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A systematic review of melodic intonation therapy used by speech therapists on speech recovery for patients with non-fluent aphasia

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ABSTRACT

Background: Many studies have reported positive results regarding the benefits of melodic intonation therapy (MIT) in patients with non-fluent aphasia. Currently, there is no specific inclusion of speech therapists (STs) in MIT research. Investigating effective speech therapy (ST) techniques to address the language functions hindered by non-fluent aphasia could yield evidence for aphasia rehabilitation research.

Objective: This systematic review (SR) examines the effectiveness of the traditional MIT protocol used by STs on speech recovery for patients with non-fluent aphasia after stroke. It also discusses other characteristics of the traditional MIT, such as the participants, the MIT protocol applied, the therapy intensity, and the role of STs.

Materials and methods: This SR followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 statement. The four computerized databases (PubMed, Embase, ICTRP, and Google Scholar) were searched in February 2024 to review all empirical findings. We also conducted a hand search in relevant journals. The search yielded 538 studies, of which 2 met the criteria and underwent review. The methodological quality of the included studies was evaluated using the Cochrane Collaboration's tool for assessing the risk of bias. Furthermore, the protocol was registered in PROSPERO under the reference CRD42024508733.

Results: This review included 2 randomized controlled trials (RCTs) involving 44 patients. We found evidence that MIT significantly improved speech recovery, precise language repetition, and functional communication in patients with non-fluent aphasia. STs were interventionists in MIT research and used MIT following the American manual, and they had previously received MIT training.

Conclusion: Our review provides some evidence of the effectiveness of MIT on speech recovery in patients with non-fluent aphasia after stroke. MIT may be a practical alternative to standard ST. There is some indication that MIT requires music therapy (MT) skills and training; therefore, STs must also have these abilities.

Introduction

Aphasia is an acquired loss or impairment of the language system caused by a symptom of brain damage.[1] It has a variety of causes. Cerebrovascular accidents, also known as stroke, are the most common cause. The left hemisphere of the brain typically experiences the pathology, and approximately one-third of stroke patients experience aphasia.[2,3] In the United States, the prevalence of aphasia is 1 in 250.[4]

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Non-fluent aphasia, also known as expressive aphasia or Broca's aphasia, is one type. This occurs in the damaged area of the inferior frontal lobe in the Broca area, located in Brodmann areas 44 and 45, which are centers for motor control, speech, and communication. Generally, about 96 to 99 percent of right-handed people and about 60 percent of left-handed have their language abilities located in the brain's left hemisphere.[5]

People with non-fluent aphasia or Broca's aphasia do not have or have fewer problems with language comprehension.[5] They can understand speech or conversation but have difficulty expressing words in speech and writing. They have difficulty putting their thoughts into words. They can only produce short utterances when speaking or writing.[6] MIT is a specific treatment for patients with aphasia. Studies have reported positive results regarding the benefits of traditional MIT for aphasic patients.[7-12] MIT is a combination of ST and MT.[13] STs utilize the MIT program as a therapeutic intervention to assist patients with aphasia.[7-12]

MIT involves speaking rhythmically and tapping the left hand to enhance speech prosody and fluency.[14] Traditional MIT is a hierarchically structured therapy that utilizes three key elements: (1) melodic intonation (singing), (2) rhythmic speech, and (3) the use of common phrases (formulaic language). The melodic and rhythmic structures only allow for two notes (high and low) and two durations (long and short). MIT consists of three linguistic tiers. The first two tiers consist of multisyllabic words and short phrases, while the third tier comprises more phonologically complex phrases. The interventionist will teach the patient to speak slowly in high- and low-note sequences that mimic everyday speech.[14]

MIT's use is based on stimulating music processing in the brain's right hemisphere to increase language ability. Research has revealed a correlation between MIT's success and the integrity of the right arcuate fasciculus, which compensates for damage in the brain's left hemisphere, which is associated with language and speech.[15-18]

A recent SR from Mata determined the number of studies involving music therapists (MTs) and their involvement and contributions to the field.[19] Currently, extensive literature focuses on the effectiveness of MIT for patients with non-fluent aphasia or Broca's aphasia. However, STs are not specifically included in MIT research. Investigating effective ST techniques to address the language functions hindered by non-fluent aphasia could yield evidence for aphasia rehabilitation research.

