

Speech Sound Disorders in Early Childhood and Their Impact on Pre-literacy and Literacy Skills: A Systematic Review

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ABSTRACT

Children with *Speech Sound Disorders* (SSD) or a history of SSD are at risk of developing literacy problems later in life. However, there is limited research on SSD children at risk of literacy problems. This systematic review aimed to review 13 international articles on preschool-age SSD and its impact on literacy skills in middle childhood or adolescence. The results of this systematic review show that children who experience SSD in early childhood have poorer early literacy and literacy skills compared to typical children. Based on the literature review, it was found that the severity of speech sound disorder (SSD) does not have a significant correlation with literacy skills. Thus, it can be concluded that children with mild SSD are still at risk of future literacy problems.

Keywords: *Speech sound disorders, Literacy, Middle childhood, Adolescence*

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INTRODUCTION

Preschool children with a history of speech sound disorders are at risk of experiencing complex problems encompassing speech, language, and academic abilities (Lewis et al., 2018). In recent years, research has shown that children with speech sound disorders tend to have poor literacy skills in middle childhood or adolescence. It is still unclear whether children with speech sound disorders undergoing speech therapy will experience a reduction in literacy risks. Although several studies report that children with speech sound disorders who receive speech therapy show improvements in verbal communication, these children still face academic difficulties (reading, writing, and oral language). Even when expressive phonological deficits are resolved, receptive phonological deficits persist. In short, speech sound disorders place children at risk for language and literacy deficits (Farquharson, 2015). While researchers have worked to identify potential risk factors and predictors, the underlying reasons for the ongoing difficulties in phonological and linguistic processing remain unknown. The strongest evidence supporting the role of SSD itself comes from

a study by Bird et al. (1995), which followed a group of children aged 5 to 7 years with SSD and found that, regardless of additional language disorders, speech difficulties at school entry significantly hindered the ability to learn to read.

Speech sound disorders in the DSM-5 are described as "difficulties in producing speech sounds that affect speech clarity or hinder verbal communication," unrelated to sensory, motor, or other physical abnormalities. Factors associated with SSD include family factors, parental information regarding early speech abilities, cognitive-linguistic factors, and the child's motor skills in early childhood (Eadie et al., 2015). The persistence of SSD into the early school years is considered a concern for literacy development, primarily because affected phonological skills are foundational for learning to read. SSD or speech sound disorders are common phenomena in early childhood (Thomas et al., 2017). The term SSD refers to articulation issues (motor-based speech problems) or phonological disorders (knowledge and use of speech sounds and sound patterns) (Eadie et al., 2015). ASHA (2018) classifies speech sound disorders into three categories: 1) individual sound errors (articulation errors such as distortions), 2) errors in sound rules or sound patterns caused by cognitive-linguistic issues (phonological errors), and 3) errors involving multiple sounds characterized by difficulty with motor planning or sequencing sounds (CAS). No research has yet examined the differences between these three issues and their impact on later reading ability.

Researchers have investigated whether the severity of SSD can predict future literacy abilities. The results of the study show that preschool children with a percentile score of 7 exhibit poor reading abilities in school age compared to their peers. The findings highlight the importance of early identification and recognition of variables that influence children's literacy abilities in school. In recent research, experts have agreed that children with SSD struggle to acquire phonological processing skills and awareness, such as sound segmenting, naming tasks, short-term memory, and rhyming (Canales et al., 2015). These abilities have been proven to be closely linked to children's later literacy skills. According to Catts (1986), children must possess three types of phonological skills: phonological awareness, phonological recoding in lexical access, and phonological recoding in working memory to develop strong reading abilities. Phonological skills such as phonological awareness (rhyming, segmenting sounds, etc.), rapid automatic naming, and phonological memory tasks impact children's abilities in reading and writing. Deficits in phonological awareness place these children at risk for literacy difficulties, as phonological awareness is a key predictor of literacy success (Farquharson, 2015).

