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Effect of music therapy on language skills in children with specific language impairment: A systematic review

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ABSTRACT

Background: Specific language impairment (SLI) delays language development without any neurological damage or disease. This impairment extends to non-linguistic tasks, such as music perception skills. In recent years, speech-language pathologists (SLPs) and music therapists (MTs) have collaborated to develop and improve approaches for children with communication disorders (CDs), including global developmental delay (GDD), SLI, mild developmental delay (DD), and the risk of developing reading difficulties, by integrating music therapy (MT) and speech therapy (ST). MT could be considered as one of the alternative methods offered to children with SLI to enhance their language skills.

Objectives: The purpose of this study was to investigate the effectiveness of MT interventions on language skills in children with SLI and to investigate the characteristics of other intervention features in these studies, such as interventionists, intervention, settings, session type, and music methods.

Materials and methods: The study was a systematic review conducted within the framework of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The quality of the research results was assessed using the critical appraisal tools provided by the Joanna Briggs Institute (JBI).

Results: Two studies met the inclusion criteria and were included in this systematic review. The two main types of MT employed were song cues and creative music therapy based on the Nordoff-Robbins approach. Current evidence suggests that music therapy improves components of language, including phonology, syntax, morphology, and other aspects of speech development, such as understanding sentences and memory for sentences, in children with SLI.

Conclusion: MT can be a valuable and effective intervention for children with SLI. The introduction of transdisciplinary programs that integrate MT and ST could be recommended. However, MT training courses are required for SLPs.

Introduction

Specific language impairment (SLI) refers to a delay in language development in the absence of any neurological damage or disease. The term "SLI" can be used interchangeably with developmental language disorder (DLD).[2] Regardless of the emphasis on language difficulties in speech comprehension and production, SLI can affect one or several components of language, including syntax (grammar), phonology, morphology, semantics, and pragmatics to varying degrees.[3] Specifically, the main language problems observed often pertain to syntax and morphology components.[4-6]

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Interestingly, this impairment extends more broadly to non-linguistic tasks. For instance, children with SLI tend to exhibit poorer music perception skills compared to typically developing children.[7] This is noteworthy because music and language share numerous commonalities and consist of perceptually unique components arranged in hierarchically structured sequences. Both are highly structured systems that we are constantly exposed to daily.[8-9] According to Levitin[10] and Schmidt-Jones,[11] the fundamental components of music encompass rhythm (duration, tempo, and meter), dynamics, melody (pitch and scales), harmony, timbre, texture, and form/structure. Music and speech share several characteristics: they utilize frequency (pitch and timbre) and temporal (rhythm) cues to convey information at an acoustic level.[12] Additionally, both music and speech involve similar cognitive skills such as learning, memory, and attention at a cognitive level.[13]

Furthermore, studies have attempted to provide deeper insights into the connection between overlapping brain regions for music and language,[14-16] some of which are located in overlapping brain areas such as the lateral parts of the inferior frontal gyrus and the anterior superior temporal gyrus.[14-15] According to Leonard *et al.,* the superior temporal gyrus, precentral gyrus, postcentral gyrus, and inferior frontal gyrus have been associated with language. Some of the regions in the temporal, parietal, and frontal lobes also seem to be involved in playing music. [16]

Music therapy is the clinical and evidence-based use of music treatments in a therapeutic relationship by a certified practitioner who has completed an accredited music therapy curriculum. MT aims to use music to reach non-musical goals, including improving communication, social, emotional, physical, and cognitive domains. Research in the field of MT supports its effectiveness in a wide range of clinical and educational settings.[17-18] According to Geist *et al*., SLPs and MTs have collaborated to develop and enhance approaches for children with severe CDs such as GDD by integrating MT and ST. Positive outcomes of MT/ST collaboration have been observed in a relatively short period.[19]

Studies have examined the effect of using songs for language learning in individuals with language disorders (LDs), including SLI and mild DD,[20] as well as the risk of developing reading problems in individuals with a history of speech and language delay and weak phonological awareness skills.[21] Both studies utilized audio-recorded, live-sung, and spoken-script presentations. These studies have demonstrated a positive effect of songs on incidental word learning,[20] and narratives exhibited a richer vocabulary.[21] Mari *et al*. investigated music understanding and specific linguistic abilities in children with SLI and found that they struggled with music perception, specifically melody and song identification tasks. The authors suggested that training programs incorporating both language and music to stimulate children with SLI might be beneficial in their rehabilitation.[7] Based on the evidence cited above, we hypothesize that MT could serve as an alternative approach for enhancing the language skills of children with SLI.