Therefore, the primary aim of this SR was to examine the emergence in the scientific literature of the effectiveness of the traditional MIT protocol used by STs on the speech recovery of patients with non-fluent aphasia after stroke. Furthermore, the secondary aim was to examine other characteristics of the traditional MIT, such as the participants, the MIT protocol applied, the therapy intensity, and the role of STs. The authors intended to answer the following research questions:

(1) What is the effectiveness of the traditional MIT protocol used by speech therapists on the speech recovery of patients with non-fluent aphasia after stroke?

(2) What are other characteristics of traditional MIT, such as the participants, the MIT protocol applied, the therapy intensity, and the role of speech therapists?

Materials and methods

This SR was reported according to the PRISMA 2020 statement to guide the methodology of this research.[20] Additionally, the protocol was registered in PROSPERO under the reference CRD42024508733 (https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=508733).

Inclusion and exclusion criteria

Table 1 illustrates a selection criterion for this SR. The inclusion and exclusion criteria based on the population, intervention, comparator, outcome, and study design (PICOS) principles to capture well-prepared studies of interventions are addressed.

Table 1. Inclusion and exclusion criteria.

PICOS	Inclusion	Exclusion
P	Patients with non-fluent aphasia (Broca's aphasia) with a history of stroke (e.g., ischemic stroke, hemorrhagic stroke)	Patients with other types of aphasia (e.g., Wernicke, Global, Isolation, Transcortical motor, Transcortical sensory, Conduction, and Anomic) and Apraxia of speech
I	Melodic intonation therapy	Modified melodic intonation therapy and other types of music therapy
C	Speech therapy, treatment as usual, waiting list, no control group, no intervention group.	N/A
O	Language skills (e.g., information content, fluency, auditory comprehension, repetition and naming)	Primary outcomes were not focus on improvement in language skills
S	RCTs	Other types of study design (e.g., quasi-experimental studies, single-group studies, single case studies, case series, editorials, opinions and commentaries, and qualitative studies)

Search strategy

The four computerized databases were conducted in February 2024 using the following databases: PubMed (75), Embase (77), ICTRP (75), and Google Scholar (295). The researchers also conducted a hand search in relevant music therapy journals to find other potentially eligible studies (16). Furthermore, we used backward citations to check reference lists of all relevant articles. The search was limited to articles written in the English language. Articles published up-to-date information on the existing literature from 2013 onward.

Table 2 demonstrates comprehensive search syntax. The search terms were combined using the Boolean operator OR, and each PICO was combined using the Boolean operator AND.

Table 2. Search syntax.

PICOS	Search terms
P	"Stroke" OR "Aphasia" OR "non-fluent aphasia" OR "Broca aphasia"
I	"Melodic intonation therapy"
C	"Speech therapy" OR "Waiting list" OR "No control group"
O	"Language" OR "linguistic skills" OR "Information content" OR "Auditory comprehension" OR "Fluency" OR "Repetition" OR "Naming" OR "Communication"
S	"Randomized controlled trials"

Study selection and Data extraction

Two researchers (N.W. and T.K.) independently screened the titles and abstracts of all identified articles. For studies meeting the eligibility criteria, full-text articles were reviewed. Disagreements about whether a study should be included were discussed until a consensus was reached, involving a third researcher (V.B.) where necessary.

Data were then extracted by the two researchers (N.W. and T.K.) using a data extraction sheet for study design, participants, MIT protocol applied, intervention, duration, language measurements, role of speech-language therapist, and results. The two researchers (N.W. and T.K.) independently extracted each data extraction throughout the entire data extraction process. Disagreements about data extraction were discussed until consensus was reached, involving a third researcher (V.B.) where necessary.

Quality assessment

The methodological quality of the included studies was evaluated using the Cochrane Collaboration tool to assess the risk of bias for RCTs.[21] The two researchers (N.W. and T.K.) independently reviewed and scored the studies. After applying the methodological quality framework to all research, the ratings were translated into percentages to allow quality comparisons across papers. In the disagreement, a third researcher (V.B.) was consulted. However, there was no disagreement to resolve. Table 3 provides a summary of the risk of bias for RCTs.

Table3. Risk of bias for RCTs.