Reading problems are closely related to phonological processing (Boada et al., 2022). There is also evidence that poor phonological representations are linked to speech perception and phonological awareness (Boada et al., 2006). Experts agree that phonological errors in SSD are also thought to stem from weak or deficient phonological representations (Boada et al., 2022). Therefore, most studies investigating the relationship between SSD and literacy have focused on children with the

phonological subtype of SSD as the primary issue. Holm et al. (2008) showed that children with consistent speech sound errors and a diagnosis of phonological disorder had lower phonological awareness (PA) compared to children with inconsistent speech sound errors and a diagnosis of speech delay. Consistent evidence from previous studies has shown that SSD is strongly associated with reading ability when accompanied by language problems. Children with SSD who also have a Language Impairment (LI) are at risk for spelling difficulties (Lewis et al., 2002).

Experts agree that word decoding heavily relies on intact phonological abilities such as phonological awareness and rapid naming (Tambyraja et al., 2020). Given that SSD in children is generally phonologically-based, it makes sense that they are at higher risk of struggling to understand and apply the grapheme-phoneme relationships necessary for word decoding. However, evidence regarding the prevalence of literacy problems in children with SSD remains scarce. Certainly, many studies show that, as a group, children with SSD are more likely to experience difficulties in reading and spelling compared to typically developing children (Lewis et al., 2011), regardless of whether they have a co-occurring language disorder (Lewis et al., 2019), and even if their speech errors are considered normal. Overall, few studies report the level of literacy risk in children with SSD. However, there is some evidence of overlap between literacy problems and speech production errors, even among children who may not have an SSD diagnosis. Data on the long-term outcomes of SSD in adolescent children is needed to determine the long-term impact on education, employment status, and social skills (Lewis et al., 2019). This literature review aims to examine recent research on the relationship between SSD diagnoses in early childhood, or those that persist into school age, and their impact on literacy abilities in middle childhood and adolescence. This study is expected to provide deeper insights and recommendations for parents and practitioners in early identification of literacy problems.

METHOD

In the process, the systematic review consists of several stages. This study was conducted as a qualitative systematic review to synthesize findings on the relationship between speech sound disorders and literacy skills, focusing on thematic patterns emerging from the reviewed studies. The stages and details of this study will be explained separately in the next section. The researchers used the SPIDER formula (Sample, Phenomenon of Interest, Design, Evaluation, and Research Type) during the literature search phase. Based on this formula, the research question was formulated as: "What is the relationship between speech sound disorders in children or adolescents and the development of literacy skills in the future, based on evidence from observational or experimental studies?" After identifying the research question, the researchers created search keywords to find relevant articles in the database. In this study, the keywords used incorporated Boolean operators, namely ("speech sound disorders" OR "phonological delay" OR "phonological disorders" OR "articulation

disorders” AND “literacy skills” OR “reading skills” OR “writing skills” AND child OR preschool OR “school age” OR adolescent). These keywords were then used in the Google Scholar and SCOPUS databases. After finding articles in both databases, the researchers conducted a selection process for the obtained articles. During the selection process, the researchers used the RAYYAN application to check for duplicates, read titles and abstracts, and proceed with full-text screening.

Based on the articles obtained, only 13 articles met the researchers' criteria and were included for the review process. Based on the 13 selected articles, a total of approximately 500 participants were included in the review. The participants' ages ranged from 3 to 18 years, with the majority being preschool-aged children (3–6 years old) and school-aged children (7–12 years old). The studies primarily focused on children and adolescents diagnosed with speech sound disorders, including phonological and articulation disorders, without severe cognitive or sensory impairments. Most participants were reported to come from English-speaking backgrounds, aligning with the inclusion criteria of articles published in English.

