Music-Based Interventions for People Living with Dementia, targeting Behavioral and Psychological Symptoms: a scoping review

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Running Title: Mbi targeting BPSD: a scoping review

*Lídia Sousa**: Faculty of Medicine of Porto University - Portugal; CINTESIS - Center for Health Technologies and Services Research. Contact: lidiasousa99@gmail; Orcid: https://orcid.org/0000-0003-3560-9193

Maria João Neves: Unidade de Saúde Familiar de Espinho – ACES Grande Porto VIII; Faculty of Medicine of Porto University – Portugal. Contact: mariajoaoantunesneves@gmail.com

Bárbara Moura: Centro Hospitalar de Vila Nova de Gaia/Espinho; Faculty of Medicine of Porto University – Portugal. Contact: barbararmoura@gmail.com

Justine Schneider: School of Sociology & Social Policy University of Nottingham UK. Contact: Justine.Schneider@nottingham.ac.uk

Lia Fernandes: Faculty of Medicine of Porto University - Portugal; CINTESIS - Center for Health Technologies and Services Research; *Psychiatry Service of Centro Hospitalar Universitário de S. João Porto, Portugal.* Contact: liapns@gmail.com

*Corresponding Author: Lídia Sousa

Contacts: lidiasousa99@gmail.com; Telephone: 00351 916184269

Address: Faculdade de Medicina da Universidade do Porto, Al. Prof. Hernâni Monteiro, 4200 - 319 Porto, PORTUGAL

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Data availability statement

Further details on search history, data extraction and quality appraisal are available upon request to the authors.

Abstract

Introduction: Dementia care is a major public health issue worldwide. The management of behavioral and psychological symptoms (BPSD) is one of the hardest challenges in this context. Non-pharmacological strategies, like music-based interventions (Mbi), seem promising options, being considered low-risk, widely available and inclusive. This scoping review aimed at mapping all Mbi used in dementia care, targeting BPSD and debriefing its components, structure and rationale. Music therapy and other therapeutic music activities were included.

Methods: The Arksey and O'Malley framework, Cochrane recommendations and PRISMA checklist were followed. Embase, PubMed, PsycINFO, ASSIA and Humanities Index were searched from first records until the 31st of March 2020. Snowballing process and screening of relevant journals were also undertaken. A panel of experts critically guided the evidence synthesis.

Results: Overall, 103 studies (34 RCT; 12 NRT; 40 Before/After studies and 17 Case Studies) met inclusion criteria. Basic elements of the Mbi, the rationale supporting its development and hypothesis tested were mostly underreported, thus hampering cross-study comparisons and generalizations. Despite this, available evidence indicates that: it is feasible to deliver Mbi to PwD at very different stages and in different settings - from community to acute setting - even for non-music therapists; positive or neutral effects in BPSD are often reported but not without exception; individualization seems a critical factor mediating Mbi effects.

Conclusions: Detailed intervention and research reporting are essential to interpretation, replication and translation into practice. Ten years after the

publication of specific reporting guidelines, this goal is not yet fully achieved in music in dementia care.

Key Words: Scoping Review; Dementia; Behavioral Symptoms; Non-pharmacological Therapy; Music.

Key Points:

- This scoping review included studies reporting the administration of Musicbased Interventions (Mbi) to patients with dementia, targeting behavioral and psychological symptoms, independently of the setting.
- 103 studies (34 RCT; 12 NRT; 40 Before/After studies and 17 Case Studies) were included in the analysis.
- There was a focus on mapping and detailing the intervention theory, content, delivery schedule and mode, interventionists, setting and treatment fidelity strategies.
- We identified more areas of doubt that remain to be elucidated than assumptions that can be directly translated to practice. Despite that, it was possible to infer some generalizations with clinical relevance.

Introduction

Approximately 50 million people live with dementia across the world⁽¹⁾. People living with dementia (PwD) experience not only the typical cognitive symptoms but also Behavioral and Psychological Symptoms of Dementia (BPSD), like agitation, disinhibition, irritability and psychosis⁽²⁾. BPSD cause significant suffering to PwD and, when poorly managed, may lead to severe medical complications, prolongation of hospital admissions, family distress, and increased premature institutionalization, all carrying an inevitable economic burden⁽³⁾.

The use of major sedatives and physical restraint, despite quite frequent, is associated with sub-optimal efficacy and important secondary effects, such as increased risk of cardiovascular events and mortality^{(3-10).}

Many recent studies, conducted mainly in the community and long-term care setting, showed promising results regarding the administration of psychosocial interventions to PwD⁽¹¹⁻¹⁷⁾. The main international guidelines already recommend that non-pharmacological strategies should be the first line in BPSD management⁽¹⁸⁻²¹⁾. But there is still a need for more robust evidence regarding effectivity⁽¹²⁾ and cost-effectiveness⁽²²⁾ of specific non-pharmacological interventions.

Music-based interventions (Mbi) - including formal music therapy and other less strictly defined therapeutic music activities, performed to obtain health benefits, but without the intervention of a trained music therapist - seem to have a positive effect in mood and behavioral alterations of PwD, at least in the short term^(15, 16, 23, 24). However, previous systematic reviews did not confirm or refute the

effectivity of specific Mbi in BPSD management, nor did they present a clear characterization of the components and rationale of available Mbi^(12-16, 24-27).

This review is innovative because of its main focus on debriefing the intervention's components, structure and rationale, according to recent and widely applicable recommendations to standardize the reporting of evaluative studies - the Template for Intervention Description and Replication (TIDieR) checklist⁽²⁸⁾ - and because of its large scope (including not only Music Therapy studies, but also other therapeutic music activities, both within and beyond clinical settings); specificity regarding the evaluation of the musical component (excluding multicomponent interventions integrating dancing, physical exercise or multisensory stimulation) and regarding the therapeutic aim of the intervention (restricting the inclusion criteria to interventions performed to reduce BPSD).

We sought to increase knowledge in the field of music in dementia care by mapping and characterizing available original studies and analyzing the evidence they yield to permit cross-study comparisons, inferences and generalizations. Highlighting gaps and limitations to be addressed in future research was also a main concern. All this can ultimately be useful to inform the development of protocols to deliver Mbi with specific therapeutic aims, tailored to specific populations of PwD and in specific settings.

Review question(s)

 What are the main characteristics of studies testing Mbi with PwD, targeting BPSD?

- 2. What are the main components, structure and rationale of those Mbi, defined according to TiDIER checklist items?
- 3. From the available body of evidence, what are the main inferences and generalizations that can be translated to practice or used to guide future research?

Methods

A scoping review was considered suitable to answer the proposed research questions because of its flexibility, breadth and broad scope. This methodology warrants the mapping and characterization of a large body of evidence, in a time and cost-effective manner - still using a rigorous and transparent methodology. It also permits an iterative process of refining the research questions and consulting experts, who may guide the process from evidence search to synthesis.

The present review complies with Arksey and O'Malley's methodological framework⁽²⁹⁾, the Cochrane collaboration recommendations for the conduction of Scoping Reviews⁽³⁰⁾ and the PRISMA - ScR checklist⁽³¹⁾. According to them, the following steps were completed: identification of the main objective/research questions; identification of relevant studies; study selection; data extraction; collating, summarizing and reporting the results; consultation of relevant stakeholders and iterative reformulation of the research questions. As an additional step, the Downs and Black checklist⁽³²⁾ was used to evaluate the quality of RCT and NRT. The inclusion criteria and search strategy adopted are based on the PICOS headings (Table 1).