	Van der Meulen *et al.*[7]	Van der Meulen *et al.*[8]
Random sequence generation (selection bias)	+	+
Allocation concealment (selection bias)	+	+
Blinding of participants and personnel (performance bias)	-	-
Blinding of outcome assessment (detection bias)	+	+
Incomplete outcome data (attrition bias)	+	+
Selective reporting (reporting bias)	+	?
Other bias	?	?

Results

Figure 1 shows a PRISMA statement chart that details the selection process. A total of 538 records were screened through the database (N=522) and hand searches (N=16). After removing duplicates, 160 articles remained. The researchers analyzed the abstracts of these articles, resulting in 26 potentially eligible full-text articles; we retained 2 studies for inclusion in the review.

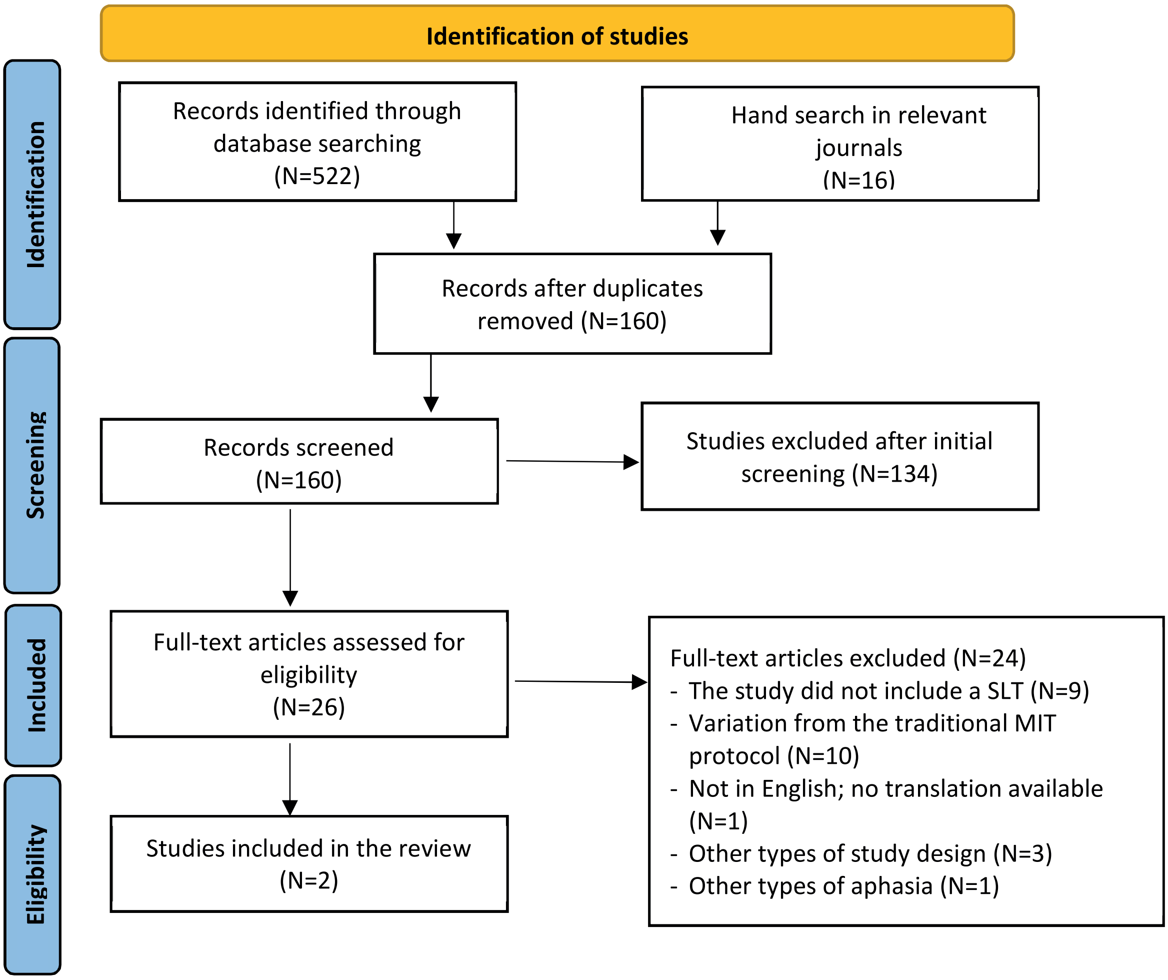

Figure 1. *Methodology flowchart.*

Table 4 presents the included studies. Two studies were conducted in the Netherlands.[7,8] However, it should be noted that the same group of researchers conducted these studies.[7,8] Furthermore, it is essential to note that the selection criteria for the methodological design were RCTs. This review included a total of 2 randomized comparisons.[7,8] All studies were generally highly scientific (level I evidence). Van der Meulen *et al.*[7] conducted a multicenter, waiting-list RCT with a crossover design.