In the article selection process, the researchers had several inclusion criteria, including: (1) the study was conducted within the last 15 years, (2) the subjects have a history of speech sound disorders or are currently experiencing a speech sound disorder, (3) the subjects do not have severe disorders affecting their cognitive abilities, (4) the subjects do not have hearing impairments or cleft lip and palate, (5) the articles are in English. Articles that did not meet the researchers' criteria included: (1) studies conducted more than 15 years ago, (2) no evidence that the subjects are currently experiencing or have a history of speech sound disorders, (3) subjects have severe brain developmental disorders affecting their cognitive abilities, (4) the articles are not in English, (5) articles classified as literature reviews, proceedings, theses, dissertations, books, etc. The data extracted from the included studies were analyzed through thematic synthesis to identify patterns in the relationship between speech sound disorders and literacy skills

FINDING AND DISCUSSION

RESEARCH RESULT

Children with speech sound disorders (SSD) often face significant challenges in acquiring phonological processing skills, which are crucial for later literacy development. Various studies have examined the relationship between SSD and literacy skills, focusing on phonological awareness (PA), reading comprehension, spelling, and writing abilities. For instance, research by Canales et al. (2015) found that no single area of literacy was more impacted by SSD, although children with SSD exhibited lower scores across all literacy subtests compared to their typical peers. Furthermore, studies by Tambyraja et al. (2020) and Lewis et al. (2018) emphasized

that phonological awareness and percentage consonant correct (PCC) are significant predictors of literacy problems, with a particular focus on the risks faced by children with SSD and comorbid conditions such as language impairments. Research also indicated that children with Childhood Apraxia of Speech (CAS) perform worse in literacy tasks, particularly in PA and writing readiness (Kim et al., 2015). The prevalence of literacy issues in children with SSD is further supported by findings from Thomas et al. (2017) and Farquharson (2015), who demonstrated that children with SSD, particularly when combined with genetic and environmental factors, tend to show lower literacy skills. These studies underscore the importance of early identification and intervention for children with SSD to address potential literacy difficulties.

The following PRISMA diagram illustrates the journal selection process for this systematic review, while Table I provides a summary of the key findings from the reviewed studies.

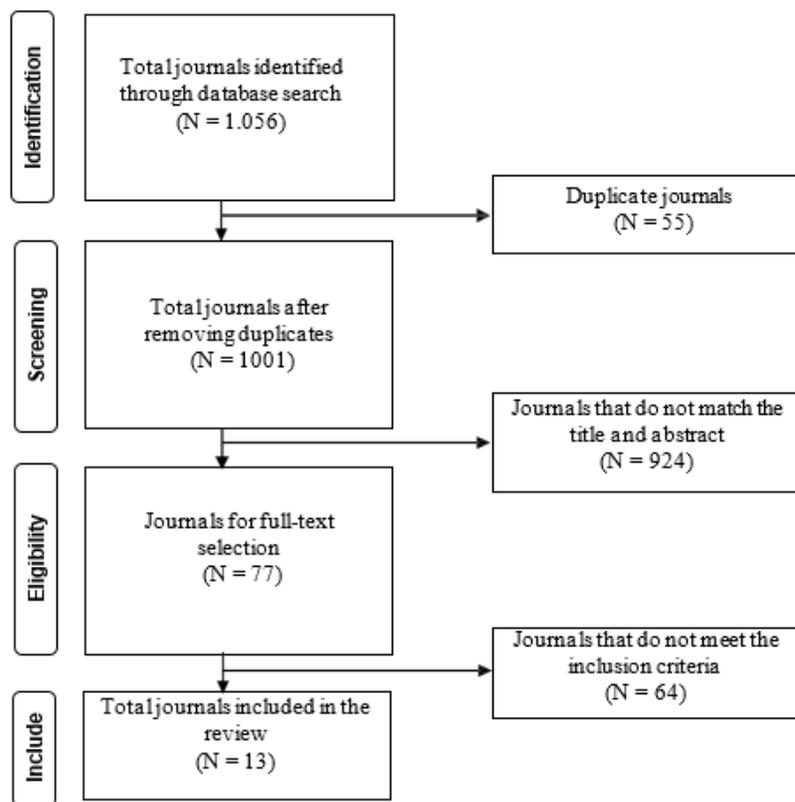


Figure 1: PRISMA Chart for Journal Selection Process

Table 1: The Impact of Speech Sound Disorders on Pre-literacy and Literacy Skills

