

# Research Paper: Phonological Awareness in Preschool Persian Speaking Children With Speech Sound Disorder: Impact of Comorbid Language Impairment



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## ABSTRACT

**Introduction:** This study aimed to investigate Phonological Awareness (PA) in children with Speech Sound Disorder (SSD). There are conflicting results about the pre-literacy skills of children with SSD. Previous studies have documented the heterogeneity within SSD children. The presence of a comorbid Language Impairment (LI) is an important factor for this heterogeneity.

**Materials and Methods:** The current study examined how a comorbid LI is related to phonological awareness as a pre-literacy skill in a sample of 5- to 6-year-old children with SSD. Participants were 46 children who divided into SSD and LI (n=13), isolated SSD (n=17), and normally developing peers (n=16). Speech production, language, and PA were assessed in these children.

**Results:** PA scores were significantly lower for children with comorbid LI. The difference between children with isolated SSD without any LI and normally developing children on PA tasks was observed only in words with same final consonant (P=0.021). These two groups performed similar on other PA tasks. Phoneme blending was the only variable that not yielded significant differences between three groups of children (P=0.183). The study of relation between children's skills on the percentage of consonants correct (PCC), oromotor abilities, language skills, and PA showed that only there was a relation between spoken language and rhyme in children with SSD and LI (r=0.63, P=0.021).

**Conclusion:** These results suggest that children with SSD and comorbid LI experience PA deficits. These results suggested that PA and spoken language should be assessed in preschoolers with SSD.

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## 1. Introduction

It is not clear which groups of Speech Sound Disorder (SSD) children experience difficulties in pre-literacy skills or which features of Phonological Awareness (PA) are most likely to be damaged.

Therefore, the aim of this study was to investigate PA in children with SSD. PA is a wide pre-literacy ability that contains recognizing and manipulating components of oral language such as words, syllables, onsets, and rimes. The role of PA compared to the importance of other aspects of language in learning to read has been demonstrated in numerous studies. However, there has been considerable emphasis on the function of both PA and language skills in the development of later literacy skills [1, 2].

A child with SSD has sound production disorders more than the same-aged children without any structural or neurological abnormality of articulators, significant hearing impairment, and low intelligence [3]. The prevalence of SSD is high in children [4]. Persistent SSD is typically comorbid with LI [5]. Shriberg et al. in an epidemiological study found comorbidity of speech delay and language impairment as 1.3% [6].

Children with SSD have been categorized in several ways: etiology [7], psycholinguistic processing models [8], and behavioral symptoms [9]. With regard to etiology, Shriberg et al. [7] found a set of diagnostic markers to differentiate subtypes with known genetic etiologies from other subtypes of SSD with unknown origin. Psycholinguistic processing model have not provided a classification system. The components of this system are input, lexical representation, and output. The input processes consist of peripheral auditory processing, word/non-word discrimination, detection of phonological forms related to the language, as well as the phonetic judgment of speech sounds. The lexical representation contains phonological, semantic, grammatical, orthographic, and the information about motor program. The output processes consist of motor programming, motor planning, and motor execution. So many processes in this model are involved in speech perception and production. The model focuses to find which process has been impaired in children's speech and literacy difficulties. Stackhouse and Wells offered specific profiles of the underlying speech processing skills and deficits of children with and without SSD and or LI [8]. Dodd [9] without considering the etiology, classified the SSD into five subtypes based on surface speech errors, including

articulation disorder, phonological delay, consistent a typical phonological disorder, inconsistent phonological disorder, and childhood apraxia of speech. The nature of SSD has been recognized by these classification systems. These systems have changed diagnostic categories and treatment approaches. Categorizing SSD children, according to whether or not SSD is accompanied by LI is one clinically useful scheme to classify subtypes of SSD [10].

It has been demonstrated that children with a history of SSD and comorbid LI show deficits on PA tasks and language measures relative to Normally Developing (ND) peers. These children acted more poorly than children with isolated SSD in academic achievement [5, 11]. Children with SSD and comorbid LI experience additional impairments, including phonology representational impairments and syntactic difficulties that are a main feature of many children with LI [3].

