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A systematic review of the effect of music therapy compared to speech therapy on social communication skills in preschool children with autism spectrum disorder

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ABSTRACT

Background: Autism spectrum disorder (ASD) is defined by impairment in social communication and the presence of restricted interests and repetitive behaviors. Individuals with ASD receive a variety of interventions tailored to their specific needs, enhancing their social, communication, and adaptive skills. Speech therapy (ST) aims to promote speech and language development and further improve social and communication skills in children diagnosed with ASD. Music therapy (MT) has been recognized as an intervention for individuals with ASD to facilitate social and communication skills. At present, there is no systematic review (SR) of MT compared to ST on social communication skills in preschool children with ASD.

Objective: This SR aimed to (a) investigate the effectiveness of MT compared to ST on social communication skills for preschool children with ASD and (b) investigate which type of MT, compared to ST, affects the social communication skills of preschool children with ASD.

Materials and methods: This SR was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines using five databases: the CINAHL Complete, PubMed, Scopus, ERIC, and Cochrance. The researchers also conducted a hand search for reference lists of identified articles and pertinent reviews for additional studies. We assessed the risk of bias using the Risk of Bias in Non-randomized Studies-of Interventions (ROBINS-I) tool and the Revised Cochrane risk-of-bias tool for randomized trials (RoB 2).

Results: The initial literature search yielded 63 articles. Following the exclusion of non-relevant studies, 2 studies met the inclusion criteria for this review. The results indicated that the differences in overall efficacy between MT and ST were not statistically significant. Both therapies are effective for speech production, including semantics, phonology, pragmatics, and prosody in preschool children with ASD. MT, specifically developmental speech and language training through music (DSLM), is equally successful as ST in enhancing speech production. Behavioral intervention, applied behavior analysis verbal behavior (ABA-VB), is also effective in improving core symptoms of autism, such as social and communication deficits.

Conclusion: MT has comparable efficacy in enhancing speech production compared to ST, which impacts social communication in preschool children with ASD. Nevertheless, ST remains a cornerstone in addressing communication deficits in children with ASD, focusing on structured speech and language development. MT provides a complementary approach that can enhance speech production and bring more enjoyment to these young children, who frequently struggle with social communication. Therefore, MT could be viewed as a complementary approach to traditional ST. Limitations included research on the use of DSLM and ABA-VB by music therapists has been sparse, and the number of studies has been small.

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Further study would allow for more precise conclusions regarding the effect of MT compared to ST on social communication skills in preschool children with ASD.

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition that affects children. It is defined by impairment in social communication and the presence of restricted interests and repetitive behaviors.[1] Individuals with ASD receive various interventions tailored to their specific needs, enhancing their social, communication, and adaptive skills. The most effective intervention for ASD remains a subject of controversy. Speech therapy (ST) aims to promote speech and language development and improve social and communication skills in children diagnosed with ASD.[2] Early intervention with ST is crucial for developing these children's speech, language, and social communication skills.[3]

Music therapy (MT) has been recognized as an intervention for individuals with ASD to facilitate social and communication skills. Numerous studies have studied approaches that enhance aspects of social communication in preschool and school-aged children with ASD, such as improvisational music therapy,[4] the Orff method,[5] family-centered music therapy,[6] and piano therapy programs,[7] each with unique benefits and applications. A recent systematic review by Tsirigoti and Georgiadi[8] revealed a wider recognition of MT as a valuable treatment for children with ASD. However, the results of this study were mixed because no conclusions could be drawn regarding the extent of its efficacy compared to the standard treatments that children typically receive.

A few studies have investigated brain regions similarly and differentially involved with listening and covert production of singing relative to speech. It demonstrated the overlap in neural process activations during speech and music tasks. A distinct pattern of differential laterality is observed in the left temporal lobe for both covert production and listening tasks involving speech over singing. Conversely, singing over speech is observed in the right temporal lobe for listening tasks alone.[9,10]

Research in ASD indicates that while individuals with ASD may exhibit atypical predictive processing in language, their musical prediction abilities can remain intact. This suggests that music could be a bridge to improve language prediction skills, especially when individual differences are considered.[11] The shared cognitive and neural mechanisms between music and language, such as pitch, rhythm, and syntax, highlight the potential for music to enhance language skills. However, the precise neural mechanisms remain incompletely understood, necessitating further interdisciplinary research.[12]

So far, there have been a few studies that have compared the effects of MT versus ST on social communication skills in preschool children with ASD. For example, a study by Lim[13] examined the impact of MT (DSLM), ST, and no training on the verbal expression of children between the ages of 3 and 5 who have ASD. The findings indicated that individuals who received instruction in MT and ST substantially improved their verbal production. Both individuals with high and low functioning levels experienced improvements in their speech production. However, participants with low functioning demonstrated a more significant improvement after the MT than the ST. Children with ASD can interpret significant linguistic information from music stimuli, apply pattern perception principles, and produce functional speech.

