psychiatric disorders on global functioning in children with SSD.

Methods: Children aged 4–16 years (n=301) who had incorrectly expressed phonemes as chief complaint were recruited retrospectively. Speech sound errors were evaluated with Speech Sound Development Test (SSDT), Clinical Global Impressions-Severity Scale (CGI-S) and psychiatric comorbidities were also evaluated according to DSM-5. Multiple linear regressions were performed to clarify the association between global functioning and speech sound errors, socio-demographic characteristics, and psychiatric comorbidities.

Results: Of the 301 participants 218 (72.4%) were female and the mean age was 75.49 ± 22.88 months. Attention deficit hyperactivity disorder (ADHD) (25.6%), intellectual disability (ID) (23.6%), Specific Learning Disorder (SLD) (8.3%) and Oppositional Defiant Disorder (ODD) (3%) were identified as the most common comorbid psychiatric disorders in SSD. Multiple linear regression models confirmed that increased total number of incorrectly expressed phonemes, increased age, and low IQ values were associated with global functioning issues. In the adjusted model, only ID had a significant effect on global functioning.

Conclusion: Global functioning in SSD is affected by psychiatric comorbidities and especially by ID. It follows that psychiatric and cognitive assessment is important in the comprehensive evaluation of functioning in children diagnosed with SSD, for providing necessary therapies and educational guidance to enhance global functioning.

Keywords: Speech Sound Disorder, Psychiatric Comorbidities, Global Functioning, Attention Deficit Hyperactivity Disorder, Oppositional Defiant Disorder, Intellectual Disability

INTRODUCTION

Speech and language disorders have lifelong consequences form childhood to adulthood that affect social and emotional life and behavior , with negative effects on academic achievement during school years (1-5). Speech and language disorders affect 4% to 9% of children in early childhood (6, 7). The term speech sound disorder (SSD) includes both articulation (motor skills) and phonological issues (knowledge and use of speech sounds and language patterns of speech) (8). However, SSD and its symptomatology differ from language impairment, which is characterized by deficiencies in expression or understanding of syntax, morphology, or pragmatic skills (8). The SSD spectrum ranges from mild articulation problems to more serious phonological disorders that involve multiple errors in speech tone production and negatively affect comprehensibility(9). Although the findings of prevalence studies differ, the limited data obtained from large cohorts indicate that the prevalence of SSD in the population is 15.6% at 3 years old, 6.4% at 5 years, and 3.8% at 8 years, decreasing with

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age.(2, 10, 11)Another study reported the prevalence of SSD in 6-year-oldsas 3.8% (4.5% in boys and 3.1% in girls) (6).

In addition to the negative effects of SSD alone, the presence of other comorbid disorders causes significant problems in academic and social life (9, 12). High comorbidity rates have been reported in children with SSD, especially when accompanied by language disorders (8). Early follow-up studies have shown that individuals with a history of SSD experience greater reading difficulties than control participants (13, 14).

Regarding comorbidity of SSD with language impairment, the available data are limited and variable, ranging between 1.33% and 4.6% in children aged 5–6 years (2, 6). It has been reported that occurrence of SSD and/or language impairment and reading impairment varies between 1.6% and 8.1% (15). However, other evidence suggests that the presence of SSD alone is not a determinant of reading skills, which are thought to be negatively affected in cases of SSD with language impairment comorbidity (9).

Studies examining the relationship between ADHD and SSD have reported higher ADHD symptom scores among children with moderate and severe SSD than those without SSD (16). Another study found that a group with SSD accompanied by language impairment returned higher ADHD scores than those with SSD alone(17). Studies of the relationship between cognitive functions or intelligence quotient (IQ) scores and SSD have also reported varying results. In one study of preschool children, there was no significant difference between the IQ scores of children with speech disorders and those with normal speech (18). In a study of children with mental retardation, severity of articulation disorder was found to relate to mental age although a high rate of articulation disorder was detected (19).

Although a limited number of large-sample studies have investigated psychiatric comorbidities in children with SSD, no existing published study has examined the effects of these psychiatric comorbidities on global functioning. To investigate this relationship, the present study hypothesized that comorbid psychiatric disorders would negatively affect global functioning in children with SSD.