Currently, there is no systematic review on how music therapy affects language skills, especially in children with SLI. Therefore, the primary objective of this systematic review was to investigate the effectiveness of MT interventions on language skills in children with SLI. Also, the second objective of this study was to investigate the characteristics of the other intervention features of these studies (i.e., interventionists, intervention, setting, session type, and music methods). This method offers a comprehensive perspective on current knowledge, which will help guide future research and clinical practice. The authors aimed to answer the following research questions:

(1) What music therapy interventions have affected language skills for children with specific language impairments?

(2) What are the characteristics of the other intervention features of these studies? (i.e., interventionists, intervention, setting, session type, and music methods)?

Materials and methods

The study was a systematic review based on the PRISMA framework.[22] Relevant articles were retrieved using four electronic databases: PubMed, ERIC, APA PsycInfo, and CINAHL Complete. The publications included in the review were published between 1994 and 2023.

The basic query developed for the literature search was: ("music" OR "music therapy") AND ("specific language impairment" OR "developmental language disorder" OR "delayed speech" OR "expressive language disorder" OR "receptive language disorder") AND (language OR speech OR receptive OR expressive OR phonology OR semantic OR syntax OR morphology OR pragmatic) AND child*. The boolean operators in this query were modified to accommodate database settings.

Inclusion and exclusion criteria

The inclusion criteria included studies with quantitative and qualitative descriptive research. Published articles and grey literature, including theses and dissertations, were also considered. The literature included in this review focused on children aged birth to six years with a documented SLI, regardless of etiology. MT must be used in the interventions outlined to address language skills. The search was also limited to English-language journal articles.

The exclusion criteria were pre-publication, unpublished articles, and other types of grey literature. Clinical outcomes in other treatment areas (physical/motor, cognitive, and socio-emotional) were also not considered. Participants included children older than six years old and diagnosed with other communication disorders (e.g., autistic spectrum disorder (ASD), hearing loss (HL), intellectual disability (ID), visual impairment, learning disorder (LD), and DD) were excluded. Studies were only included if they were written in English.

Data collection and analysis

Following the screening of publications for inclusion,

the two researchers (N.W. and V.B.) independently extracted the data relevant to the research questions. They analyzed the quality of the research results using the JBI critical appraisal tools according to research type. The researchers then addressed any mistakes, discrepancies, or clarifications needed for the coding document. In cases of disagreement, a consensus approach was adopted that included the third author. However, a third opinion was not required because there was no disagreement between reviewers.

Figure 1 illustrates the methodology flowchart for each stage of the search process, as explained in this methodology.[22] Based on the PRISMA, the researchers also generated a coding document and collected inter-rater reliability (IRR) to limit the risk of bias during data extraction.