A study by Lim and Draper examined the impact of MT (ABA-VB), ST (ABA-VB), and no training on the speech production of children between the ages of 3 and 5 who have ASD.[14] The findings indicated that MT and ST effectively produced the four ABA verbal operants. However, there was no statistically significant difference between them. The findings also indicated that MT incorporated with the ABA-VB program was the most successful in enhancing echoic production, whereas ST was the most effective in enhancing tact production. Therefore, the ABA-VB program can incorporate music, and musical stimuli can improve the functional verbal output in children with ASD.

Presently, no SR is comparing the effects of MT versus ST on social communication skills in preschool children with ASD.

The current SR aimed to 1) investigate the effectiveness of MT compared to ST on social communication skills for preschool children with ASD, and 2) investigate which type of MT, compared to ST, affects the social communication skills of preschool children with ASD. The researchers set out to address the following research questions:

1) What was the effectiveness of music therapy on the social communication skills of preschool children with ASD compared to speech therapy?
2) Which type of music therapy, compared to speech therapy, affects the social communication skills of preschool children with ASD?

Materials and methods

This SR was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[15]

Search strategy

Relevant articles were obtained by searching five databases: CINAHL Complete, PubMed, Scopus, ERIC, and Cochrance. Each database was searched from 2009 to 2024. The researchers also conducted a hand search for reference lists of identified articles and pertinent reviews for additional studies. References from the reviewed articles were screened to find more articles of interest. Only studies in English were included.

The following keywords were used in the search: ("music" OR "music therapy" OR "music intervention") AND ("speech therapy" OR "language intervention") AND ("preschool") AND ("autism" OR "ASD" OR autism spectrum

disorder" OR "pervasive developmental disorder") AND ("social communication" OR "social behavior" OR "social skills" OR "communication" OR "communication skills"). Each database was searched from 2009 to 2024.

Inclusion and exclusion criteria

The PICOS (participants, interventions, comparisons, outcomes, and study design) framework informed this review's eligibility criteria. Studies that investigated the effect of MT compared to ST on preschool children with ASD were included. The primary outcome of interest was the improvement of social communication skills.

The researchers applied the following inclusion criteria for the selection of articles: 1) preschool children with ASD aged between 2 to 6, 2) music therapy provided by a qualified music therapist or music student, 3) compared to speech therapy, 4) the improvement of communication, social, or social communication skills, 5) experimental (e.g., randomized control trials) or quasi-experimental (e.g., A-B design) designs, 6) studies published between 2009 and 2024, and 7) studies published in English.

The exclusion criteria were as follows: 1) children aged under 2 years or more than 6 years, 2) presence of other neurodevelopmental disorders such as epilepsy, Attention Deficit Hyperactivity Disorder (ADHD), and intellectual disability (ID), 3) outcomes were not reported or not related to social communication, and 4) no experimental studies, case studies, reviews, case reports, commentaries, or letters.

Study selection

After reading titles and abstracts, two researchers (V.B. and N.W.) screened and excluded irrelevant articles. We checked reference lists of retrieved systematic reviews and assessed full texts for eligibility. We attempted to reach a consensus on any disagreements. A third reviewer's opinion was considered to resolve the issue if necessary. However, there was no disagreement.

Quality assessment

Two researchers (V.B. and N.W.) independently assessed the risk of bias according to the criteria of the ROBINS-I tool[16] and the RoB 2.[17]

The ROBINS-I tool[16] consists of the following domains: pre-intervention (bias due to confounding, bias in the selection of participants into the study), at intervention (bias in classification of interventions), post-intervention (bias due to deviations from intended interventions, bias due to missing data, bias in measurement of outcomes, bias in selection of the reported result). Each domain is classified into five categories: "Low risk of bias," "Moderate risk of bias," "Serious risk of bias," "Critical risk of bias," or "No information."

The RoB 2 tool[17] consists of the following domains: bias arising from the randomization process, bias due to deviations from intended interventions, bias in missing outcome data, bias in measuring the outcome, and bias in selecting the reported result. Each domain is classified into three categories: "low risk of bias," "some concerns," or "high risk of bias."