METHOD

Participants

This one-year survey was conducted between the children ages of 4-16 years, who applied to the Kanuni Sultan Süleyman Training and Research Hospital Child and Adolescent Psychiatry Clinic during the period of 01.01.2015-31.12.2017, those presenting with *incorrectly expressed phonemes as chief complaint* were recruited retrospectively. Of the 403 candidates enrolled the study, 50 were excluded because they did not meet the criteria for speech sound disorder. A further 52 who did not complete the Speech Sound Development Test (SSDT) were also excluded. The final study sample therefore comprised 301 patients. Their functional level was assessed by clinician-administered CGI-S, and the Stanford Binet Test was used to measure their cognitive level.

The exclusion criteria were (1) articulation problems due to secondary causes, such as neurological or hearing problems; (2) structural anomalies leading to articulation deficit, such as cleft palate; and (3) inability to complete assessments. Routine assessments to rule out articulation problems resulting from secondary causes included physical and neurological examination and developmental and auditory tests. Ethical approval was obtained from the Kanuni Sultan Süleyman Education and Research Hospital Ethics Committee (Approval Number: 2018.7.20).

Measures

Speech Sound Development Test (SSDT)

The SSDT consists of 123 words, which are used to test the 21target consonants. Each child was individually assessed, sitting side-by-side with the interviewer at a table in a quiet room. The SSDT is an imitative test, requiring the child only to repeat the stimulus word. The test assesses “auditory perception and auditory sequential aspects of sound as speech” including articulation mistakes of omission, distortion, substitution, addition, and/or incorrect sequencing of speech sounds (20). The test’s Cronbach’s Alpha value of 0.843 was deemed adequate (20).

Clinical Global Impressions-Severity Scale

The CGI-S is a three-dimensional scale developed to assess the severity and prognosis of psychiatric disorders and any side effects associated with psychopharmacological drugs (21). The version of the scale used in the present study assesses the global severity of the disease.

Stanford Binet Intelligence Scale

Stanford Binet Intelligence scale was used to assess estimated Intelligence Quotient. The validation of this test battery has been shown in different studies (22). It

has good psychometric properties and is standardized for ages two to 85 and adapted to Turkish population by Uğurel – Şemin (1987) (23).

Statistical Analyses

SPSS 20.0 statistical software (SPSS Inc, Chicago, Illinois, United States) was used to analyze the data. Descriptive statistics (frequencies, proportions, medians and interquartile ranges) were used to report the study group's demographic characteristics. Initially, the normality of the total scores was tested using the Kolmogorov-Smirnov normality test and graphs. Therefore, the statistical analysis employed Mann-Whitney U-tests and X^2 tests as a univariate analysis. Crude and Adjusted multiple linear regressions were performed to clarify the association between global functioning and speech sound errors, socio-demographic characteristics, and psychiatric comorbid disorders. The model included independent variables that were found to be significant; a value of $p < 0.05$ was considered statistically significant.

RESULTS

Of the 301 participants in the final sample, 218 (72.4%) were female and 83 (37.6%) were male. The mean participant age was 75.49 ± 22.88 months (range 48–192 months). Table 1 shows the median and interquartile range of articulation error type (omission, distortion, substitution, and/or incorrect sequencing of speech sounds), age, CGI, and IQ level by gender for all participants. No significant differences were observed in speech sound variables between genders ($p > 0.05$). Total number of incorrectly expressed phonemes decreased with increasing age ($r=0.137$; $p=0.017$).

Comorbid psychiatric disorders among patients with SSD are shown in Table 2. Among these, ADHD was found in 25.6% of cases; ID in 23.6%; SLD in 8.3%; ODD in 3%; anxiety disorders in 1%; ASD in 1%; and other psychiatric disorders in 2.7%.No significant differences were observed in comorbid psychiatric disorders between genders ($p > 0.05$).

Among patients with SSD, the mean CGI-S score was 3.04 ± 0.42 (range 2–4). To understand the association between global functioning, speech sound errors, and socio-demographic characteristics, multiple linear regression analysis were performed as shown in Table 3. In model 1, The global functioning is predicted by age($\beta=0.003$). In model 2, The global functioning is predicted by total number of incorrectly expressed phonemes ($\beta=0.056$). In model 3, The global functioning is predicted by total number of incorrectly expressed phonemes and IQ ($\beta=0.056$ and $\beta=-0.004$, respectively).