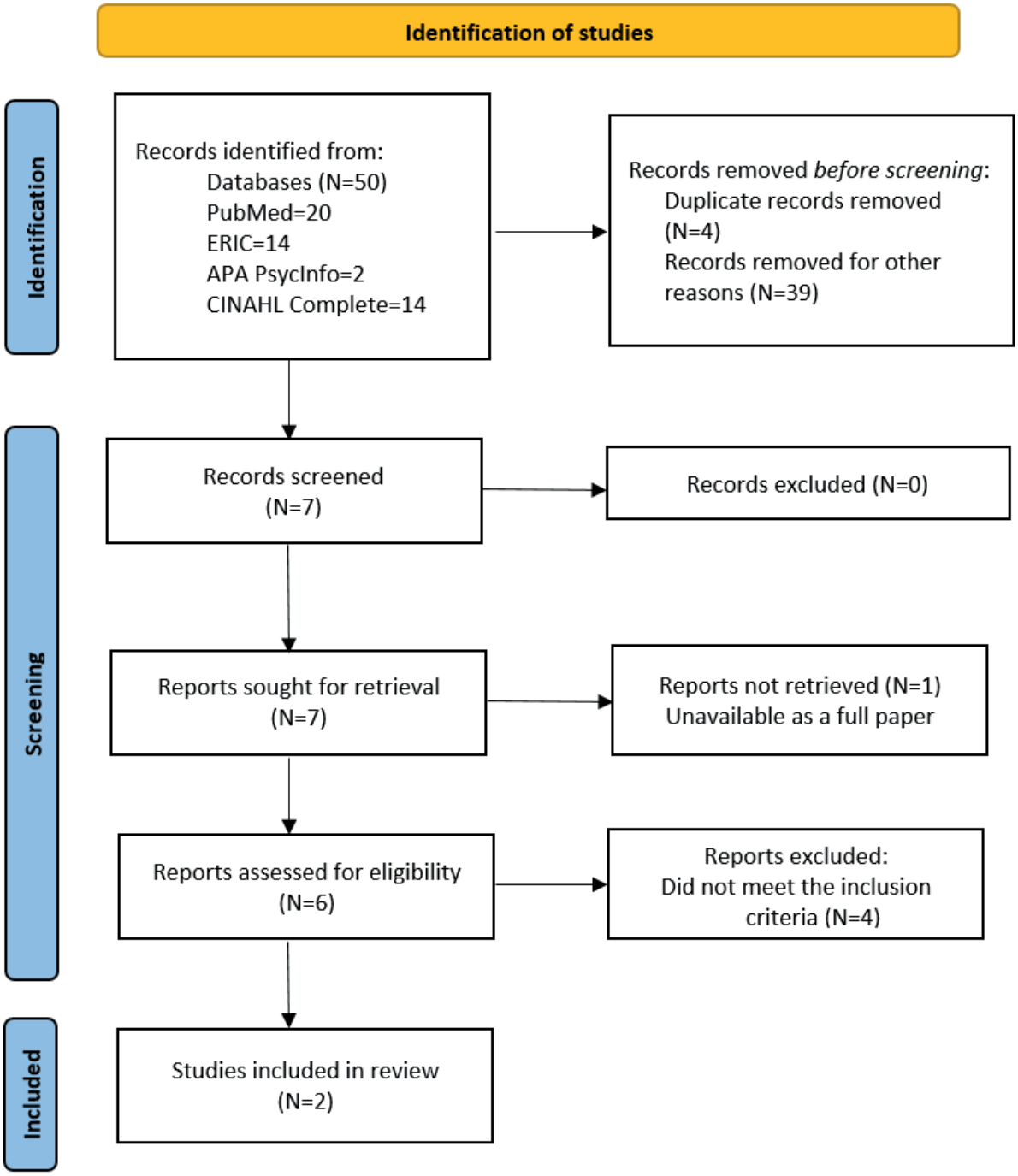

Figure 1. *Methodology flowchart.*

Data extraction

During data extraction, the researchers randomly selected 50% of the data set to estimate the IRR on the inclusion and exclusion of studies, which was obtained for 1 of the 2 studies. We calculated the IRR on all 12 variables by taking the total number of exact agreements divided by agreements plus disagreements and multiplying by 100%. Once the IRR process was complete, the researchers continued to code the remaining documents in the data set independently.

The extracted information included document details (database source, publication origin, publication age, and document type), participant information (diagnoses, age), information about the interventionists (professional occupation), characteristics of the intervention (setting, session type, musical methods), and outcomes of the intervention (developmental domain(s) addressed, types of language skills, and outcomes).

The researchers provided a narrative description of the literature in the dataset, including the type, age, and source of publication. Then, the researchers identified and analyzed variations in diagnosis, age groups, interventionist profession, types of music experiences, and language goals covered in the literature as part of this evaluation. Furthermore, the researchers discovered gaps in the literature and described limitations or disagreements found in the literature. Finally, the researchers might obtain future research directions from this analysis.