Young et al. found in a longitudinal study that there were few differences between the individuals with isolated SSD and controls with regard to all areas of academic achievement, whereas the SSD individuals with LI straggled significantly behind controls [12]. It has also been demonstrated that the children with a history of severe phonological impairment promote the speech development and normal achievement of literacy abilities by early phonological and metaphonological intervention [13].

Difficulty in developing phonological representations could influence speech, language, and reading development [8]. There are enough data for phonological impairment in SSD and LI. However, it seems that the main problem in a subgroup of children with SSD is motor impairments [3]. The risk of reading problem is not high in the last subgroup [11, 14].

In the current study, the children's performance on measures of speech sounds production, language skills, and PA were assessed. Performance on these measures was evaluated in 3 groups of children, including SSD and LI, isolated SSD, and ND. Language status is an important predictor of reading outcome in children with SSD and concomitant LI [15]. On the other hand, PA is a strong predictor for learning to read [16]. By assessing the relation among speech difficulties, language condition, and PA, we may be able to increase our understanding of SSD subtypes, have suggestions for prevention and treatment of these disorders, and estimate the literacy outcome in different SSD subtypes.

## 2. Materials and Methods

In this cross-sectional study, participants were 46 children at 5–6 years of age who were divided into 3 groups; SSD and LI (n=13), isolated SSD (n=17), and ND (n=16). SSD children were recruited from speech therapy clinics affiliated to Tehran University of Medical Sciences. Boys (56.5%) were participated more than girls (43.5%). Children with isolated SSD or with comorbid LI, were similar regarding their mother's education. ND children were from preschool centers in Tehran. The permission was given from the Ministry of Education to recruit these children. ND children had no history of a speech or language impairment receiving speech-language therapy. They matched with SSD children regarding age, gender, residential areas, and mother's education. Matching of children with regard to residential areas, and mother's education was done to minimize the effect of socioeconomic status. All participants were assessed to be assured of the following inclusion criteria: 1. Normal hearing, 2. Normal structure and function of articulators, 3. Native Farsi speaker, 4. Normal nonverbal intelligence.

### Procedures and measures

To reduce the effect of fatigue on test results, SSD and ND children were tested individually at speech therapy clinics and preschool centers over three sessions lasting 45 minutes each. Institutional Review Board of Tehran University of Medical Sciences approved the conduct of this study. After parents signed informed consent forms for their children to participate, the tests were administered by an expert in speech language pathology who was experienced in working with young children and administering the test protocol individually in their centers. As described in the following sections, speech production, language, and PA were assessed. Speech production was audiotape recorded using Kingston Sound Recorder model DVR- 902.

The phonology and oromotor subtests of Persian Diagnostic Evaluation Articulation and Phonology (P-DEAP) [17] were administered for the assessment of speech production and motor ability. Oromotor subtest has 3 tasks; diadochokinesis (repetition one syllable structure 10 times), isolated movements (imitations of oral motor actions), and sequence movements (imitations sequential oral motor activities). The score was calculated for each task based on P-DEAP.

For speech production assessment, participants were asked to name 54 pictures that elicited all Persian vow-

els and consonants in initial and final word syllables. Phonological information that extracted in this subtest was used to identify SSD and ND children and calculate Percentage of Consonants Correct (PCC). The children who scored below 95% identified as SSD and above 95% identified as ND [17].

### Language assessment

Language status was assessed by standardized Farsi adaptation of Test of Language Development-Primary, third edition (TOLD-P: 3) [18]. This test has six subtests; picture vocabulary, relational vocabulary, oral vocabulary, syntactic understanding, sentence imitation, and morphological completion. These subtests were combined to acquire composite scores for semantics, syntax, listening, organizing, speaking, and spoken language. The Farsi version of TOLD-P: 3 uses standard scores with a mean of 100 and SD of 15 for composite scores. Diagnosis of LI was based on scores >1.5 SD below the mean on two composite scores of the TOLD-P: 3.

### Phonological awareness

Five PA tasks were selected for PA assessment; rhyme detection, alliteration detection, detection of words with same initial consonant, detection of words with same final consonant, and phoneme blending. Each of five PA tasks has been detected as appropriate for 5-6 year children by Soleymani et al. (2016) [19]. Each task has three practice items and ten test items that were presented with pictures.