Table 1. Speech sound Eerror and vociodemographic variables in according to gender

	Female Median (IQR 25-75)	Male Median (IQR 25-75)	Total Median (IQR 25-75)	Test Statistics Z; p	Cohen's d
Age (month)	69 (62-79)	71 (61-82)	71 (61-82)	0,425; 0,671	-0.0728
IQ (N=258)	88,0 (75,0-99,0)	88,00 (74,0-100,0)	88,00 (75,0-99,0)	0,315; 0,753	-0.1320
Total Incorrect expressed phoneme	7,0 (5,0-9,0)	7,00 (5,0-9,0)	7,00 (5,0-9,0)	0,659; 0,486	-0.0311
Incorrect expressed phoneme at the beginning of word	5,0 (3,0-8,0)	5,00 (4,0-8,0)	5,00 (3,0-8,0)	1,184; 0,236	0.2332
Incorrect expressed phoneme at the middle of word	5,0 (3,0-8,0)	6,00 (3,0-7,0)	5,00 (3,0-8,0)	0,446; 0,655	-0.0598
Incorrect expressed phoneme at the end of word	4,0 (3,0-5,0)	4,00 (2,0-5,0)	4,00 (3,0-5,0)	1,517; 0,129	0.0187
Substitution Error	8,0 (5,0-10,0)	8,00 (5,0-10,0)	8,00 (5,0-10,0)	0,307; 0,759	-0.0728
Omission Error	2,0 (1,0-3,0)	2,00 (1,0-3,0)	2,00 (1,0-3,0)	0,364; 0,716	-0.1320
CGI-S	3,0 (3,0-3,0)	3,00 (3,0-3,0)	3,00 (3,0-3,0)	0,821; 0,412	-0.0311

IQ= Intelligence Quotient; CGI-S= Clinical Global Impression-Severity; IOR= Inter Quartile Range

To understand the association between global functioning and comorbid psychiatric disorders, we performed multiple linear regression analyses (Table 4). While analysis of the crude effect of comorbid disorders (ADHD, ODD and ID) revealed a significant predictive effect on global functioning (β =0.151; β =0.258; β =0.285, respectively), adjustment revealed ID as the main predictive factor in this regard (β =0.249).

Table 2. Comorbid psychiatric disorders of SSD patients in according to gender

	Female (N %)	Male (N %)	Total (N %)	p
ADHD	16 (19,3)	61 (28)	77 (25,6)	0,122
SLD	3 (3,6)	22 (10,1)	25 (8,3)	0,069
ID	21 (25,3)	50(22,9)	71 (23,6)	0,666
ASD	2 (2,4)	1 (0,5)	3 (1,0)	0,128
Stuttering	3 (3,6)	12 (5,5)	15 (5,0)	0,501
Anxiety Disorder	2 (2,4)	1 (0,5)	3 (1,0)	0,128
ODD	-	9 (4,1)	9 (3,0)	0,060
Other Psychiatric disorders	3 (3,6)	5 (2,3)	8 (2,7)	0,524

ADHD=Attention Deficit Hyperactivity Disorder; SLD= Special Learning Disorder; ID= Intellectual Disorder; ASD= Autism Spectrum Disorder; ODD= Oppositional Defiant Disorder

Table 3. Multiple linear regression models for determining the sociodemographic and speech sound error variables on global functioning