Results

The searches identified 50 articles published between 1994 and 2023. After removing records before screening, seven studies remained. One study was excluded because it was unavailable as a full paper, and four studies still needed to meet the inclusion criteria. Finally, two studies met the inclusion criteria and were included in this systematic review (Figure 1). The two studies identified for this systematic review included one case study (50%) and one observational pilot study (50%). These studies were generally of low scientific quality since they consisted of case studies (level IV evidence) and observational pilot studies (level III evidence). Additionally, one study was conducted in Australia, while the other was conducted in Germany (Table 1).

In all, these studies included 20 participants with SLI who met the inclusion criteria for this review. This included 13 males (65.0%), and seven females (25.0%). Children ranged in age from 3 to 6. Race or ethnicity was not reported for 20 children (100%), of whom 2 spoke English and 18 spoke German. Participants in one study had moderate-to-severe SLI,[23] while participants in the other did not mention it.[24] Children receiving direct language intervention from an SLP were excluded.[23] On the other hand, children receive speech therapy and early intervention programs continuously due to ethical considerations.[24]

Two studies provided MT exclusively through song cues[23] and creative music therapy based on the Nordoff-Robbins approach.[24] The treatment intensity ranged between six bi-weekly individual sessions of up to 30 minutes[23] and eight weekly individual sessions of up to 25 minutes.[24] One study (50.0%) took place in school-based settings[23], and the other (50.0%) in hospital-based settings[24. The] intervention was delivered individually.[23,24] One study (50.0%) delivered the intervention by a speech-language pathologist,[23] and the other (50.0%) delivered it by a music therapist.[24]

All studies (100%) reported formal or standardized language measures. Tan and Shoemark used the Renfrew Action Picture Test (RAPT) to evaluate the grammatical structures used and the Language Assessment and Remediation Procedure (LARSP) to evaluate a more in-depth analysis of the language structures used, which provided information about both the syntax and morphological structures.[23] Whereas Groß *et al*. used the speech development test for children aged three to five years (SETK 3-5) as the first standardized German language test to evaluate speech abilities. This test instrument was divided into three areas of speech development with five subtests: understanding sentences (VS), generation of morphological rules (MR), phonological memory for non-words (PGN), memory for sentences (SG), and memory for word sequences (GW).[24]

Table 1. Included studies.

Study	Design	Participants	Music therapy	Control	Treatment intensity	Setting	Interventionist	Measures	Language outcomes	Results
Tan & Shoemark, *2017* (Australia)	Case study (feasibility study)	Two English speaking children with moderate-to-severe SLI (one male and one female, 6.3 and 6.8 years, respectively)	Song cues	Traditional speech cues	Six bi-weekly individual sessions of up to 30 minutes	School-based settings	Speech-language pathologist	1. The Renfrew Action Picture Test (RAPT) 2. Language Assessment and Remediation Procedure (LARSP)	1. Syntax (sentence structure) 2. Morphology (word structure)	• There was an increase in syntax learning, but no increase in morphology learning after receiving song cues. • Song and speech cues in morphology intervention could not be compared since neither participant achieved a morphology goal.
Groß *et al.*, 2010 (Germany)	Observational pilot study	Eighteen German speaking children with SLI, (twelve male and six females, aged 3.5 to 6 years	Creative music therapy based on the Nordoff-Robbins approach	No control group	Eight weeks individual sessions of up to 25 minutes	Hospital-based settings	Music therapist	1. Speech development test for children aged three to five years (SETK 3-5) 2. The SON-R 2 1/2 - 7 (individual intelligence test) 3. The Nordoff-Robbins scales	1. Understanding sentences (VS) 2. Generation of morphological rules (MR) 3. Phonological memory for non-words (PGN) 4. Memory for sentences (SG) 5. Memory for word sequences (GW)	• Creative music therapy had a significant improvement kn phonological memory and the children's understanding of sentences. • A positive shift in the memory of sentences and generation of morphological rules was observed.