[Insert Table 1]

Inclusion criteria: Participants were PwD with a formal clinical diagnosis; the intervention tested was an Mbi, performed in any setting (clinical or not) and the main outcomes were the effects of Mbi on BPSD or the need to use sedatives and/or physical restraint. Studies presented original empirical evidence using qualitative and/or quantitative methods, without restrictions regarding design. Articles written in English; Spanish; French; Italian or Portuguese were fully analyzed.

Exclusion criteria: Participants without a formal dementia diagnosis; other interventions administered simultaneously with Mbi, or utilization of multicomponent interventions, where the specific effect of music was impossible to isolate.

Search Strategy and Data Extraction

The search was conducted in the following databases: Embase, PubMed, PsycINFO, ASSIA and Humanities Index. The keywords used are fully described in Table 2. Snowballing process and reference lists screening were performed. No restrictions on language or date of publication were applied at this stage. Electronic search was concluded by the 31st of March 2020. Direct search on music therapy journals (Journal of Music Therapy; Nordic Journal of Music Therapy; British Journal of Music Therapy; Australian Journal of Music Therapy) was also performed.

Retrieved articles were screened independently by two reviewers. After title and abstract screening, the full text of selected articles was evaluated independently by two reviewers. Disagreements were resolved with the consultation of a third reviewer. Data was extracted and confirmed by two reviewers.

Consultation of experts was employed to provide additional strength to the evidence synthesis. Besides commenting on every phase of the review and guiding the clinical and academic relevance of the research questions, the panel critically commented on the findings and guided the structure of the results presentation. Experts from different backgrounds (2 psychiatrists; 1 psychologist; 1 music therapist; 1 sociologist), with clinical and research experience in dementia care and particularly music-based interventions, were recruited.

[Insert Table 2]

Quality Appraisal

Two reviewers independently assessed the quality of RCT and NRT published in 2010 and after, using the Downs and Black (1998) checklist⁽³²⁾ to yield a qualitative classification (excellent: 26-28 points; good: 20-25 points; fair:15-19 points; poor: \leq 14 points). One strength of this checklist is its suitability to assess non-randomized as well as randomized studies. It consists of 27 items across five domains: reporting, external validity, internal validity (bias and selection bias) and power. The items' power (27) and subject blinding (14) were not applicable.

Modifications of the scale and score ranges were performed as previously reported^(15, 33). Disagreements in the quality appraisal were resolved by a third reviewer.

Results

Study Selection

A PRISMA flow diagram is presented in Figure 1. Electronic searches on main databases identified 2955 potentially relevant titles. Through additional searches, further 9 potential papers were identified. No ongoing studies were located. After exclusion of duplicates, 2495 records remained. Of these, 2307 did not meet the inclusion criteria, leaving 188 articles for full-text analysis. Six studies were not analyzed in full due to the language barrier⁽³⁴⁻³⁹⁾. One hundred and three studies - 34 randomized controlled trials (RCT), 12 non-randomized trials (NRT), 40 Before and After studies (B&A) and 17 Case Series (CS) - were included in the analysis.

[Insert Figure 1]

Characteristics of Included Studies

Studies published before 2010

Studies before the year 2010 (when the first reporting guidelines for Mbi were published⁽⁴⁰⁾) were not analyzed as thoroughly as more recent studies since the quality and standardization of the reports are expected to be significantly

inferior. Table 3 presents an overview of their main characteristics. It stands out that most studies were conducted in the decade of 2000-2010, took place in the USA and targeted PwD in residential long-term care setting. Most often, interventions were administered by a music therapist and consisted of passive individual interventions, with a fixed schedule and with individualization of music choices being reported. Importantly, this process of individualization was not clearly described in most cases. Some authors⁽⁴¹⁻⁴⁵⁾ mentioned that family members and/or patients were consulted to investigate music preferences, but it was not detailed specifically how this was operationalized. Only a minority of studies⁽⁴⁵⁻⁵⁰⁾ tested administration of Mbi in specific situations (prior to peak agitation, during meal times or during other care situations). Details of the rooms where interventions took place where not systematically described. Treatment fidelity strategies were also globally overlooked.

There was confusion regarding basic characteristics of the interventions. Some studies⁽⁵¹⁻⁵³⁾ mentioned the use of music therapy, but the intervention of interest was not clearly reported, so it was not possible to ascertain if a music therapist was involved and/or if all other criteria for formal music therapy were met.

Overall, a lack of standardization of the reports and of a uniform terminology was verified, thus impairing a clear understanding of what was delivered, when, and under what circumstances, to whom and by whom. None of the studies presented a protocol for administration of the Mbi that was replicable. Details of its development and theoretical background were also lacking. Additionally, it was

found that most studies had small samples and used a B&A methodology, lacking randomization and adequate controls.

[Insert Table 3]

Studies published after 2010

The main characteristics of studies published in 2010 and after are provided in Table 4 (studies other than RCT) and Table 5 (RCT). The latter includes significantly more details, since the study designs and quality of reported evidence are expected to be superior.

• <u>Studies other than RCT: methodological aspects</u>

The 29 studies that did not follow an RCT methodology were mainly B&A (n=11) and CS (n=11), thus providing low-quality evidence. Regarding the non-randomized trials, most were of fair quality (n=4) according to our formal quality appraisal, with only two being classified as good quality and one having poor methodological quality.

Despite mentioning that having dementia was an inclusion criterion, most studies did not make clear if the participants had a formal clinical diagnosis and how this was made. The vast majority of studies were conducted in long-term residential institutions, with acute hospital settings being investigated in only 3 reports⁽⁵⁴⁻⁵⁶⁾.

Outcome measures used to evaluate the impact of Mbi on BPSD varied greatly, and many studies did not use validated instruments. Overall, studies

reported positive results, but the effects in BPSD did not consistently achieve statistical significance. Importantly, in one study it was reported that the number of episodes of behavioral disturbance significantly increased when ambient baroque music was played⁽⁵⁷⁾.

<u>Studies other than RCT: TiDler checklist items analysis</u>

Most such studies reported the intervention name and/or a phrase to described it, but the lack of uniformity regarding the terminology used to characterize the interventions was striking.

The *theoretical background* supporting the specific structure of Mbi applied was not described in most studies, along with the specific details of protocol development.

Logistic details, such as the *materials used* (i.e. music players and/or musical instruments) were fairly reported, but the description of the *specific procedures* undertaken during the intervention lacked sufficient detail to allow replication.

In most trials, an individual Mbi was utilized rather than a group approach. Most frequently, it was delivered by a caregiver (n=7), a staff/health professional (n=6) or a Music Therapist (n=5), sometimes with both a caregiver and staff or Music Therapist being involved (n=3). Most individual interventions consisted of receptive interventions (n=13) (i.e., listening to pre-recorded music) being actively administered by the *intervention coordinator*, despite the absence of a fixed structure.

Group interventions were more often administered by a Music Therapist (n=6), or a musician (n=3). In 2 cases this role was performed by a researcher^(58, 59). Mbi consisted essentially of mixed active/receptive interventions, combining music listening, playing instruments and singing, most often under the active direction of the person administering the intervention, but still using flexible *structures*.

The specific *place of administration* of the Mbi (type and characteristic of the room) was generally underreported.

Frequency, duration and dose were fairly reported in most studies, thus ensuring replicability, but the heterogeneity was so high that it is not possible to make relevant inferences from cross-study comparison. On the contrary, the criteria for administration ("fixed schedule" or "on-demand") was seldom clearly reported.