	Model 1			Model 2			Model 3		
	B (95% CI)	TVs	VIF	B (95% CI)	TVs	VIF	B (95% CI)	TVs	VIF
Age (Month)	**0,003 (0,001-0,005)**	1,00	1,00	0,002 (-0,001,0,005)	0,73	1,37	0,001 (-0,001,0,004)	0,64	1,57
Gender	-0,044 (-0,151-0,063)	1,00	1,00	-0,053 (-0,160,0,054)	0,96	1,04	0,058 (-0,167,0,060)	0,95	1,05
Total Incorrect expressed phoneme	-	-	-	**0,056 (0,019,0,093)**	0,21	4,79	**0,021 (0,011,0,095)**	0,18	5,49
Incorrect expressed phoneme at the beginning of word	-	-	-	-0,021 (-0,050,0,008)	0,30	3,34	0,016 (-0,062,0,002)	0,27	3,65
Incorrect expressed phoneme at the middle of word	-	-	-	-0,006 (-0,041,0,029)	0,21	4,70	0,007 (-0,034,0,044)	0,19	5,28
Incorrect expressed phoneme at the end of word	-	-	-	-0,012 (-0,046,0,021)	0,45	2,23	0,016 (-0,053,0,021)	0,42	2,39
Substitution Error	-	-	-	0,001 (-0,036,0,038)	0,16	6,13	0,001 (-0,041,0,042)	0,15	6,59
Omission Error	-	-	-	-0,001 (-0,032,0,031)	0,58	1,72	-0,012 (-0,043,0,028)	0,54	1,84
IQ	-	-	-	-	-	-	**-0,004 (-0,008, – 0,001)**	0,72	1,39
R^2	0,021			0,075			0,117		
R^2_{adj}	0,014			0,049			0,85		
F	3,151			2,944			3,663		

IQ= Intelligent Quotient; CGI-S= Clinical Global Impression-Severity; R^2: the coefficient of determination; R^2_{adj}: the adjusted coefficient of determination, TVs: tolerance values, VIF: variance inflation factor values.

Table 4. Linear regression models for determining the comorbid psychiatric disorders on global functioning

		CGI-S Score	Crude	Adjusted		
		Mean±SD (Min-Max)	B (95% CI)	B (95% CI)	TVs	VIF
ADHD	**Yes[1]**	3,02±0,40 (2-4)	**0,151 (0,042,0,260)**	0,067 (-0,047,0,181)	0,87	1,14
	No	3,17±0,47 (3-4)				
SLD	**Yes[1]**	3,04±0,42 (2-4)	0,157 (-0,017,0,330)	0,150 (-0,028,0,329)	0,89	1,13
	No	3,20±0,41 (2-4)				
ID	**Yes[1]**	3,00±0,38 (2-4)	**0,258 (0,148,0,368)**	**0,249 (0,134,0,364)**	0,91	1,10
	No	3,25±0,50 (3-3)				
ASD	**Yes[1]**	3,06±0,43 (2-4)	-0,057 (-0,542,0,428)	0,012 (-0,457,0,481)	0,99	1,01
	No	3,00±0,00 (2-3)				
Anxiety Disorder	**Yes[1]**	3,06±0,43 (2-4)	-0,057 (-0,542,0,428)	-0,071 (-0,539,0,396)	1,00	1,03
	No	3,00±0,00 (2-4)				
ODD	**Yes[1]**	3,05±0,40 (2-4)	**0,285 (0,004,0,567)**	0,197 (-0,080,0,474)	0,96	1,00
	No	3,33±0,87 (2-4)				
Other Psychiatric Disorders	**Yes[1]**	3,06±0,41 (2-4)	-0,058 (-0,358,0,242)	-0,053 (-0,343,0,336)	0,99	1,01
	No	3,00±0,76 (2-4)				

ADHD=Attention Deficit Hyperactivity Disorder; SLD= Special Learning Disorder; ID= Intellectual Disorder; ASD= Autism Spectrum Disorder; ODD= Oppositional Defiant Disorder; CGI-S= Clinical Global Impression-Severity; TVs: tolerance values, VIF: variance inflation factor values; 1= Reference; Adjusted Model R^2 (the coefficient of determination)=0,096; Adjusted Model R^2_{adj} (the adjusted coefficient of determination)=0,071, Adjusted Model F=3,883.

DISCUSSION

The present study investigated the relationship between comorbidities with SSD and their effects on SSD. ADHD and ID were identified as the most prevalent comorbidities. One key finding was that while linear regression models indicate that ADHD, ID, and ODD affect global functioning, the adjusted model suggests that only ID has a significant predictive effect in this regard. Another important finding is that increased total incorrectly expressed phonemes, older age, and lower IQ impact negatively on global functioning in multiple linear regression models.