Table 4. Included studies.

Study/ Year/ Country	Study design	Participant	Intervention	Duration	Language measurements	Role of speech therapist	Language benefits
Van der Meulen *et al.*[7] (Netherlands)	Randomized, waiting list, single-blind, multicenter clinical trial	Total: 27 participants (N=16 in the experimental group and N=11 in the control group) Inclusion criteria: - Aphasic after left hemisphere stroke - 2 to 3 months after stroke - Premorbid right-handed - Age between 18 and 80 years - Native language Dutch - MIT candidacy (non-fluent aphasia, articulation deficits, repetition severely affected, and moderate to good auditory language comprehension)	Experimental group: the traditional MIT protocol Control group: delayed MIT	5 hours per week (a minimum of 3 hours per week plus iPod-base homework) for 6 weeks	- Sabadel story retelling task - Amsterdam-Nijmegen Everyday Language Test (ANELT) - Aachen Aphasia Test (AAT: subtests repetition and naming) - MIT repetition task	Interventionist	Improvement in functional communication and language repetition
Van der Meulen *et al.*[8] (Netherlands)	Randomized, waiting list, single-blind, multicenter clinical trial	Total: 17 participants (n = 10 in the experimental group and n = 7 in the control group) Inclusion criteria: - Aphasic after left hemisphere stroke - Up to 12 months after stroke - Premorbid right-handed - Age between 18 and 80 years - Native language Dutch - MIT candidacy (non-fluent aphasia, poorly articulated speech, poor - language repetition, and - moderate to good auditory - language comprehension)	Experimental group: the traditional MIT protocol Control group: delayed MIT	5 hours per week (a minimum of 3 hours per week plus iPod-based homework) for 6 weeks	- Sabadel story retelling task - Amsterdam-Nijmegen Everyday Language Test (ANELT) - Aachen Aphasia Test (subtests repetition and naming) - MIT repetition task	Interventionist	Improvements in language repetition of trained material.

Van der Meulen *et al*. also used a multicenter waiting-list RCT design.[8] A total of 44 patients were included in this systematic review.[7,8] Van der Meulen *et al*.[7] included 27 participants: 16 in the experimental group and 11 in the control group. Van der Meulen *et al*.[8] included 17 participants: 10 in the experimental group and 7 in the control group. All participants included only people with non-fluent aphasia because of stroke. At this point, there was a wide age range, from 18 years old to 80. All authors described their participants' etiologies: strokes in the left hemisphere. However, the stroke took between 2-3 months and 12 months.[7,8]

The traditional MIT intervention was used in two studies.[7,8] Each participant adhered to the traditional protocol. No minor variations were permitted in delivery; the Dutch language was used for intervention. The two studies provided the exact intervention dosage. They did, however, use the various types of homework equipment provided. In Van der Meulen *et al*., the MIT sessions were 5 hours per week (a minimum of 3 hours per week plus homework for 6 weeks).[7] Conversely, in Van der Meulen *et al.,* the MIT sessions lasted 5 hours per week (a minimum of 3 hours per week, plus iPod-based homework for 6 weeks).[8] In these studies, STs previously receiving training at MIT provided the traditional intervention. Crucially, MIT was used following the American manual.[7,8]

All studies reported standardized language measures.[7,8] Van der Meulen *et al*.[7] and Van der Meulen *et al*.[8] used the Sabadel story retelling task and the Amsterdam-Nijmegen Everyday Language Test (ANELT) to evaluate verbal communication. Also, the authors also used the Aachen Aphasia Test (subtests repetition and naming) and the MIT repetition task to assess the ability to repeat and name.[7,8]

The study of Van der Meulen *et al*. demonstrated that MIT benefits language production in severe nonfluent aphasia in the subacute phase poststroke.[7] The experiment group improved verbal communication, suggesting a generalization of verbal communication capabilities in daily life. Also, the experimental group improved language repetition in the trained (MIT test) and the untrained (AAT subtest repetition), suggesting a generalization to untrained material. The result found that the control group received delayed MIT, resulting in less improvement in training material repetition.