Most studies did not mention *individualization strategies* or did not report them properly. Even when some degree of individualization of the Mbi was clearly described, it often consisted of a general adaptation to the population of interest, rather than a true adjustment of the protocol to each participant.

Fidelity strategies were consistently underreported across studies.

<u>RCT studies: methodological aspects</u>

The 31 RCT included 1947 PwD, mainly recruited from long-term care institutions (n=24). The vast majority of these studies were of fair quality (n=23), with only one being classified as good and seven as having poor methodological quality.

Almost half of the studies (n=14) utilized an active comparator, frequently implying some degree of interpersonal interaction and including other elements, like cooking, painting or multisensory stimulation.

The most frequently used instruments to access BPSD were the Cohen Mansfield Agitation Inventory (CMAI) and the Neuropsychiatric Inventory (NPI). None of the studies reported statistically significant negative effects, suggesting that MbI tested did not worsen BPSD. In most cases there was at least a trend towards a positive effect of the interventions.

<u>RCT studies: TiDler checklist items analysis</u>

Although supposed to be studies of better methodological quality, the *terminology* used to describe the Mbi also lacked uniformity and systematization in most RCTs.

Likewise, the *development process* of the protocols and the rationale and theories behind its conceptualization were seldom presented and explained with sufficient detail to allow a critical discussion.

Logistic details about the materials used were fairly reported but, overall, the procedures of administration of the Mbi were lacking, making it difficult to replicate the interventions and to analyze in detail its components.

Regarding *basic procedures*, the majority of Mbi identified were group interventions (n=23). Most often they consisted of a mixed active and receptive intervention, combining in different ways music listening, singing and playing instruments. Individual interventions consisted essentially in individualized music listening programs or formal music therapy.

In only 15 studies, was there a clear reference that the *person who administered the intervention* was a Music Therapist. More frequently, Mbi were delivered by a health professional (nurse, nurse assistant, occupational therapists, physiotherapist, psychologist) with experience in dementia care. In only two cases musically educated non-health professionals (music teacher^(60, 61) and musician^(62, 63)) delivered the Mbi.

The specific *place of administration* of the intervention was not reported in detail in most studies, with only a few⁽⁶⁴⁻⁶⁹⁾ presenting specific characteristics of the rooms, such as temperature, lighting and noise.

Frequency, duration and dose of the interventions were reported in most studies. Once again, those parameters were highly variable and seemed to be empirically defined rather than based on strong theoretical assumptions. Also, in most cases, it was not clear whether the intervention was performed at a fixed time of the day, nor under what criteria it should be delivered.

Individualization of the musical choices was often reported, based on patients' preferences, accessed through interviews with the patients and/or family/informal carers or the application of non-validated questionnaires.

In RCTs, strategies to ensure treatment fidelity were used more frequently than in non-randomized studies. The most frequent were the administration of standardized training to activity coordinators, the elaboration of a structured protocol to be followed (most often not reported) and the implementation of slightly informal intervention monitoring processes (by researchers or other health

professionals with Mbi training). However, *reporting of adherence* to these strategies lacked sufficient detail.

[Insert Tables 4 and 5]

Discussion

This review analyzed studies reporting the administration of Mbi to PwD, targeting BPSD, independently of the setting. Overall, the quality of included studies was fair to low. The main points of criticism arising from the formal quality appraisal are: the lack of adequate identification and control of potential confounding factors, the absence of monitoring and report of adverse events, the underreporting of concealment and the low external validity of the studies

From our analysis, the lack of standardization of reports is striking, making it hard to reproduce the interventions and replicate the results. This hampers the possibility of future investigations to build on previous work.

The fact that there is a limited number of instruments, specifically designed to evaluate the effects of Mbi in PwD and which have not been applied widely, further complicates evidence synthesis, particularly in what concerns effectivity investigations. Different authors used very different measures, even when evaluating the same outcomes, and some researchers even developed their own non-validated instruments. Variability in the measures used is relevant, because capturing the multicomponent effects of complex psychosocial interventions is difficult, even without inconsistent approaches to measurement. If greater attention

was devoted to using a common core set of outcome measures, the quality of evidence produced in this field could improve significantly.

Inferences and Generalizations with Potential Clinical Relevance

Despite the lack of consistency across reports of individual studies, some inferences can be extracted from our analysis.

According to the available evidence, it seems possible to deliver Mbi to PwD, with positive effects, even without directly involving a Music Therapist ^{(67, 70-77).} This was previously considered to be an important open question⁽⁷⁸⁾. Despite the seemingly intuitive idea that Mbi programs should be delivered under the supervision, or at least with the consultation, of a certified Music Therapist, we could not find evidence to support this assumption. It appears from our results that many interventionists have at least some kind of musical education or musical background, and, logically, this should facilitate the administration of an Mbi. However, having training in dementia care and knowing well the PwD to whom the Mbi is to be delivered, may be even more important.

It also seems feasible to involve family carers in the administration of Mbi to PwD, with positive results⁽⁷⁹⁾. Since family carers, in general, know the PwD well, they are in a privileged position to perform individualized Mbi. This has the potential to increase the well-being and satisfaction of the carers and increase the connection with the PwD, apart from ameliorating BPSD.

In most cases, the impact of the Mbi was positive or neutral but this is not without exception⁽⁵⁷⁾. Thus, more attention should be paid to the exploration of variables that can mediate negative effects. In particular, the actual occurrence of

systematically underreported side effects, as has been previously hypothesized⁽¹³⁾, such as sore throat after singing or cases of distress specifically related to the Mbi, would be interesting to explore.

Individualization of music choices seems to be a critical factor mediating the effect of an Mbi, since, in recent years, progressively more studies have adopted this strategy with positive results. It has been proposed that individual interventions should be adjusted to the preferences of a PwD, especially when they are expressing relevant BPSD, allowing for a fine attunement according to the patient's reactions⁽¹⁶⁾. In theory, the effect of individualization (considering the musical memories and musical background of the target population) might explain why PwD appear to react differently to standard Mbi (inter-person variation). More research is needed, though, to make informed decisions about what Mbi may work for whom, and when.

Unanswered questions

Many other unexplored factors deserve consideration in future research efforts. Factors mediating intra-individual variation to an Mbi are one example. Individual studies reported different reactions of PwD on different occasions, even when the Mbi was individualized. At different times of the day a PwD might be more prone to respond well to an Mbi. For instance, before bathing or other caring situations that might upset the person, the intervention may have a more positive impact, preventing or reducing the severity of emerging episodes of agitation.

The state of consciousness of a PwD and their capacity to sustain attention during an Mbi might also modulate its effect. For example, when PwD experience

delirium, as in the context of dehydration or acute infection, they may react very differently than they would in their basal state, when they are more capable of understanding the environment and focusing their attention on the intervention. The latter could help explain why studies carried out in the acute hospital setting⁽⁵⁴⁻⁵⁶⁾ (where PwD are expected to be acutely ill), did not report compelling evidence pointing towards positive effects of Mbi, by comparison with studies in long-term care institutions^(60, 61, 64, 68, 73, 80, 81). The short and highly variable time frame for care in the acute setting may also complicate the planning of an Mbi to be delivered there. Larger-scale and longitudinal studies would be needed to explore these issues.

In a previous meta-analysis of RCT⁽¹⁶⁾ it has been reported that music therapy exerted a larger and more positive effect on patients with mild to moderate dementia than on patients with moderate to severe dementia. But patients with moderate dementia were included in both groups, potentially confusing subgroup analysis. Our review was not focused on effectivity, but yet, the main results of individual studies were briefly analyzed and we still believe that much remains to be clarified regarding the relationship between dementia severity and the effects of Mbi.