Discussion

The primary objective of this systematic review was to investigate the effectiveness of MT interventions on language skills in children with SLI. There have been a few studies that have investigated the effect of MT on language skills for individuals with SLI.[23,24] Current evidence suggests that music therapy, including song cues and creative music therapy based on the Nordoff-Robbins approach, improves components of language such as phonology, syntax, morphology, and other areas of speech development in children with SLI.

Phonology

Groß *et al*. found that phonological memory for non-words showed statistically significant outcomes, which supports the possibility that MT intervention may influence the development of this parameter, which grew more noticeably during periods with MT. Phonological memory is undoubtedly associated with prosodic abilities.[24] PGN is the ability to store and recall speech sounds in short-term memory. Groß *et al*. believed that the gains occur because MT targets listening, perception, processing, and memorizing sounds and musical structures.[24] According to Anvari *et al*., music perception involves auditory systems that partially overlap with those engaged in phonological awareness.[25] Auditory-temporal processing is relevant in speech and music. Children must discriminate, and process sounds extracted from perceived acoustic signals that change over time in both areas. The ability to discriminate between similar-sounding consonants is essential to phonological awareness.[26] Thus, creative music therapy based on the Nordoff-Robbins approach, which included singing and making music with percussion instruments, can support the development of PA.

Morphology

Tan and Shoemark found an increase in syntax learning after receiving song cues. One participant achieved the first three syntax goals (e.g., subject-(verb)ing, subject-(verb)ing-object, and subject-(verb)ing-location), and the other participant reached the fourth syntax goal but did not achieve it (subject-verb-complement).[23] The natural speech inflection patterns of target sentences in the syntax intervention were transformed into musical prosody during the intervention by singing a tune that was accompanied by the guitar to provide rhythmic emphasis.[27] Rhythmic attendance aids in the learning and recall of text in songs. The rhythm inherent in song provides a temporal-metrical framework that enables perceptual grouping and chunking of information into more manageable units to aid recall.[27] In song, that combines speech, melody, and rhythm, the prosodic aspects of speech are modified more than usual. The additional cues offered by rhythm and melody will likely reduce the cognitive demands required for auditory signal processing and allow children to concentrate on language learning.[28] These results suggest that adding syntax intervention benefits children with SLI, and song cues could be similarly effective—or even better—than speech cues in syntactic intervention. However, it should be noted that both participants continued to fall below the 1st percentile for their age groups.[23]

Other areas of speech development

Furthermore, Groß *et al*. found that understanding sentences showed statistically significant outcomes, supporting the notion that MT intervention may influence the development of this parameter, which expanded more significantly during periods with MT. The improvement in the understanding of sentences on the subscale might be due to the ability to relate to another person. Children started to communicate more frequently and have more social contacts during MT sessions.[24] In creative music therapy based on the Nordoff-Robbins approach, the therapist traditionally interacts directly with the child, promoting musical participation and engagement; therefore, it encourages relatedness, communication, and socializing.[29]

Groß *et al.* also found that memory for sentences, which had previously been at a very low level, improved after MT intervention. It could be that when making music, it is constantly practiced and worked on to comprehend the form and general structure of a sentence in order to comprehend its meaning fully. Additionally, they can modify the music according to his or her abilities by having it gradually shortened or enlarged.[24]

The second objective of this study was to investigate the characteristics of the other intervention features of these studies (i.e., interventionists, intervention, setting, session type, and music methods).

Setting and interventionists

Tan and Shoemark conducted MT in school by a registered SLP, a master's equivalency student, who was enrolled in a music therapy equivalency program. Her experience and confidence as a SLP may have resulted in differences in how the two cueing techniques were executed.[23] These concurred with previous studies by Kouri and Winn,[20] and Kouri and Telander.[21] A graduate student in speech-language pathology with a strong musical background provided interventions. On the other hand, Groß *et al*. conducted MT in outpatients in hospitals by two MTs with a master's degree in music therapy and sufficient clinical experience (a minimum of two years) in their field. [24] Therefore, it is important to note that MT training courses are required for SLPs to understand and learn aspects of MT and develop new approaches to practice within school or clinical settings.