The study of Van der Meulen *et al*.[8] demonstrated improvements in both trained and untrained items. The authors also compared the experimental group's language improvement post-MIT to the control group. They discovered that MIT only improved training material repetition. It did not affect word retrieval, everyday verbal communication, or generalization to untrained material. After finishing MIT, patients were unable to maintain their MIT-related language gains.

Discussion

The primary aim of this systematic review was to examine the emergence in the scientific literature of the effectiveness of the traditional MIT protocol used by STs on the speech recovery of patients with non-fluent aphasia.

The main findings showed that MIT significantly improved speech recovery, specifically language repetition[7,8] and functional communication in patients with non-fluent aphasia.[7] The outcome evaluations used in the different clinical trials reported to date assess the efficacy of MIT in post-stroke aphasia. These two studies used the AAT to assess repetition and the ANELT test to assess functional communication.[7,8] Similar to van de Sandt-Koenderman *et al*., the findings indicated that the participants demonstrated significant improvement in repetition using the AAT and everyday verbal communication, as measured by the ANELT.[10]

Some studies have used the communicative activity log (CAL) questionnaire to assess communication. The findings indicated that stroke survivors with nonfluent aphasia have improved their communication skills.[9,11] One study has used the Japanese version of the Western Aphasia Battery (WAB) to assess repetition. The result showed that MIT improved language output (as indicated by the spontaneous speech, repetition, and naming subscores of the WAB).[12] In contrast to Plukwongchuen *et al*., the study demonstrated the positive effects of MIT on spontaneous speech and naming, but not repetition, in Thai stroke patients with aphasia.[22] This study used the Thai version of the WAB test to assess linguistic function. Note that this study used a different measurement tool and did not define the type of aphasia or stroke duration.

Remarkably, Van der Meulen *et al*.,[7] found that patients with subacute severe nonfluent aphasia in the control group experienced less improvement in the repetition of trained material when they received 6-week delayed MIT. Meanwhile, there was an overall more significant improvement in the early MIT group. Therefore, timing influences therapy outcomes. Earlier treatment led to more significant improvement. This is consistent with studies demonstrating that spontaneous recovery occurs within the first three months after a stroke.[23,24]

The secondary aim of this systematic review also included examining other aspects of the traditional MIT, such as participants, MIT protocol, therapy intensity, and the role of the STs.

Participants

In the study by Van der Meulen *et al*., patients with severe nonfluent aphasia persist until 2 to 3 months poststroke.[7] In the study by Van der Meulen *et al*., patients with severe nonfluent aphasia persist for more than 1-year poststroke.[8] The effect of MIT in chronic aphasia is more restricted than its effect in earlier stages post-stroke. When the etiology of aphasia is a stroke, recovery of language function peaks in the first three months.[23,24] Also, Hojo *et al*. found an association between the initial severity of aphasia and recovery rates.[25] People with severe aphasia recovered less than people with mild aphasia, and this trend was obvious in Wernicke and Broca aphasia. Furthermore, in terms of the aphasia type, conduction aphasia had the highest recovery rates, followed by Anomic, Wernicke, and Broca aphasia. Global aphasia showed much lower recovery rates. Future studies should explore a correlation between severity, aphasia type, and recovery rates.

Additionally, the two included studies provided a lack of detailed documentation of the size and location of the lesion, which had significant neurological characteristics.[7,8] van de Sandt-Koenderman *et al*.[10] found no consistent shift in language activation between the left and right hemispheres. However, subacute patients exhibited symmetrical or right-lateralized language activation before therapy, which tended to become more right-lateralized after treatment. Some chronic patients exhibited left-lateralized language activation, which became stronger following therapy. Furthermore, Tabei *et al*. found that after MIT-J training, the right hemisphere showed decreased activation in correct naming trials, but incorrect trials remained stimulated similarly.[12] Patients with severe chronic non-fluent aphasia have improved neural processing efficiency and decreased cognitive workload.

Besides, there was a wide age range, from 18 to 80. The studies did not provide solid outcome information for each specific age group.[7,8] Hojo *et al*. found that age and recovery rates showed a significant negative correlation.[25] Younger patients recovered more rapidly, and this trend was particularly noticeable in Wernicke aphasics but not in Broca aphasics. The future study should explore a correlation between age and recovery rates.