Investigating factors that mediate the duration of the positive effects of Mbi also seems crucial to guide the planning of Mbi protocols. For instance, it could be interesting to explore whether there is any association between the speed of disappearance of positive effects after an Mbi is delivered and the degree of cognitive impairment of the PwD. People with mild dementia may recall the

intervention for a longer time and have the capacity to focus and participate in an Mbi during a longer period. Potentially, they could benefit from slightly longer and less frequent sessions than those with more severe cognitive deficits.

It has been previously argued that individual music therapy should be provided once a week to individuals with cognitive decline, and group music therapy should be provided several times a week to people with disruptive behaviors to reduce anxiety levels and depressive moods⁽¹⁶⁾. In this review we did not find evidence that could either confirm or refute these assertions. A recent Cochrane review⁽¹³⁾ concluded that PwD in institutional care who receive at least five sessions of a music-based therapeutic intervention probably have fewer depressive symptoms and behavioral problems. It has also been reported elsewhere that group music therapy a few times a week would be more beneficial for PwD experiencing depressive moods and anxiety⁽¹⁶⁾, but the evidence sustaining this is not strong. We believe that much remains to be understood regarding the most beneficial frequency of Mbi administration for PwD.

There is also the need for more research regarding the utilization of "fixed schedule" versus "on-demand" / "as needed" / "as requested" administration of Mbi. It makes sense in theory and there is some evidence pointing in the direction of a positive effect of using "on-demand" administration of Mbi^(54, 82, 83) (i.e. prior to known peaks of agitation of a specific PwD; when a red flag for emerging agitation is incidentally identified). But we did not find head-to-head comparisons of "fixed schedule" versus "on-demand" administrations of Mbi.

Many issues of relevance to the development of Mbi have not been resolved by this evidence synthesis. Questions remain regarding the musical aspects of the interventions (including form, tempo, rhythm, melody, harmony, voicing, and tonality of music choices), their dose and duration, and the optimal group size. The specific setting (patients' bedside/ specific room) where Mbi should be delivered and the ideal delivery mode (live/recorded, headphones/loudspeaker, active/receptive) are also unexplored aspects. It has been previously reported⁽⁸⁴⁾ that receptive music therapy focused on "relaxation" is a method that probably better reduces neuropsychiatric symptoms, though we did not find convincing evidence to sustain this assumption nor to elaborate a rationale that could explain it in theory.

The specific effect of the musical components of the intervention (i.e., potentially intrinsic emotional and cognitive modulation properties) versus the effect of music as a bridging element, fostering a meaningful interaction with a carer, is also another importer point that still remains to be clarified.

Likewise, we found no studies exploring the differential effect of Mbi on different dementia types. In theory, since in dementias of different etiologies different brain structures are affected more severely⁽⁸⁵⁾, the response to a complex stimulus like an Mbi might depend fairly on this covariate.

Moreover, the relative importance of sociocultural differences for the success of an Mbi also remains to be fully understood. Music and musical taste have cultural dimensions, they are shaped by societal influences, yet they are not bound by geography. Moreover, preferences for a given music culture are clearly

not restricted to members of that culture. Delivering culturally-appropriate Mbi to PwD from minority groups remains a challenge for interventions that originate in the dominant culture.

Strengths and Limitations of the Review

This review has some characteristics that make it innovative and relevant. The proposed research questions tackle some unique points that have not been sought after in previous reviews and the main goal of the evidence synthesis was to analyze the included studies using a structured approach framed by the TiDIER checklist⁽²⁸⁾. An extensive description of the main characteristics of identified Mbi was sought, the lack of which is an important point of criticism towards previous SR on music in dementia care⁽¹⁴⁾.

Additionally, evidence interpretation and synthesis were guided by expert consultation, leading to an iterative process of refining the research questions and identifying the most crucial points/characteristics of Mbi to be analyzed, while striving to ensure adequate literature coverage, contextualization, relevance, thoroughness and real-world applicability of the review.

Notwithstanding, some shortcomings must be taken into consideration. As a scoping review, the lack of a quantitative synthesis of evidence is an anticipated limitation. Moreover, six studies were not considered in the analysis, due to the language barrier, despite being referenced. Finally, the fact that studies published before 2010 were given a different weight in evidence synthesis might also be a point of criticism.

Conclusion

Mbi are especially difficult to fully and transparently describe because of the complexity of music stimuli and other factors such as choice of music, mode of delivery, or the combination of music with other intervention strategies⁽⁴⁰⁾. Regarding the use of Mbi in dementia care, despite the growing number of studies with progressively more robust methodologies, there is still much to be done regarding the report of interventions and the adequacy of outcome measures.

In this scoping review, we have mapped and characterized more than 100 studies that have investigated the use of Mbi (without other components like dancing, massage or aromatherapy) in various settings, targeting BPSD. After carefully detailing the main characteristics and assumptions of each intervention, and circumspectly trying to make general inferences, we identified several questions that remain to be addressed before the evidence in existence can be rigorously translated into practice.

The best conclusions that we can draw from the available evidence are that a successful intervention would happen at least once a week, for more than 30', under the direction of someone with at least some training in dementia care and should it be tailored to the preferences of the participant. The possibility of negative effects must not be overlooked, and these should be identified promptly.

In future studies, more attention should be paid to the replicability of Mbi protocols and the specification of participants' characteristics, such as dementia etiology and degree of cognitive impairment. The measurement of a common core set of outcomes (such as total length of exposure and quantification of

engagement with the intervention; BPSD and wellbeing measurements, before,

during and after the intervention and overall level of satisfaction of participants) is

also advisable.

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Figure 1 - PRISMA flowchart (modified)

Table 1 - PICOS headings

Population	Patients with a clinical diagnosis of dementia (any type)
Intervention	Music-based intervention (music therapy or other therapeutic music activities)
Control	Treatment as usual; Other non-pharmacological interventions, like active engagement in social contact; or no control
Outcomes	Behavioral and Psychological Symptoms of Dementia; Use of psychotropic medication and/or Physical restraint.
Study Design	No restrictions based on study design

Table 2 - Search strategies utilized to search electronic databases

ASSIA; PsycARTICES

ab((Dementia OR spatiotemporal Dementia OR AIDS Dementia Complex OR Dementia, Vascular OR Dementia, Multi-Infarct/ OR shiv associated dementia OR multifont dementia OR DEMENTIA WITH Lewy BODIES OR VASCULAR DEMENTIA OR Alzheimer Disease OR Alzheimer* OR cognitive impairment OR Acute Confusional state OR Acute Confusion OR Delirium)) AND ab((music* intervention* OR music* therap*/ OR music*))

PsycINFO; Embase

- 1 exp Dementia/
- 2 exp Alzheimer Disease/
- 3 (dement* or alzheimer*).ti,ab.
- 4 acute confusion.mp. or confusion/ or acute confusion/ or delirium/
- 5 acute confusional state.mp.
- 6 delirium.mp. or delirium/
- 7 1 or 2 or 3 or 4 or 5 or 6
- 8 music.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, sy, tc, id, tm, tn, dm, mf, dv, kw, fs]
- 9 music therapy/ or music/ or music.mp.
- 10 music interventions.mp.
- 11 8 or 9 or 10
- 16 7 and 11