According to the existing literature, language disorders are the most commonly observed comorbid disorders in children with SSD, varying in prevalence between 21% and 75%. Comorbidity of expressive language disorder has been found to increase in the presence of severe SSD (24). The study's retrospective design meant that patients with articulation disorder as primary complaint were included while those who presented with language disorder were not included. This limitation may explain the absence of language disorder comorbidity.

In an earlier study investigating ADHD comorbidity in children with SSD, 20 of 108 children with SSD were found to have ADHD (18.5%) while those with SSD+SLI (specific language impairment)exhibited more ADHD symptoms than those without SLI (13% vs 39%) (17). Another study found that language disorder was a better predictor of ADHD symptoms than SSD (16). Studies conducted in ADHD clinics have reported that the frequency of language-related problems varies between 30% and 50% (25). The present study found rates of ADHD comorbidity in SSD similar to those reported in the literature.

In one earlier study of 777 children with cognitive impairment aged 6 to 16 years, Wilson et al. concluded that there was a high incidence of articulation problems in children with ID and that severity of articulation errors was associated with mental age. Wilson's findings also indicated that articulatory skills, which improve until about age 8 in typically developing children, continue to show improvement beyond that age in children with cognitive impairments (19). In general, individuals with cognitive impairments exhibit the same phonological processes as normal children but with higher frequency of occurrence of articulation errors (26). As in the literature, the high rate of ID observed in our study sample suggests that assessment of cognitive capacity may benefit children with SSD.

Unlike the clear association between language impairment and reading disability, studies of the relationship between early childhood SSD and reading disability at school age have reported mixed results. While the present study found an SLD comorbidity rate of 8.3%, a number of investigators have reported

that a significant proportion of children with SSD have reading difficulties and/or continue to have reading and spelling difficulties (27-29) that may persist into adulthood (30). While children with isolated SSD do not appear to be at high risk for reading disabilities, they are at risk for spelling difficulties, especially if the speech disorder persists after age 6 (4, 5, 12). Previous studies have suggested that preschool syntactic/semantic impairments are better predictors of later academic problems than preschool speech sound disorders (4).

In multiple linear regression models to determine the impact of socio-demographic and speech sound error variables on global functioning, increased total incorrectly expressed phonemes, older age, and low IQ were found to have negative effects in this regard. Although the prevalence of SSD decreases with age (2, 10, 11), cases in which SSD continues to older ages are commonly more chronic in course and comorbidities, and global functioning may therefore be more impaired. One earlier study found that psychiatric comorbidity was high in language disorders and impacted negatively on Clinical Global Assessment Scale (C-GAS) scores (31). Another study found evidence that adults with articulation problems in childhood achieved lower scores in exams, received less extended training as a result of academic failure, and worked in less qualified jobs (32). As incorrectly expressed phoneme increase, clarity of speech decreases, and global functioning may deteriorate.

In the present study, linear regression models show that ADHD, ID and ODD affect global functioning, but the adjusted model shows that only ID has a significant predictive effect in this regard. Existing evidence suggests that low IQ scores affect global functioning alone (33), and high frequency of occurrence of articulation difficulties may also impact global functioning. In cognitively impaired children, the incidence and severity of articulation difficulties is closely related to mental age (19).

The present findings confirm the importance of a comprehensive approach for children with SSD. As individuals who present with articulation problems may have other underlying issues, speech therapy alone is not enough; cognitive skills should also be evaluated, providing necessary therapies and educational guidance to enhance global functioning.

Limitations

The study's main limitations are the lack of parental global functioning assessment and the retrospective design. As there is no SSD-specific global functioning scale, global functioning was evaluated here using CGI. Subtypes and symptom severity of ADHD was not assessed. Although, anxiety disorders and depressive disorder rates were found lower; due to retrospective design and primary inclusion criteria of this study, our findings have to be interpreted with cautiously. Despite these limitations, this is the first study to evaluate comorbidity and global functioning in a relatively large sample of children with SSD.

Conflict of interest: The authors declare no conflict of interest.

Ethical approval: As the study involved human participants, all procedures complied with the ethical standards of the Kanuni Sultan Süleyman Education and Research Hospital Ethics Committee (approval number: 2018.7.20) and with the 1964 Helsinki Declaration and its later amendments (or comparable ethical standards).

Informed consent: Informed consent was obtained from all participants included in the study.

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