In addition, the sample of participants met the criteria for good candidacy for MIT therapy, and they benefited from the therapy.[7,8] Similar to previous studies, a positive response to MIT therapy was associated with left hemisphere lesions.[15-18] MIT is based on three main components: singing, rhythmic speech, and common phrases. Singing activates the right hemisphere, which takes over the function of the left-brain speech areas when severe damage occurs. However, the two included studies did not explore language lateralization and neuroplastic reorganization after or during MIT.[7,8] Therefore, the participants in the MIT trial and the clinical benefits resulting from functional and structural changes in the right hemisphere remain unknown.

MIT protocol applied

Speech therapists used MIT following the American manual and the protocol in Dutch target utterances.[7,8] Remarkably, all studies employed the traditional MIT methodology.[7,8] MIT involved both formulaic statements, such as "How are you?" and nonformulaic statements, such as "The ministers are talking nonsense" and "A thunderstorm is coming our way." As a result, they could not fully understand the influence of the MIT components and could not conclude the role of formulaic and nonformulaic language. Evidence supports the idea that the right hemisphere facilitates formulaic language processing.[26] On the other hand, the left hemisphere facilitates non-formulaic language.[27] Consequently, left-hemisphere stroke patients often retain the ability to produce formulaic expressions.[28]

In addition, the researchers provided homework assignments in both studies to ensure therapy intensity. They captured the target utterances in a short video on an iPod application so patients could sing along with the video or repeat the utterances later.[7,8]

Therapy intensity

In the study by Van der Meulen *et al*. and Van der Meulen *et al*., the face-to-face therapy time was 5 hours per week (minimum 3 hours per week plus homework) for 6 weeks.[7,8] This range of therapy intensity showed improvement in functional communication[7] and repetition tasks.[7,8] However, the question of the intensity of therapy remains open. A systematic review by Brady *et al*.[29] found that studies with high-intensity treatment had higher drop-out rates than those with less frequent treatment. Some aphasic patients may not be able to commit to high-intensity therapy. Additionally, the range of optimal timing for aphasia therapy, precisely the post-stroke period, may have led to generalizations about verbal communication. MIT may be more beneficial in the subacute stage than the chronic stage after a stroke.

Role of speech therapist

Speech therapists were interventionists in MIT research.[7,8] They had previously received MIT training and delivered the traditional MIT intervention. According to many studies, STs were licensed MTs who administered the MIT.[9-12] Contrary to Mata, the role of MTs in the MIT study was that of practitioners.[19] They frequently use their professional music composition and singing expertise to modify MIT. ST and MT were separated because MIT necessitates music therapy skills. However, the two disciplines can collaborate in a clinical context to perform MIT or work separately, but the combined expertise of both experts would result in best research practices. Our study reveals that MIT necessitates MT skills and training, which STs must also fulfill.

Limitations and future research

Our study has several limitations. First, the low number of included studies (N=2) and the total number of participants (N=44) used in this review may not represent the general population. To corroborate the findings, a larger sample size was required, as the limited sample size was a limitation and, therefore, insufficient to draw definite conclusions. Second, this study did not provide information about MIT's role in neurobiological mechanisms that promote language recovery and neuroplastic reorganization. Future research should investigate language lateralization and neuroplastic reorganization during or after MIT to determine how language lateralization and neuronal reorganization change in patients with non-fluent aphasia during or after MIT.

Despite the several limitations of this review, the research provides a solid basis for further investigations into MIT's noteworthy—and possibly unexpected—

contribution to speech recovery. It is also crucial to consider the clinical implications of the results in speech therapy.

This study found a significant correlation between treatment intensity and therapy outcomes after MIT. Earlier treatment may also lead to more substantial improvement. Importantly, this finding suggests STs must also possess music therapy skills and training when using MIT.

Conclusions

This systematic review demonstrates that MIT may benefit language repetition and functional communication in patients with non-fluent aphasia. Additionally, MIT may be a practical alternative to standard speech therapy in encouraging speech recovery for these patients. However, MIT requires music therapy skills and training; speech therapists must also have these abilities.

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 Ethics Committee, Faculty of Associated Medical Sciences, Chiang Mai University (CMU), Thailand (AMSEC-66EM-024) approved the study for exemption review. The data that support this study's findings are available on request from the corresponding author.

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