SCOPUS

(Dementia OR spatiotemporal Dementia OR AIDS Dementia Complex OR Dementia, Vascular OR Dementia, Multi-Infarct/ OR shiv associated dementia OR multifont dementia OR DEMENTIA WITH Lewy BODIES OR VASCULAR DEMENTIA OR Alzheimer Disease OR Alzheimer* OR cognitive impairment OR Acute Confusional state OR Acute Confusion OR Delirium) AND (music* intervention* OR music* therap*/ OR music*)

Pubmed

("Dementia"[Mesh] OR "Alzheimer Disease"[Mesh] OR "Dementia, Vascular"[Mesh] OR "Dementia, Multi-Infarct"[Mesh] OR "AIDS Dementia Complex"[Mesh] OR "Frontotemporal Dementia"[Mesh] OR "Lewy Body Disease"[Mesh]) OR ("Delirium" [Majr] OR "Confusion"[Majr]) AND ("Music"[Mesh] OR "Music Therapy"[Mesh] OR music* OR music* intervent*)

Study Type	w	hen and Where?			What, to Whom?	
	Year	Country	Setting	Intervention	Structure	Population
RCT n=3	2000' 2009: n=6 2008: n=2 2007: n=6 2006: n=5 2005: n=2 2004: n=2 2003: n=1 2002: n=2 2001: n=1 2000: n=3	n=19 USA	Hospital n=8 Acute care n=1 Non-acute dementia special care unit n=7	Music Listening[†] n=19	Music Therapist n=24	PwD n=39
NRT n=5	90's 1998: n=1 1997: n=1 1996: n=2 1995: n=1 1994: n=3 1993: n=3 1992: n=1	n=4 Australia	Day Hospital n=3	Music Listening [†] , Singing and Playing Instruments n=14	Group n=18 Individual n=24 Both n=1	Not Only PwD (Major Psychiatric Disorders; MCI; Delirium, Other conditions with cognitive deficits) n=4
B&A n=29	80´s 1989: n=1	n=3 Canada Sweden	Long-term Care Institution n=27 Residential n=25 Day Care n=2	Music Listening [†] and Singing n=4		
CS n=6	<1980 n=0	n=2 UK Italy France Japan	Community n=2	Live Music (by Musicians) n=3		
		n=1 Israel South Korea Iceland Denmark Spain China	Patient´s Home n=2	Singing n=2		
			Not clearly specified n=1	Music Class n=1		
			Total: n = 43			

Table 3 - Characteristics of all studies published before 2010

Legend: B&A: Before and After study; CS: Case Studies; MCI: Mild Cognitive Impairment; NRT: Non-randomized trial; PwD: Patients with Dementia; RCT: Randomized Controlled Trial; UK: United Kingdom; USA: United States of America. [†] Pre-recorded music.

Table 4 - Characteristics of studies other than RCT publi	ished in 2010 or after
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Author							Ма	in Characteri	stics of the	Interventions					Timing for	Administrati	ion	
Year Country Quality	Design Sample Size	Participan ts	Setting (macro and micro)	Individual/ Group	Responsibl e for administrati on	Directiv e/ Non- directiv e	Receptive/ Active/Mix ed	Highly Structure d/ Flexible/ No formal structure	Openin g/ Closing events	Intervention name Music used	Individualizati on	Materials /Instrument s	Techniques used	Sessio ns Duratio n	Frequen cy	Total program duration	Fixed Schedule/ Criteria for administrati on	BPSD Related Outcome Measures
Brahmi et al 2019 France NA	B&A n=40	Dementia of any type	Long Term Care Setting (Alzheimer's Unit of University Hospital)	Individual and Group sessions	Music Therapist	Directiv e	Mixed	Flexible Structure	No	Music chosen by the Music Therapist	No clear reference to individualizati on	Instrument s not specified	Music listening; Music production; Stimulation of: creativity, expression, communication ; autonomy	15 to 45'	3 times a week	6 months	?	Consumption of Benzodiazepin es [†] PRN psychotropics [†] Prescriptions of neuroleptics, antidepressant s or hypnotics
Chang et al 2010 Taiwan NA	B&A n=41	Dementia	Long Term Care Setting (Care facility) - Lunch room	Group	Researcher	Non- directiv e	Receptive	Flexible Structure	No	Background Music - Nature music (piano and nature sounds)	No clear reference to individualizati on	Internal broadcast network	Music Listening (pre- composed music)	60'	Daily in alternate d weeks	8 weeks	During lunch time	CMAI [†]
Cox <i>et al</i> 2011; Cox <i>et al</i> 2014 Australia NA	B&A n=7	AD (moderate to severe stages)	Long Term Care Setting (Care facility) - Dementia- specific unit	Individual	Musician	Non- directiv e	Receptive	Flexible Structure	Yes	Live Violin Recital - Popular music 1898- 1950	Potential songs piloted on 4 non- participants without dementia and 1 PwD to determine: popularity of the songs; entertainment and rhythmic value; appeal to males/ females; emotional or reminiscent reactions. Some songs suggested by PwD' guardians	Violin	Music Listening (Live Music)	18'	< 1/week	4 weeks (3 session)	After 2 p.m.	CMAI [†]
Daykin et al 2017 UK NA	B&A n=85	Dementia of any Type	Acute Care Setting (Geriatric Ward) - Activity room close to the ward	Group (5 to 8 participant s)	Professiona I orchestral musician trained to work with PwD	Directiv e	Mixed	Flexible Structure	Yes	Inclusive participatory music activity to support wellbeing - (Familiar songs)	?	Viola; hand-held percussion instruments	Singing (familiar songs); Playing percussion instruments; Song writing; Composing; Participants invited to conduct	Up to 120'	Weekly	10 weeks	?	ArtsObs scale Average length of stay Reduction of anti-psychotics use, number of falls and need for one-o-one attention
de la Rubia Orti <i>et al</i>	B&A n=25	AD (mild degree)	Long Term Care Setting	Group (12 to 13 participant s)	Music Therapist	Directiv e	Active	Flexible Structure	Yes	Music therapy session	No clear reference to individualizati on	?	Singing; Stimulation of: social and	60'	Once	1 day	Before 9:30 a.m.	HADS [†] Cortisol salivary levels