In rhyme oddity detection task or alliteration oddity detection task, the children were presented with three pictured words, which were named by the child, and were expected to choose the one that did not rhyme with the other two words (e.g. /tup/ [ball], /sup/ [soap], /tab/ [swing]) and for alliteration task, the one did not sound the same at the beginning of the word with the other two words (e.g. /sup/ [soup], /sut/ [whistle], /tut/ [berry]).

In detection of words with same initial consonant or detection of words with same final consonant, the children were presented with three pictured words, which were named by the child, and were expected to identify words in which the initial (e.g. /yæx/[ice], /fil/ [elephant], /yek/ [one]) or final (e.g. /tup/ [ball], /sup/ [soup], /tab/ [swing]) consonants are identical.

Pictured words were presented in phoneme blending task. An examiner named isolated phonemes of each word and child blended isolated phonemes into a word

and pointed to the appropriate picture (e.g. isolated phonemes /š/, /o/, /t/, /o/, /r/ represented /šotor/ [camel]).

The Kolmogorov-Smirnov test showed that the data have a normal distribution. The bivariate Pearson correlation was used to study relation between speech production and oral motor ability, language, and PA measures in three groups separately. The Independent t test was used to compare the variables means between males and females. Differences in these three measures between different groups were compared by several 1-way ANOVAs. Statistical correction for multiple comparisons was made by the Bonferroni correction. P value was  $\leq 0.05$  for all analyses.

### 3. Results

Demographic characteristics (sex and age) and mean scores on the composite scores of TOLD-P: 3, speech production, and PA for the three groups (ND, isolated SSD, and SSD and LI) are presented in Table 1. The SSD and LI children scored lower compared to two other groups with regard to PCC, measures for language assessment, and PA.

Interestingly, there was no difference in three groups of children between boys and girls with regard to these several variables. To find the relation between children's abilities on PCC, oromotor abilities, language, and PA, we carried out correlation analysis in three groups of children separately. No relationships among these abilities was observed ( $P \geq 0.05$ ). The only relation was observed between spoken language and rhyme in children with SSD and LI ( $r=0.63, P=0.021$ ).

Because we were particularly interested in the relationship between PCC, language abilities, and PA, we examined these relationships for PA composite score, spoken language composite score, and PCC by regression analysis. The results showed that PCC and spoken language composite score did not explain significant independence variance for PA composite score in ND and isolated SSD children ( $P \geq 0.05$ ) (Table 2). Although the interaction between PCC and spoken language statistically and significantly predicted PA in SSD and LI children, ( $F_{1,11}=0.123, P \leq 0.001, R^2=0.011$ ).

Several 1-way ANOVAs carried out on the variables in order to assess the differences among groups. The results of these ANOVAs showed no differences between groups

**Table 1.** Demographic characteristics and means (SD) for variables of control and SSD children

Demographic Characteristics		ND <sup>1</sup>	Isolated SSD <sup>2</sup>	SSD+LI <sup>3</sup>
Sex n (%)	Male	9(56.3)	9(52.9)	8(61.5)
	Female	7(43.8)	8(47.1)	5(38.5)
Age (mon)		65.87(2.89)	65.64(3.96)	66.30(4.49)
Oral motor ability and speech production	Diadochokinesis	8.37(1.08)	8.23(1.14)	7.53(2.25)
	Isolated movements	11.81(0.75)	11.64(0.99)	11.30(1.31)
	Sequence movements	16.81(1.72)	16.58(2.82)	15.23(2.86)
	PCC <sup>4</sup>	97.30(1.63)	84.37(6.34)	72.39(7.85)
Language assessment	Spoken language	103(6.73)	97.41(6.32)	57.92(13.20)
	Semantics	104.50(6.93)	100.76(8.66)	70.07(10.65)
	Syntax	101.87(7.22)	95.76( 6.29)	62.53(10.69)
	Listening	104.06(8.31)	98.05(7.57)	71.00(10.12)
	Organizing	106.12(8.59)	99.64(10.84)	60.46(13.24)
	Speaking	98.68(9.59)	96.52(9.99)	69.15(8.92)
	Rhyme	5.75(1.77)	4.76(1.14)	3.23(1.01)
	Alliteration	6.18(1.37)	5.76(1.78)	3.23(0.59)
PA	Words with same initial consonant	4(1.36)	3.64(0.99)	2.15(0.66)
	Words with same final consonant	4.37(1.31)	3.47(0.87)	2.53(0.51)
	Phoneme bending	5.62(3.28)	5.41(2.39)	3.84(0.89)