Two researchers (V.B. and N.W.) independently assessed the risk of bias in each domain, and the researchers discussed discrepancies until a consensus was reached. A third reviewer's opinion was considered to resolve the issue if necessary. However, there was no disagreement.

Data extraction and analysis

Two researchers (V.B. and N.W.) independently extracted all data using a data collection form. We recorded the following data in a table from each eligible article: 1) the name of the first author, 2) the year of publication, 3) the country, 4) participants, 5) the type of MT intervention, 6) control, 7) duration, 8) measurements, and 9) outcomes.

This review used a descriptive analysis. The researchers (V.B. and N.W.) did not analyze subgroups or subsets or undertake a meta-analysis of the studies.

Results

Figure 1 summarizes the PRISMA flowchart of the study. The initial literature search yielded 63 articles after duplicates were removed. All articles were published from 2009 to 2024. 60 titles and abstracts were examined to remove irrelevant and review articles. After that, 48 studies were excluded after initial screening, leaving 12 full-text articles assessed for eligibility. Then, 10 full-text articles were excluded after applying inclusion and exclusion criteria. A total of 2 articles were included in the current study.

Table 1 summarizes the risk of bias in a non-randomized study using the ROBINS-I scale. The response for an overall risk-of-bias judgment was moderate. Table 2 summarizes the risk of bias in a randomized study using the RoB2 scale. The response for an overall risk-of-bias judgment was some concern.

Table 3 presents the included studies. 2 studies were conducted in the United States of America (USA). Importantly, it should be noted that the same primary investigator conducted these studies. According to Johns Hopkins nursing evidence-based practice model and guidelines, one study was a randomized controlled trial (RCT),[13] which was high quality scientific (level I evidence),[18] while the other was a non-RCT pre/post evaluation,[14] which was generally good quality scientific (level II evidence).[18]