2017			(Valencia's										emotional					
Spain			Alzneimers Association)										expression; temporal					
opun			-										orientation;					
NA			Relaxing										memory;					
			environment										physical					
			; stable										activity					
			of 22°C															
Dunn and			Community															
Dunn and Rilev-			Setting							Listening to		MSF						
Doucet			(Day Care							Non-		(multi-	Musia					
	B&A		Center)			Non-		Flexible		Religious	reference to	sensory	listening (pre-					
2012	~ 5	Dementia	Private	Individual	Caregivers	directiv	Receptive	Structure	No	(NRM)	individualizati	environme	composed	?	Variable	4 weeks	?	ABST
USA	n=5		corner with			е				Religious	on	nı) equipment	music)					
COA			a							(RM) Music		CD player						
NA			comfortable															
			ondi							Music								
			Long Term							Therapeutic								
Engstrom			Care Setting							Caregiving								
et al			(Nursing							(MTC)	No clear						During	
2011	CS	15	-		a .	Non-	D ()	Flexible		- Children's	reference to		0 ¹				morning	10100
	n-1	AD	From	Individual	Caregiver	directiv	Receptive	Structure	NO	songs, sing-	individualizati	None	Singing	?	Weekly	4 weeks	care	VNVIS
Sweden			bedroom to			C				along songs	on						situations	
NA			bathroom							and popular								
										the early								
										20th century								
												Musical						
Gold et al			Acute Care Setting									Instruments (keyboard	Listening to					
			(Geriatric									guitar,	Live Music;					More positive
	CS	Dementia	Ward								No details of	drums,	Enabling and					and/or fewer
2014		("advance	And Family	Group	Music	Directiv	Mixed	Flexible	Yes	Music	individualizati	xylophones	supporting	45-60'	Weekly	12	?	negative
ПК	n=9	0 dementia")	Ward)		i nerapist	е		Structure		Inerapy	on process	, Wrist- bells	Stimulation of			weeks		moos/benavior
U.V.		domontia)	-								provided	tambourine	spontaneous					observed)
NA			Separate									s, shakers	interaction					
			lounge									and						
										Music		beaters)						
Hammar										Therapeutic			Caregiver					
et al			Care Setting							Caregiving			continuously					
2011a			(Nursing		Corosius					(MTC)	No details of		during caring				Durine	
	CS	AD (n=1)	Home)		(with MTC	Directiv	_	Flexible		- Children's	individualizati		situation,				morning	OERS
Sweden	n 0	VaD (n=1)	- Dotionto'	Individual	training)	e	Receptive	Structure	No	songs, sing-	on process	None	accompanying	?	Weekly	8 weeks	care	RTCS
NA	n=2	. ,	bedroom		0,					along songs	provided		with body movements:				situations	
			and							and popular			song which the					
			bathroom							songs from the early			PwD would					
										20 th century			recognize					
			Long Term										Caregiver					
Hammar			Care Setting							Music			singing					
era/ 2011b	B&A		(INUTSING Home)		Caregivers					Caregiving	No details of		continuously				During	ann a ^t
	200	AD (n=5),	-	Individual	(with MTC	Directiv	Receptive	Flexible	No	(MTC)	individualizati	None	during caring	?	Weekly	8 weeks	morning	OERS'
Sweden	n=10	vaD (n=5)	Patients'		training)	e		Structure		-	on process		situation,		,		care	RTCS ^T
			bedroom							Children's	provided		with body				31001013	
NA			and bathroom							songs, sing- along songs			movements;					
			bauil00III							along songs								

										and popular songs from the early 20 th century			song which the PwD would recognize					
Ho <i>et al</i> 2011 Taiwan NA	B&A n=22	Dementia of any type	Long Term Care Setting (Hospital- based Nursing Home) - Dining area	Group	Researcher (musically educated)	Non- directiv e	Receptive	Flexible Structure	No	Background Music - 6 piano pieces composed by researchers (tempo of 60–80 beats/min, smooth rhythm to achieve a relaxing effect, minor tonalities, smooth melody lines, and no dramatic changes in volume and rhythm)	No clear reference to individualizati on	CD player	Music Listening (pre-recorded music); music volume of 55–70 dB (chosen to be slightly louder than the background noise, found to be an average 55 dB)	60'	2 times a day	4 weeks	Mealtimes (between 11:30 a.m. and 12:30 p.m. for lunch and between 5:00 p.m. and 6:00 p.m. for dinner)	CMAI [†]
Holden et al 2019 USA NA	CS n=18 (Dyad PwD and carer)	Dementia of any type (moderate to severe stages)	Community Setting - Patients Home	Individual (PwD and carer)	Music Therapist (additional training in NMT)	Directiv e	Mixed	Flexible Structure	Yes	Neurologic Music Therapy (NMT) Principles: MSOT MACT AMMT	Possibility to choose between 3 songs in each theme	Guitar; basket with percussion instruments ; pentatonic xylophone; erase board with markers; song lists; theme- based visual and tactile aids; theme- based music playlists (tablet allowing music listening)	Singing; Playing Instruments; Stimulation of: sensory orientation; selective attention; memory; improvisation and reminiscence	60' to 90'	Weekly	6 weeks	?	BPSD [†]
Huber et a/ 2020 Switzerla nd Fair (16/27)	NRT (crossover design: M&M and TAU) n=23 Group 1: 10 Group 2: 13	Dementia of any type (moderate to severe stages)	Long Term Care Setting (Care home)	Individual	Companion (caregivers, social workers, sociocultura I animators)	Directiv e	Receptive	Flexible Structure	No	Music & Memory (M&M)	Relatives asked about PwD music preferences	Headphone s, iPod®	Music Listening	20 to 30'	2 times a week	4 weeks	30' before peak levels of disturbance	CSDD [†] CMAI OERS [†]

Ihara <i>et al</i> 2019 USA Fair (17/27)	NRT n= 51 M&M:31 DPA:20	Dementia	Community Setting (Adult Day Health Centers) - Common room with adequate temperature and door closed	Individual	?	Non- directiv e	Receptive	No formal structure	?	Music & Memory (M&M)	Individualized playlists developed by asking caregivers about PwD favorite music or by playing different songs to see their reactions	Headphone s, iPod®	Music Listening	60'	2 times a week	6 weeks	?	CSDD CMAI Positive changes in mood and agitation (subjectively observed)
Keough et al 2016 USA NA	CS n=6	AD ("mid- stage of the disease")	Community Setting (home or assisted living facility) - Ample room, separated from visual/audito ry distraction, access to bathroom	Group	2 Music Therapists	Directiv e	Mixed	Flexible Structure	Yes	Music Therapy	No clear reference to individualizati on	Piano, drums	Singing; Drumming; Stimulation of: improvisation and movement. Session structured around skills.	50'	?	20 sessions	Monday mornings	Positive changes in expressive language and emotion (subjectively observed)
Kulibert et al 2019 USA NA	B&A n=24	Dementia of any type (self- identified)	Community Setting - Patients' Home	Individual (PwD and Carer)	Family Caregiver	Non- directiv e	Mixed	No Formal Structure	No	Music & Memory (M&M)	Music preference interviews with dyads; (Music Assessment Questionnair e and the Music Genre/ Artist Preference Matrix)	iPod® Shuffle, headphone s, small speaker; list of activities	Singing along, tapping, dancing, talking about associations with the music	?	?	3 months	?	RMBPC
Locke and Mudford 2010 New Zealand NA	CS n=1	AD (early onset)	Long Term Care Setting (secure dementia unit of a rest home)	Individual	?	Non- directiv e	Receptive	No formal structure	No	Music Listening - Popular music from the 1950s and 1960s; classical music	Family advised on preferred music genres	Audiotape player, headphone s	Music Listening (pre- recorded music)	20'	Daily	10 sessions	?	Reduced disruptive chanting and speech-like vocalizations (subjectively observed)
Long <i>et al</i> 2016 USA NA	CS n=1	AD	Long Term Care Setting (Care facility)	Individual	Nurse Student	Directiv e	Receptive	Flexible Structure	?	Music & Memory (M&M) - Top-selling songs from the resident's 16-30 age period including country, gospel, blues, and rock	Questionnair e inquiring PwD about personal history with music; observation of reactions to music genres and artists; songs added to the list based on the positive responses	iPod® shuffle; headphone s; splitter (so the resident and student could listen together); iTunes music cards to download music	Music Listening	Variabl e duratio n	Weekly	10 weeks	?	Qualitative evidence indicating decreased levels of evening agitation