1: Normal development; 2: Speech sound disorder; 3: Language impairment; 4: Percentage of consonants correct

**Table 2.** Squared multiple correlation change in multiple regressions to predict PA

Regression Analysis	PA								
	$\Delta R^2$			$\beta$			t		
	ND	SSD	SSD+LI	ND	SSD	SSD+LI	ND	SSD	SSD+LI
Spoken language PCC	0.140	0.008	0.011	-12.87	17.18	14.22	-0.49	1.02	6.27*

\*  $P < 0.001$

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with regard to age ( $F_{2,43} = 0.11, P = 0.849$ ) diadochokinesis ( $F_{2,43} = 1.20, P = 0.3309$ ), isolated movements ( $F_{2,43} = 0.89, P = 0.418$ ), sequential movements ( $F_{2,43} = 1.62, P = 0.209$ ). However, there were significant differences between various groups with regard to PCC, language measures, and PA. The results for these variables are as follows: PCC ( $F_{2,43} = 67.59, P = 0.000$ ), spoken language ( $F_{2,43} = 106.23, P = 0.000$ ), listening ( $F_{2,43} = 58.57, P = 0.000$ ), semantics ( $F_{2,43} = 65.20, P = 0.000$ ), organizing ( $F_{2,43} = 71.96, P = 0.000$ ), speaking ( $F_{2,43} = 41.36, P = 0.000$ ), syntax ( $F_{2,43} = 96.49, P = 0.000$ ), rhyme ( $F_{2,43} = 12.23, P = 0.000$ ), alliteration ( $F_{2,43} = 18.32, P = 0.000$ ), words with same initial consonant ( $F_{2,43} = 11.64, P = 0.000$ ), words with same final consonant ( $F_{2,43} = 13.50, P = 0.000$ ).

Post hoc multiple comparisons were used to find which groups were different. Statistical correction for multiple comparisons was made by Bonferroni correction method. The results indicated that the mean of language measures and PCC had significant difference between children with SSD and LI and two other groups of children.

The results of Bonferroni in Post hoc multiple comparisons indicated that the mean of rhyme ( $P = 0.134$ ), alliteration ( $P = 1.000$ ), words with same initial consonant ( $P = 1.000$ ) showed no significant difference between ND and isolated SSD children. The difference was observed only in words with same final consonant ( $P = 0.021$ ) in these two groups. Children with SSD and LI showed significant differences in rhyme ( $P = 0.000$  with ND children,  $P = 0.012$  with isolated SSD children), alliteration ( $P = 0.000$  with ND and isolated SSD children), words with same initial consonant ( $P = 0.000$  with ND children,  $P = 0.001$  with isolated SSD children), and words with same final consonant ( $P = 0.000$  with ND children,  $P = 0.040$  with isolated SSD children) with two other groups of children. The only variable with no significant differences between three groups of children was phoneme blending ( $P = 0.183$ ).

#### 4. Discussion

The present study investigated PA between subtypes of children with SSD, including isolated SSD and SSD ac-

companied with LI. The performances of these children were compared with a control children matched with age and nonverbal ability. Our examination revealed that children with isolated SSD performed similar to control participants without a history of speech disorder on PA tasks. These children were responded different only with regard to words with the same final consonant task. This finding is contrary to the results from a study that showed children with isolated SSD performed poorer on PA tasks than control age and nonverbal matched participants without a history of speech disorder [5]. But this finding is consistent with Rvachew [20] findings that reported isolated SSD subgroup achieved scores on PA tasks that were indistinguishable from ND children.