No.	Author	Subject	Type of SSD	Affected pre-literacy and literacy skills
1.	Lewis et al., (2019)	110 children were assessed for preschool SSD (85 with SSD and 25 typical), and 133 children were assessed for literacy at school age (85 with SSD and 48 typical)	Phonological delay/disorders (+ SLI)	Understanding of meaningful and non-meaningful word decoding, reading comprehension, phonological awareness, and spelling
2.	Canales et al., (2015)	240 children (Kindergarten: 60 children, Grade 1: 60 children, Grade 2: 60 children, Grade 3: 60 children)	Phonological delay/disorders (+ SLI)	Language and writing skills and information comprehension
3.	Tambyraja et al., (2020)	120 children (32 preschool, 83 in grade 1, 5 in grade 2), with 78 male children and 42 female children	Phonological delay/disorders	<i>Phonological Awareness (PA)</i>
4.	Farquharson (2015)	10 children from grade 4 to grade 7, aged between 9.4 and 13 years, were divided into 2 groups: the group with a history of SSD (4 males, 1 female) and the typical children group (2 males, 3 females)	Phonological delay/disorders	Reading skills
5.	Thomas et al., (2017)	245 children aged 3.5 to 9 years (focus on SSD in children aged 3.5 years)	Phonological delay/disorders	<i>Phonological awareness</i> and reading skills

6.	Eadie et al., (2014)	1494 children	Phonological delay/disorders	<i>Phonological awareness, dan Rapid Automatic Naming (RAN)</i>
7.	Boada et al., (2022)	86 children with SSD and 37 typical children	Phonological delay/disorders	Reading comprehension, spelling, and reading fluency
8.	Lewis et al., (2018)	408 children evaluated during middle childhood (7-11.9 years), and 271 evaluated during adolescence (12-17.9 years)	Phonological delay/disorders	Spelling and reading skills
9.	Kim et al., (2015)	304 first-grade children (23 with SSD, 13 with LI, and 10 with comorbidity) were assessed on writing skills during the fall, winter, and spring	Childhood Apraxia of Speech (CAS)	Phonological awareness, print awareness, and writing readiness
10.	McLeod et al., (2017)	275 children aged 4-5 years from 45 kindergartens (132 SSD and 128 typical)	Phonological delay/ disorders	Phonological processing and early literacy skills: letter naming and letter sound naming
11.	Thomas et al., (2018)	30 children with SSD with an average age of 7.3 years and 30 typical children	Phonological delay/ disorders	Phonological awareness
12.	Lavebre et al., (2017)	8 children with CAS and 8 children with TD, aged 4-5 years	Childhood Apraxia of Speech (CAS)	Phonological awareness, print awareness, and writing readiness

13.	Lewis et al., (2014)	170 children were assessed at the ages of 4-6 years, and then reassessed at ages 11-18 years	Phonological delay/disorders and comorbidity (SSD +LI)	Reading and spelling
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DISCUSSION

Pre-literacy assessments such as PA, letter-to-sound knowledge, and print awareness are necessary for early intervention. As it is well known, pre-literacy skills serve as the foundation for a child's future literacy abilities. PA (phonological awareness) is one of the pre-literacy skills that is closely related to reading ability. PA refers to a child's ability to understand the smallest units of sound (words, syllables, rhymes, etc.) and how to manipulate these smallest units of speech sounds. Children with good PA generally have adequate reading and spelling skills (Thomas et al., 2018). Based on the systematic review conducted by the author, it was found that most children with SSD tend to have poorer pre-literacy skills compared to their age-matched peers. The pre-literacy skills measured in the reviewed studies include phonological awareness, phonological processing, print awareness, letter-to-sound knowledge, letter knowledge, and writing readiness. Several studies have also examined the impact of SSD on literacy abilities such as reading comprehension, reading, writing, spelling, etc.