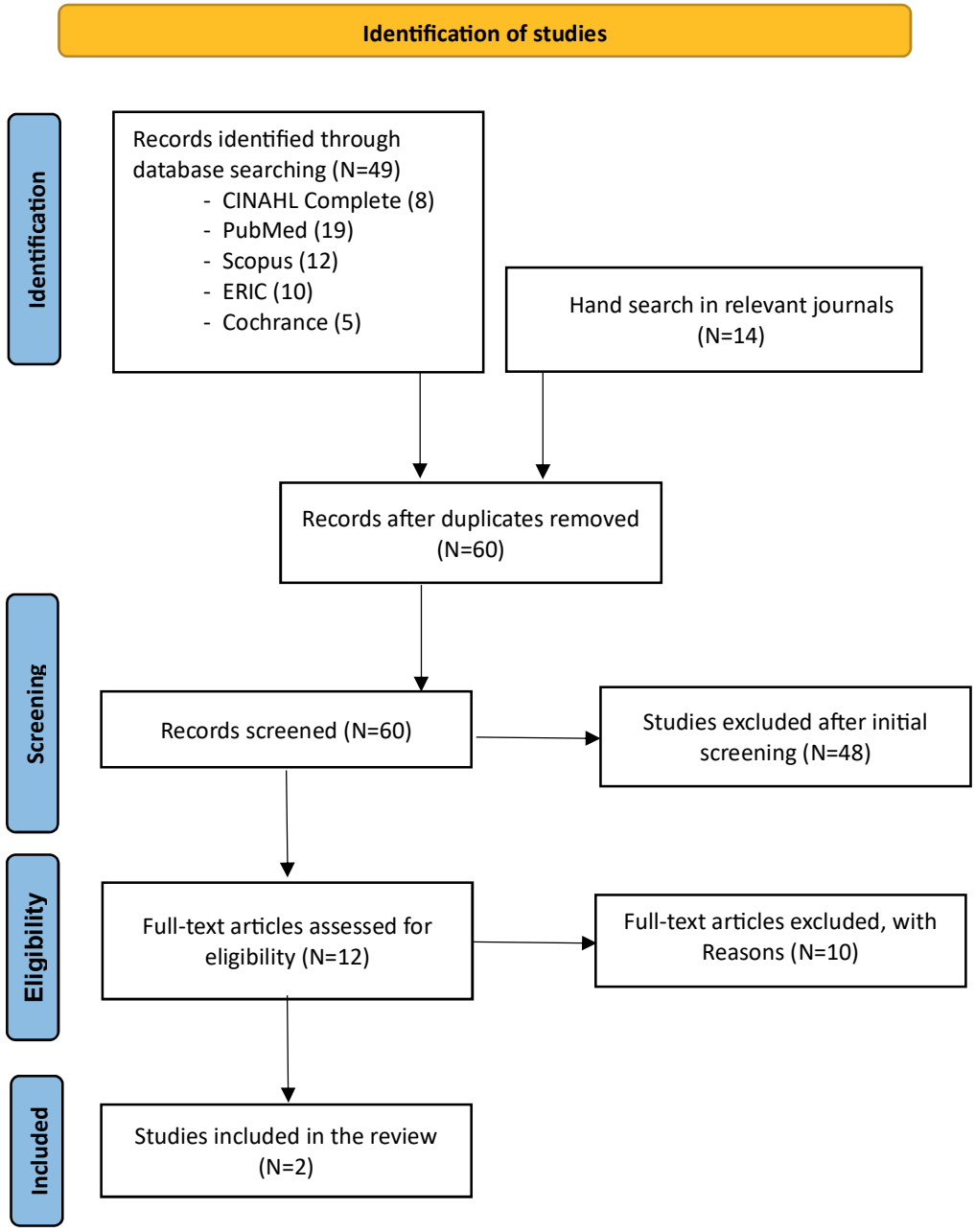

Figure 1. *Methodology flowchart.*

Table 1. Risk of bias in non-randomized study using the ROBINS-I scale.

Authors	Bias due to confounding	Bias in selection of participants into the study	Bias in classification of interventions	Bias due to deviations from the intended intervention	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of the reported result	Overall bias
Lim and Draper 2011[14]	Moderate	Moderate	Moderate	Moderate	Low	Low	Low	Moderate

Table 2. Risk of bias in a randomized study using the RoB2 scale.

Authors	Risk of bias arising from the randomization process	Risk of bias due to deviations from the intended intervention	Missing outcome data	Risk of bias in measurement of the outcome	Risk of bias in selection of the reported result	Overall risk of bias
Lim 2010[13]	Some concern	Some concern	Some concern	Low	Low	Some concern

Table 3. Included studies.

Study/ Year/ Country	Study design	Participant	Intervention	Control	Duration	Interventionist	Measurements	Outcomes
Lim/ 2010/ USA[13]	RCT	- Children with ASD aged 3-5 year - N=50, 25 with moderate/ severe ASD and 25 with mild ASD	MT, DSLM	- ST - No training	6 sessions 3 days, 2 times/day	Music student and investigator (music therapist)	VPES	- Children in the MT or ST group improved on speech production compared to the no-training group. - No significant difference was observed between the MT group and the ST group on speech production in children with ASD.
Lim&Draper/ 2011/ USA[14]	Non-RCT Pre/post evaluation	- Children with ASD aged 3-5 year - N=22, verbal or preverbal with presence of immediate echolalia	MT, ABA-VB	- ST, ABA-VB - No training	6 sessions 2 weeks, 3 days/week	Certified music therapist	VPES	- Children in the MT or ST group improved on verbal operants production compared to the no-training group. - No significant difference was observed between the MT group and the ST group in in speech production n children with ASD.

Studies included children aged from three to five years. In the study by Lim, 25 had moderate/severe ASD, and 25 had mild ASD.[13] Children who are categorized as "age-appropriate" and "mildly impaired" on the Childhood Autism Rating Scale (CARS) were classified as participants of high functioning level. Children who were identified as "moderately impaired" and "severely impaired" on the CARS were at a low functioning level. On the other hand, in the study by Lim and Darper, 22 children with ASD were verbal or preverbal with the presence of immediate echolalia.[14] This study did not determine the functioning level based on CARS scores.

In the study by Lim, children with ASD in the MT group received DSLM.[13] The children watched the music video for 9 minutes. All the songs were recorded on videotape and shown to the participants via a television monitor. A female music student sang all six songs, with the investigator accompanying her on guitar. The ST group received the same texts for the six songs used in the music stimuli. Children watched the speech video for 5 minutes and 40 seconds. All the stories were recorded on videotape and shown to the participants via a television monitor. Those in the no-intervention group did not watch the music or speech video. In the MT and ST groups, children with ASD received a total of six training sessions for three days, two times a day. A female music student provided all training sessions.