Methodological differences may explain these contradictory results. Rvachew examined the predictive relationship between PA abilities and reading in children with a preschool history of SSD. The other study showed that history of SSD (with or without LI) is a risk factor for deficits on pre-literacy tasks such as PA. The SSD heterogeneous population is composed of distinct subtypes that are differentiated by behavioral symptoms [9]. These studies did not investigate pre-literacy skills in different subtypes of these children as Holm et al. did. [21]. Holm et al. showed that different subtypes of SSD children have different performances on PA tasks. Children who experience consistent atypical phonological disorders were less efficient in PA skills than children with inconsistent phonological disorder [21]. Phonological impairments alone do not determine pre-literacy outcome. Peterson et al. showed that surface errors in speech along with other linguistic factors determined delayed PA skills [22]. Phonological impairment alone did not determine

PA tended to be poor in children with SSD and LI relative to ND and isolated SSD children. The results supported the research that reported SSD and LI children experience weaker phonological processing skills than the general children [23, 24]. Rvachew and Grawburg detected the variables that may contribute to poor PA skills in preschool-aged children with SSD. They found that children with SSD and poor language skills were at greatest risk of delayed PA skills. Therefore, they sug-

gested that children with SSD should receive assessments of their speech perception, receptive vocabulary, PA, and emergent literacy skills [24].

Some children have difficulties with speech sound production but not with pre-literacy and literacy skills. By collecting the results of different research, Peterson et al. have shown that most children who suffer from SSD have a type of language impairment that primarily affects phonologic processing [25].

Comparing the mean values of PCC revealed that SSD and LI children have more severe speech-sound disorders than isolated SSD. Although children with comorbid LI had more severe SSD on average than children with isolated SSD, PCC was not associated with PA tasks. Therefore, PCC did not explain PA as a predictor of reading skills, because it considers all speech sound errors as equal [26]. It is thought that speech sound production, which depends on phonological representations, could predict variance in PA. Although, the results confirmed that the interaction between PCC and spoken language could predict PA in children with SSD and LI. The study result is consistent with Preston and Edwards [26], that PCC cannot predict significant variance in PA. The interesting finding in their study was that the type of the consonant errors can account for variance in PA. They showed that variance of PA composite scores can be predicted by vocabulary and age. The relationship between PCC and spoken language for explanation of the variance in PA skills, may indicate weak underlying phonological representations for children with SSD and LI. That is, children with SSD and LI have also trouble attending the sound features of words in tasks such as rhyme, alliteration, words with same initial consonant, and words with same final consonant. This supports other researchers claims regarding the importance of evaluating comprehensive language assessment in children with SSD [27].

The present study had several caveats that should be noted. Intervention histories and social economic status of the participants were not assessed in this cross-sectional study. There are several categorization systems for SSD, including etiology [7], psycholinguistic processing models [8], and behavioral symptoms [9]. Although none of these classification systems have robust empirical support, the classification of children into isolated SSD and SSD with LI has been discussed in psycholinguistic processing model. This model may explain the relationship between cause and surface level speech errors [28]. This study only investigated the relationship between a few components of this model, phonological representation that assessed by PA tasks and semantic and syntactic representation that

assessed by TOLD-P: 3. All children performed well in motor execution component. We suggest to assess more components in these children based on this model.

Intervention with focus on PA skills for children with spoken language impairment is currently being supported in English language [29]. This article studied PA skills in subtypes of Persian-speaking children with SSD. We found Persian-speaking children with SSD and LI children had delayed PA skills. Future study is suggested with intervention on PA skills in these children.

Preschoolers with SSD are frequently served clinically. This study explored the preschoolers with SSD. The ability of children with isolated SSD without any language impairment was similar to ND children on PA tasks. Children with SSD that experience language impairment performed PA tasks weakly. These findings showed that the ability to develop accurate spoken language and phonological representations are important for PA tasks.

Children with SSD are a heterogeneous group. Future work is required to precisely identify the nature of the relationship between speech sound problems and literacy-related skills such as PA in these children. Furthermore, the results help promote our knowledge of which SSD children may be at particular risk for pre-literacy difficulties so that early intervention can be applied. Thus, it would seem practical for clinicians to consider PA and spoken language when evaluating and treating preschoolers with SSD.

## Ethical Considerations

### Compliance with ethical guideline

The code of the ethics committee for this study is 93-01-32-25221. The purpose of study was clarified to the children's parents. The children evaluated when their parents signed written consent forms.

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### Conflict of interest

This study has no conflict of interest.

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