McCreedy et al 2019 USA NA	B&A n=45	AD (moderate to severe stages)	Long Term Care Setting (Nursing home)	Individual	Certified Nursing Assistants	?	Receptive	No formal structure	No	Music & Memory (M&M)	Participants' preferred music between 16 and 26 y of age	Personaliz ed music device	?	?	?	?	On demand "times of the day when behaviors were likely to occur"	ABMI [†] CMAI [†] MDS-ABS
Nair <i>et al</i> 2010 Australia Good (20/27)	NRT (Crossove r design) n=75 Group 1:38 Group 2: 37	Dementia	Long Term Care Setting (Dementia- specific, aged care facility) - Common area	Group	?	Non- directiv e	Receptive	No formal structure	No	Ambient Baroque Music - (List of Baroque music selections provided by authors)	No clear reference to individualizati on	CD player	Music Listening (pre- recorded music)	240'	Daily	4 weeks	3 p.m. to 7 p.m.	Number of episodes of behavioral disturbance [‡]
Osman et al 2016 UK NA	CS n=20 (10 dyads)	Dementia	Community Setting	Group (PwD and carer)	Musician	Directiv e	Active	Highly Structure d (structure not mentione d)	Yes	Singing for the Brain (SftB)	No clear reference to individualizati on	Song sheets; Percussive instruments	Singing. Stimulation of: reminiscence, social interaction, peer support, engagement, active participation	?	?	?	?	Qualitative evidence indicating improvement in mood and well- being
Raglio et a/ 2018 Italy NA	CS n=1	AD (moderate to severe stage)	Long Term Care Setting (Nursing Home)	Individual	Music Therapist and Caregivers	Directiv e	Mixed	Flexible Structure	?	Global Music Approach to Dementia (GMA-D)	Music tailored according to PwD needs, residual skills (clinical assessment) and preferences, with flexibility and continuous adjustment	Instrument s not specified	Caregiver singing (familiar songs/improvis ed melodies sung to or together with PwD, daily, during activities of daily living); Group motor activity (GMA) with music (movement activity (GMA) with music; Structured music; Structured music; Structured music; Structured music; Structured music; MA) (rhythmic use of instruments, singing, etc.); MT sessions (relational approach)	GMA: 30' SMA:4 0' MT: 30'	GMA: Weekly SMA: Weekly MT: 2 times a week	6 weeks	GMA: On demand SMA:? MT:?	NPI
Ray and Mittelman 2015 USA NA	B&A n=132	Dementia of any type	Long Term Care Setting (Nursing home) - Private Lounge	Individual (n= 3 PwD) and Group sessions (4 to 6 participant s)	Music Therapist	Directiv e	Mixed	Flexible Structure	Yes	Music Therapy	PwD, family members, social workers, and recreation staff asked about music preferences	Acoustic guitar, keyboard, rhythm instruments , colorful scarves, djembe drums, ocean drums, and	Music Listening; Singing; Music production; Movement therapeutic activities; Stimulation of: relaxation, reminiscence, entrainment,	15 to 60'	3 times a week	2 weeks	?	CSD [†] AWS CMAI [†]

												sheet music	rhythmical synchronizatio					
Schall et al 2015 Germany NA	CS n=9	AD or VaD (advanced stages)	Community Setting - Patient's Home	Individual	Music Therapist	Directiv e	Mixed	Flexible Structure	Yes	Music Therapy Biographical ly relevant music	No details of individualizati on process provided	?	Singing and instrumental improvisation; Music Listening. Taking in consideration situational needs.	23 to 39'	Weekly	6 months	?	NPI OERS
Schroeder et al 2018 USA Fair (15/27)	NRT n= 41 IM: 21 TAU: 20	Dementia of any type	Acute Care Setting (Geriatric behavioral inpatient unit)	Individual	Recreationa I therapist and/or nursing staff	Non- directiv e	Receptive	No formal structure	No	Individualize d Music (IM) - Songs of 1940s- 1970s	Patients asked about music preferences	Cordless headphone s, iPod® shuffle	Music Listening	30′	Daily	During hospital admissi on	Late morning or "as needed" or "as requested"	Agitation [†] Negative Mood [†] Positive Mood [†] Resistance to Care [†] PRN medication One-on-one care
Shibazaki and Marshall 2015 Japan and UK NA	CS n=27 Japan:11 UK:16	Dementia (early to mid- stages)	Long Term Care Setting (Care facilities)	Group (30 to 47 participant s)	Musicians	Directiv e	Mixed	Flexible Structure	?	Live Music Concerts - Japan: songs from the time of the Second World War, classical piano pieces, traditional, community and popular songs/ pieces from the culture UK: Songs from shows, music from popular films, well known traditional songs and popular items for the western classical tradition	No clear reference to individualizati on	?	Similar style of repertoire, including instrumental music for listening and familiar songs/pieces which PwD could join in with and sing	60'	?	22 concerts	2:30 p.m.	Qualitative evidence indicating decreased levels of agitation
Shiltz <i>et al</i> 2018 USA Good (22/27)	NRT n=92 ML: 45 TAU: 47	Dementia	Long Term Care Setting (Nursing home) - Resident's rooms or gathering spaces	Individual	Nursing Staff	Non- directiv e	Receptive	No formal structure	No	Music Listening (ML)	Music faculty educators, Music Majors and Undergraduat e Psychology Majors met with PwD and families to access music preferences	Headphone s, iPod® shuffle	?	30'	3 times a week	5 months	Fixed schedule (not defined) and on demand (first intervention if agitation)	CMAI POMS-B Utilization of prescribed and PRN medication

Sung e <i>t al</i> 2010 Taiwan Fair (15/27)	NRT n=52 PMLI=29 TAU =23	Dementia (moderate to severe stages)	Long Term Care Setting (Nursing Home) - "familiar setting"	Individual	Nursing Staff	?	Receptive	?	?	Preferred Music Listening Intervention (PMLI) Based on the protocol "Individualiz ed Music for Persons with Dementia"- Gerdner 2001 and 2007	Participant's music preferences determined with the assistance of family or caregivers	CD player	Music Listening	30'	2 times a week	6 weeks	Mid- afternoon	RAID [†]
Thomas et al 2017 USA Poor (12/27)	NRT M&M NH:12,90 5 Comparis on NH:12,81 1	AD	Long Term Care Setting (Nursing home)	Individual	?	?	Receptive	No formal structure	?	Music & Memory (M&M)	Caregivers created playlists tailored to each PwD personal history and preferences	iPod®	?	?	?	6 months	?	ABS [†] PHQ-9 Reductions in antipsychotic and anxiolytic medication use [†]

Legend: [†]statistically significant positive results; [‡]statistically significant negative results

ABMI: Agitation Behavior Mapping Instrument ABMI ABS: Aggressive Behavior Scale AD: Alzheimer's Dementia AMMT: Associative Mood and Memory Training ArtsObs: Arts Observational Scale AWS: Algase Wandering Scale B&A: Before and After Study BCT: Benchmark-controlled trial BPSD: Behavioral and Psychiatric Symptoms of Dementia CAPE-BRS: Clifton Assessment Procedures for the Elderly Behavior Rating Scale CMAI: Cohen-Mansfield Agitation Inventory CODEM instrument: standardized tool to assess communication behavior in dementia CS: Case Study CSD: Cornell Scale for Depression CSDD: Cornell Scale for Depression in Dementia DPA: Daily planned activities (i.e. exercises, games) GMA-D: Global Music Approach to Dementia HADS: Hospital Anxiety and Depression Scale IM: Individualized Music MACT: Musical Attention Control Training MDS-ABS: Minimum Data Set-Aggressive Behavior Scale ML: Music Listening MSOT: Musical Sensory Orientation Training MTC: Music Sensory Orientation Training MTC: Music & Memory NA: Not applicable NMT: Neurologic Music Therapy NPI: Neuropsychiatric Inventory NRT: Non-randomized Trial OERS: Observed Emotion Rating Scale PHQ-9: Patient Health Questionnaire POMS- B: Profile of Mood States – Brief Form PMLI: Preferred Music Listening Intervention PRN: 'pro re nata', as needed PRS: Positive Response Schedule for Severe Dementia RAID: Rating Anxiety in Dementia RMBPC: Revised Memory and Behavior Problems Checklist RTCS: Resistiveness to Care Scale SftB: Singing for the Brain TAU: Treatment as Usual VNVIS: Verbal and Nonverbal Interaction Scale