Multisyllable Real Words (MSW) is a skill that is frequently discussed due to its impact from SSD. In a study involving 179 children aged 8 to 9 years with a history of SSD, it was found that children with low MSW abilities and those with persistent speech sound disorders (persistent SSD) had lower scores in word comprehension, reading comprehension, and spelling. The study divided its subjects into three groups: the Resolved SSD group, which included children with a history of SSD but who had typical speech sound abilities (N=105); the Low MSW group, which included children without a pattern of speech sound errors but who had difficulty with multisyllabic real words (N=33); and the last group, children with persistent speech sound errors into school-age and adolescence (N=41). The group with resolved SSD still experienced literacy deficits, but these did not persist into school age. Low MSW scores can lead to children having a poor and limited vocabulary. Below are the impacts arising from a history of SSD in early childhood: (1) poor oral motor skills affecting articulation, leading to difficulty in producing MSW, (2) difficulty with encoding processes, which impacts sequencing ability, (3) weak phonological representation related to slow speech rate, and (4) poor vocabulary due to reduced exposure to MSW.

Researchers also investigated whether the severity of SSD can predict future literacy abilities. The results of the study showed that preschool children with a

percentile score of 7 had poor reading abilities at school age compared to their peers. The findings of this study highlight the importance of early identification and recognition of variables that influence children's literacy abilities in school. The severity of SSD at age 3.5 years could not predict future literacy abilities (Thomas et al., 2017). This is consistent with another study that indicated children with varying levels of SSD severity did not show significant differences in their phonological awareness (PA) scores. Therefore, it can be concluded that even a child with mild SSD is still at risk of phonological awareness issues. In this study, children with SSD were categorized into three groups: mild, moderate, and severe, to examine whether the severity of SSD affects literacy abilities (Thomas et al., 2018).

Based on the review conducted by the author, it is known that phonological delay/disorders are among the most studied diagnoses of SSD, which significantly affect both emergent literacy and literacy skills in children. A study by McLeod et al. (2017) showed that the phonological pattern of cluster reduction was the most common, occurring in 128 cases (46.5%). Children with SSD exhibit low abilities in emergent literacy and phonological processing, regardless of the absence of oral motor, intelligence, and hearing impairments. Cluster reduction is a phonological pattern where a child omits one of the adjacent consonant sounds, such as turning the word "truck" into "tuck." In another study, it was found that children with SSD had significantly different literacy abilities compared to their peers. In addition to phonological delay/disorders, one SSD subgroup that may experience literacy issues is children with Childhood Apraxia of Speech (CAS). Children with CAS typically face motor planning difficulties, which may lead to challenges in literacy skills, particularly writing. Compared to other SSD subgroups, children with CAS perform worse in speech, language, and literacy. In fact, children with CAS have poorer literacy abilities than those with comorbid conditions. Children with CAS tend to struggle with learning to read and write due to poor phonological awareness (PA) and letter-to-sound knowledge. Research indicates that three children with CAS scored lower in areas such as PA, print awareness, and writing readiness. The other three children demonstrated difficulties in PA and writing readiness, while one child had difficulties with writing alone. It was also found that children with good oral motor skills experienced difficulties in all areas of emergent literacy.