In the study by Lim and Darper, children with ASD in the MT group received music integrated with the ABA-VB program, which consisted of singing the verbal instructions as part of DSLM.[14] The ST group received speech integrated with the ABA-VB program. Texts for the sentences and directions used were like those in the MT group. Those in the no-intervention group did not receive intervention. In the MT and ST group, children with ASD received a total of six training sessions for two weeks, three days a week. A certified music therapist provided all training sessions.

Lim,[13] and Lim and Darper14 used the Verbal Production Evaluation Scale (VPES) to assess the effect of MT on children with ASD by measuring participant production of target words using four speech components: semantics, phonology, pragmatics, and prosody. Semantics provides information on whether the child produced the correct target word. Phonology refers to accurately pronouncing the target word without articulation or phonetic errors in vowels or consonants. Pragmatics is the relationship between language, specific behaviors, and social or linguistic contexts. The child's verbal response ranged from an immediate response to a delayed response. Prosody refers to the variation of tone used when speaking (i.e., intonation) and vocal stress, which is the relative emphasis given to certain syllables in a word. Prosody also encompasses syntax, turn-taking in conversational interactions, types of utterance, such as question versus statement, and the speaker's attitudes, intentions, and feelings.

The study by Lim found that children in the MT or ST group improved in speech production compared to the no-training group.[13] No significant difference was observed between the MT and ST groups. Children with high-functioning ASD showed more substantial improvement in speech production than those with low-functioning ASD. Echolalia was positively related to high functioning in children with ASD, indicating a correlation between echolalia and speech production. MT enhanced speech production in children with ASD, suggesting a close link between music and language development in early childhood. The study emphasized the importance of level of functioning in indicating speech production performance and improvement, regardless of the training condition.

The study by Lim and Draper found that children in the MT or ST group improved verbal operant production.[14] Children with ASD scored higher on echolalia production than verbal production. Echolalia was positively related to verbal production in children with ASD, indicating a correlation between verbal operant production and echolalia and/or verbal imitation skills. No significant difference was observed between the MT group and the ST group. MT integrated with the ABA-VB program was shown to be the most efficient in echoic production, whereas ST integrated with the ABA-VB program was the most effective intact production. The study emphasized the effectiveness of MT for treating communication problems in children with ASD.

Discussion

The first purpose of this study was to investigate the effectiveness of MT compared to ST on social communication skills in preschool children with ASD. The results indicated that the differences between MT and ST were not statistically significant regarding overall efficacy. Both therapies are effective for speech production, including semantics, phonology, pragmatics, and prosody, in preschoolers with ASD.[13,14] Furthermore, the results indicated children in the MT group produced a more significant number of acquisitions of functional vocabulary words[13] and speech production[13,14] than those in the ST group, even though this was not significant. This aligns with specific theories that suggest shared neural processes between speech and music, potentially enhancing speech production.[9,10] Therefore, MT holds promise to be an effective intervention, similar to ST, for enhancing speech and language skills in preschool children with ASD.

This study also contributes further knowledge by highlighting that MT was the most effective in echoic production, a verbal operant of vocal imitation.[14] For instance, the antecedent variable in ecolaic was "I want more, I want more, more. Can you say I want more?" And the target phrase was "I want more." Consistent with Demaine,[22] repetitions in therapy and musical "sing-song" phrases assist children with ASD with better retaining and perceiving information and communicating in a functioning language. Children with ASD who exhibit echolalia remember information similarly to how they remember musical melodies without necessarily associating the information with semantic memory.[23] Whereas ST was

the most successful intact production, a verbal operant of labeling.[14] For instance, the antecedent variable intact was "Can you tell me, What is this?". The target word used was a combined vocabulary with color and animal (e.g., white sheep or pink pig). Tacting is a difficult skill because it requires the child to recognize the correct word and possess the vocal ability to articulate it themselves.[24] The use of tact correction techniques is crucial in reducing stereotypic vocalizations and promoting appropriate vocalizations in children with ASD.[25] Therefore, it can be seen that the effects of training conditions might be related to factors such as levels of functioning or the ability of children with ASD to communicate using speech or language. Further research is needed.

Moreover, this study revealed that MT might be especially beneficial for low-functioning children with ASD.[13] It could be that children with ASD interpret significant linguistic information in music stimuli based on pattern perception principles that enhance functional verbal production, consistent with Cooley.[19] Moreover, it could be that children with ASD exhibit restricted social processing abilities and may not interpret human communication in the same manner as typically developing children.[20] MT is used to increase verbal expressiveness because it is a leisure activity requiring less demanding interaction with others. Young children with ASD showed a preference for non-speech sounds compared to non-ASD children.[21] Findings shed light on when choosing interventions for preschool children with ASD. It may be beneficial to consider MT, that music can be particularly enjoyable for these children, who often struggle with social communication.