Intervention, session type, and music methods

Tan and Shoemark used song cues delivered individually, which were divided, with the first half focused on syntax and the second half on morphology.[23] In the syntax intervention, the natural speech inflection patterns of target sentences were turned into musical prosody[27] by singing a tune that was accompanied on the guitar to create rhythmic emphasis. In the morphology intervention, the natural speech inflection patterns of target sentences were turned into musical prosody[27] by using aspects of

melodic intonation therapy.

The structure of a song cue session includes listening, unison production, partially supported production, and independent production. In this single therapy session, the SLP introduced the target sentence structure by displaying a picture and modeling the sentence response in the specified modality (song or speech). Then, the SLP and the child sang or said the target sentence together. The SLP and the child then sang or said the first half of the sentence. The SLP faded out while the child independently completed the second half of the sentence. Lastly, the child was presented with 14 picture stimuli and sang or said the target sentences independently.[23]

On the other hand, Groß *et al*. used creative music therapy based on the Nordoff-Robbins approach, which included singing and making music with percussion instruments (i.e., bells, drums, pentatonic tone bars, shakers, reed horns, and lyres) and piano. Interventions were delivered on an individual basis.[24]

Songs were chosen for playtime and dealt with the child's interests, such as hide-and-seek or animal songs. Individual themes and musical developments arose for each child; some desired to sing and dance, others desired to be sung to, and still others desired to play an instrument on their own. According to this single therapy session, the improvised music was oriented toward the musical and vocal expressions of the child and therefore played a central role in the therapy.[24]

The findings of this study indicated that music delivery methods were in the form of using a song. These concurred with previous studies conducted by Kouri and Winn,[20] and Kouri and Telander.[21] However, it should be noted that they provided different MT interventions, including song cues,[23] the Nordoff-Robbins approach,[24] and audio-recorded, live-sung, and spoken-script presentations.[20,21]

Our findings support the idea that using a song can be used as a form of therapy by professionals such as SLPs and MTs. Also, both professionals can establish language and speech goals for children with SLI. The introduction of transdisciplinary programs in therapies that integrate MT and ST could be recommended. Tan and Shoemark suggested that it did not require the use of expensive instruments or resources to be successful.[23] This may be attractive to service providers, especially where resources and monetary funding are frequently restricted.[23]

Limitations and future research

Some limitations to this study must be considered. The first was a potential bias in this systematic review process because small sample sizes were observed in individual studies. Further research with a randomized controlled trial and larger sample sizes must be explored. It might increase the potential for results that capture the MT effects on language skills in children with SLI. Also, these two studies included participants with SLI who spoke English and German, which might differ along the opacity-transparency dimension. These two languages, however, are both intonation languages that indicate communication intentions through prosodic variations at the sentence level. More research is needed to investigate the transparency in language and lexical tone between English and German speakers about music. Additionally, there is no study focusing on each level of severity of individuals with SLI and its effect on MT. Therefore, participant characteristics should be considered.

Conclusions

The current systematic review represents a summary of the existing evidence of the effectiveness of music therapy in improving language skills in children with specific language impairments. Despite the lack of a wide range of music methods, current evidence suggests that music therapy, including song cues and creative music therapy based on the Nordoff-Robbins approach, improves components of language such as phonology, syntax, morphology, and other areas of speech development, including understanding sentences and memory for sentences in children with SLI. Language and speech development progress over time as a result of the intervention. Especially, using a song can be used as a form of therapy by professionals who work with children with SLI. In practice, music is increasingly being used in speech and language therapy. MT can be a valuable and effective intervention for children with SLI. Transdisciplinary programs that integrate MT and ST could be recommended. However, training courses are required for SLPs.

Conflict of interest

The authors declare no conflict of interest, and the review did not require full board ethics approval because it was a systematic review. The study was approved for exemption review by the Ethics Committee, Faculty of Associated Medical Sciences, Chiang Mai University (CMU), Thailand (AMSEC-66EM-009).

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