From the research, it was found that children with comorbidities (those with both speech sound disorders and language impairments) experience more severe literacy difficulties compared to typical children or those with only SSD (Lewis et al., 2014). This finding is in line with another study by Canales et al. (2015), which reported that children with comorbid SSD and language impairment in 2nd grade had significantly lower scores, especially in reading, writing, and comprehension, compared to typical children. In contrast, children with only speech sound disorders (SSD only)

showed less significant differences when compared to typical children. However, despite the differences not being as significant when compared to children with atypical development, it is still important for parents, teachers, and therapists to closely monitor children with speech sound disorders. These children are still at risk of facing literacy problems in the future.

In addition to the two studies mentioned above, there is a body of research indicating that children with comorbidities (such as speech sound disorders combined with language impairments, or childhood apraxia of speech with language disorders) have a higher risk of reading and spelling difficulties compared to children in specialized reading interventions. In fact, 25% of these children remain at risk for literacy issues at the end of the academic year, even after a year of speech therapy and schooling. This finding highlights the importance of addressing reading skills within school-based therapy, as these difficulties may not be resolved within just one academic year (Tambyraja et al., 2020). Speech therapists must carefully consider the role of phonological representation. Phonological representations, which are stored in long-term memory, may be challenging for children with SSD to access because their working memory resources are depleted when trying to store new information (Farquharson, 2015). Phonological representations refer to the small units that allow phonological information to be stored and accurately represented in memory (Boada et al., 2006).

Given the complex issues related to language, literacy, and cognition in children with speech sound disorders, it is crucial for speech therapists to collaborate with other professionals to provide comprehensive interventions for literacy challenges. A team approach, involving speech therapists, classroom teachers, and parents, can help achieve the best outcomes. Additionally, speech therapists may consult with psychologists to better understand the child's cognitive profile. This can assist in identifying which children with SSD are likely to develop strong literacy skills in the future and which children may face academic challenges. In another study involving 240 subjects, significant differences in literacy abilities were found between children with comorbid conditions (SSD and language impairment) compared to those with only SSD or typical children across all grades (Grades 1 to 3). Children with comorbid conditions consistently showed lower scores across all subtest categories (word-level reading, reading comprehension, spelling, and phonological awareness) compared to both their typical peers and those with only SSD (Canales et al., 2015). In a separate study involving 245 nine-year-old children, it was found that children with both SSD and language impairment had poorer literacy skills, particularly in areas such as word-level reading, spelling, and reading comprehension. These findings emphasize the impact that the combination of speech sound disorders and language impairments can have on

children's academic and literacy development, suggesting the need for targeted interventions to address both speech and language difficulties early on.

CONCLUSION

Speech sound disorders (SSD) in early childhood are often associated with poor literacy outcomes in school-age children. Given that children with SSD typically face phonological issues, it is reasonable to assume that they are at higher risk for difficulties in understanding and applying the grapheme-phoneme relationships necessary for word production. Based on the findings of this systematic review, it is evident that children with comorbid conditions (such as speech sound disorders and language impairments, or childhood apraxia of speech with language impairments) have a lower risk of literacy skills (reading, writing, spelling, reading comprehension) compared to children with only speech sound disorders. In addition to comorbid factors, genetic factors can also increase the risk of literacy problems in children with SSD. Children with SSD who also have genetic factors tend to have significantly lower literacy scores compared to those with SSD alone. Phonological patterns that are atypical in children (e.g., omitting the initial consonant of a word) may further exacerbate the risk of literacy problems in school-age children.

Long-term data on the outcomes of speech sound disorders (SSD) in adolescents is needed to determine the lasting impact on education, employment status, and social skills. The findings from this systematic review are expected to provide readers with a deeper understanding of the impact of SSD in childhood and its effects on literacy skills in school-age children. Additionally, this systematic review aims to offer valuable information to parents, practitioners, and teachers about the factors contributing to low literacy skills in children with SSD, which can help guide early intervention efforts. It is recommended that speech therapists collaborate with other professionals to significantly improve children's literacy skills. Therapists are also encouraged to intervene in underlying literacy issues (such as phonological awareness) rather than solely focusing on improving speech clarity.

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