The second purpose of this study was to investigate which type of MT, compared to ST, affects the social communication skills of preschool children with ASD. The results indicated that both studies used DSLM.[13,14] The interventionists in the two studies included a music student[13] and a music therapist.[14]

DSLM uses developmentally appropriate musical materials and experiences to improve speech and language skills. This is achieved through activities such as singing, chanting, playing musical instruments, and integrating music, speech, and movement,[26] which seems to help improve speech production, including semantics, phonology, pragmatics, and prosody in preschoolers with ASD.[13,14]

The effectiveness of DSLM may be attributed to its alignment with the Gestalt laws of perception often observed in children with ASD.[27] The relationship between gestalt language processing and autism is a complex and multifaceted topic that involves understanding how individuals with ASD perceive and use language. Gestalt language processing refers to the ability to perceive and interpret language as whole units rather than as individual components. This approach to language comprehension can be particularly challenging for individuals with ASD, who often experience difficulties in language and communication. Gestalt language processing can manifest in echolalia, where children with ASD may repeat phrases or sentences from others.[28] The results of this study demonstrated that MT was the most successful in echoic production for young children with ASD.[14] The explanation for this improvement might be that all songs were composed using Gestalt laws of perception, with small pitch intervals that moved in step-by-step patterns. Target words were inserted at the end of phrases, with half and full cadences and sustained note durations. Rhythmic and melodic patterns were employed to help identify target words in both scripts. Songs that utilize repetitive patterns help to maintain attention and improve speech production.

Another noteworthy finding was the efficacy of MT integrated with the ABA-VB program or ST integrated with the ABA-VB program, as investigated by Lim and Draper.[14] ABA is grounded in scientific principles of behavior and aims to improve the fundamental impairments in ASD, namely social and communication deficits.[29] While VB imparts comprehensive skills, with a particular emphasis on language skills.[30] The verbal behavior approach organizes language teaching based on Skinner's analysis of verbal operants, such as mands (requests) and tacts (labels).[31] The benefits of this integrated approach, ABA-VB, for preschool children with ASD improve a child's capacity to acquire functional language. The ABA-VB program can tap into individuals' natural motivation for things they want, making communication more meaningful and rewarding. More empirical research is necessary to support the long-term effectiveness of this approach, which has shown promise in language acquisition.[31] Speech therapists typically provide ST for preschool-aged children with ASD, and speech-language pathology is one of the most commonly accessed services for these children.[32] ST is an effective treatment for improving social communication skills,[2,3] as is MT.[8] Therefore, music therapists and speech therapists can incorporate the ABA-VB program for children with ASD to improve the core impairments in social and communication, as well as encourage more successful therapy practices.

Limitations and future research

There are some limitations in the current study that need to be addressed in future studies. First, research on using DSLM and ABA-VB by music therapists has been sparse. In practice, ST for preschool children with ASD is usually provided by speech therapists. Evidence-based practice to compare MT and ST is necessary to confirm that the interventions provided by music therapists and speech therapists are similar. Second, the small number of studies in the present study limited the comparison of MT and ST and the type of intervention concerning social communication outcomes. Therefore, a more significant number of studies are needed to support and allow for more precise conclusions regarding the effect and type of MT compared to ST on social communication skills in preschool children with ASD, particularly for use in the field of music and speech therapy.

Conclusion

This present study can corroborate the conclusions of the previously reviewed research that MT, specifically DSLM, has comparable efficacy in enhancing speech production compared to ST, which impacts social communication in preschool children with ASD. Behavioral intervention, ABA-VB, is also effective in improving core symptoms of autism, such as social and communication deficits. Additionally, the unique benefits of DSLM and ABA-VB programs, especially for low-functioning children with ASD, underscore their value as approaches for improving outcomes.

However, ST remains a cornerstone in addressing communication deficits in children with ASD, focusing on structured speech and language development.

MT provides a complementary approach that can enhance speech production and bring more enjoyment to these young children, who frequently struggle with social communication. Therefore, MT could be viewed as a complementary approach to traditional ST.

Conflicts of interest

The author(s) declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.

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Ethical approval

The Ethics Committee, Faculty of Associated Medical Sciences, Chiang Mai University (CMU), Thailand (AMSEC-67EM-033) approved the study for exemption review.

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