Table 5 - Characteristics of RCT	published in 2010 or after
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Author	Setting	Study Population	Characteristics of MbI	Duration/	Background	Treatment			
Year	- Specific	Sample Size	Materials	Frequency/D ose/	- Method of Mbl	Fidelity Strategies	Comparator	Outcome Measures	Main Findings
Country	Location		Coordinator	Timing	Development				
Ceccato et a/ 2012 Italy Fair (19/27)	Non-Acute Hospital setting (Dementia Support Centers; Outpatient Units) - Room details not specified	PwD (MMSE 12-24; Diagnosis > 15 Y; age > 65 Y; communicative and relational skills; no delirium/psychosis/ac ute medical conditions) n=50 STAM-Dem: 27 SC: 23	Sound Training for Attention and Memory in Dementia (STAM-Dem): Manualized music-based protocol designed to be used in the rehabilitation of cognitive functions in elderly PWD. Progressive series of music sessions and soundtracks that can be used in a sequence of step-by-step exercises aimed at stimulating and checking both attention and memory. Therapists pay special attention to motivational aspect and engagement. Structured protocol with 4 phases: stimulus movement association; reactions to acoustic stimuli; shifting attention; orderly and inverted repetition. Focus on "selective attention"; "sustained attention" and "alternate attention". Group sessions with 4/5 participants.	45' session Bi-weekly During 12 Ws ?	Adaptation of the STAM-Dem protocol - Adaptation process not clearly described	Standardized training mentioned Structured protocol	Standard Care (SC)	Cognition (MMSE; MPI; MPD; SPAN forward; SPAN reverse; Attentional matrices) BPSD (CMAI) Mood (GDS) Functionality (ADL) Musical Experience (GMP; SVAM)	Statistically significant difference favoring intervention group in MPI, MPD, Attentional Matrices, ADL, SVAM, and GMP scores
Cho <i>et al</i> 2018 United States Fair (16/27)	Long Term Setting (Veterans' Home skilled nursing facility) - Room details not specified	PwD (65 to 100 Y; no receptive/ expressive language problems; no severe psychiatric conditions) n=52 MTSG: 18 MLG: 17 TV Group: 17	Music Therapy Singing Group (MTSG): Sequence of songs determined by the MT to experience a combination of stimulation and relaxation; 8 lists of songs created using iTunes® (participants' preferences accessed with non-validated open-end questionnaire). MT pauses or repeats parts of the songs as needed to validate and develop the participants' musical strengths. Each session with different sets of songs, except the greeting and good-bye songs. Group sessions with 8/9 participants (2 sub-groups for each intervention group) Yamaha keyboard / CD Player MUSIC Listening Group (MLG): Listening to the identical songs in the same order that were used for the singing group. Group sessions with 8/9 participants (2 sub-groups for each intervention group) CD player Activity staff	40' sessions Bi-Weekly During 4 Ws Fixed schedule (morning or afternoon)	Person-Centered Care model - No details on intervention development	Weak	TV group (Comedy Program)	Affect scores (PANAS) Quality of life (QoL-AD)	MTSG significantly increased positive affect and decreased negative affect MTSG significantly improved quality of life
Clément et al 2012 France Poor (13/27)	Long Term Setting (Residential Home) - Room details not specified	PwD (MMSE ≤ 11; treated with Acetylcholinesterase inhibitors) n=11 Music: 5 Cooking: 6	Music Group: PwD seated in a circle around a table on which various musical instruments (mainly percussion) were placed. Music was played on a CD player and the volume was adjusted so that all participants could hear it. The excerpts were selected from a predefined list of songs covering various styles of music (classical, traditional, commercial music) completed by songs which were proposed by the patients themselves. PwD stimulated to use the hand percussions to accompany the musical track by tapping, rubbing, or shaking the instruments. Bracelets with bells attached were also given to patients with severe praxic dysfunction. Between the songs, patients were encouraged to express their feelings about the musical listening and to try to verbalize memories evoked by music. Focus on alternating between active and productive phases. Group sessions with 5 participants. CD player Psychologist Percussion instruments; Bells (musical experience)	120' session Bi-Weekly During 4 Ws – ?	No details	Intervention monitoring (supervision by 2 psychologists)	Cooking Group	Emotional state (Facial expressions and discourse content; STAI- A)	Short-term benefits of both interventions on emotional state but long-term benefits only evident after the music intervention
Cooke et al 2010 (a) and (b) Australia Fair (19/27)	Long Term Setting (Aged Care Facilities) - Room details not specified	PwD (agitation/aggression on nursing/medical records within 2 Mo) n=47 Crossover design	Music Group: Each music group session involves 30' of musician-led familiar song singing (with guitar accompaniment) and 10 minutes of pre-recorded instrumental music for active listening. Residents encouraged to participate actively through singing, playing instruments and, where appropriate, movement. The repertoire selection for the music sessions is based on: participants' musical preferences; musicians' repertoire knowledge; and the findings from the practice session. Set repertoire established for three sessions and repeated for the eight weeks. Group sessions with up to 16 participants. Guitar	40' session 3x/week During 8 Ws Fixed schedule (Monday, Wednesday and Friday Mornings)	Development of a standardized manual mentioned but not described	Standardized training mentioned Intervention monitoring (Practice session; 4 Random Spot Checks)	Reading Group	Quality of life (DQOL) Mood (GDS) Cognition (MMSE) BPSD (CMAI-C)	Music and reading activities can improve self- esteem, belonging and depression

(RAID) Group Music Therapy (GMT): Music therapist collects data on participants' music preferences, prior musical experience, Standard and interest in participating. Intervention includes gross and fine motor movements performed to music, rhythm plaving training Reduced along with music, listening to popular music, rhythm playing with instrumental accompaniment, and singing with mentioned 30' sessions instrumental accompaniment. Techniques used: song choice, music-prompted reminiscence, singing, music listening, and depression PwD instrument playing. Number of participants per group not specified. Structured immediately after Long Term (age > 65 Y: no Bi-Weekly Modified version protocol GMT and significant hearing Setting Chu et al of the protocol (12 sessions throughout the 6 Durina 6 Ws (Nursina impairment: no Depression developed by with a specific Ws Homes) receptive language (CSDD) 2014 Clair and theme) problems; ability to Fixed Standard Berstein 1990 Cortisol level did Recreation participate in a 30' schedule Care (SC) Salivarv China Intervention not significantly rooms intervention) Triangles, clappers, maracas, hand bells, and МТ (lunchtime; cortisol Adaptation monitorina change (temperature tambourines: color sound bells. (highly trained in music-therapy and dementia care; 9 Y alwavs at the Fair process not (1 research regulated to n=104 experience) same time Cognition (18/27)described assistant and Cognitive function 25-26°C) GMT: 52 and in same (MMSE) improved slightly in 2 senior MT) SC: 52 days of the sessions 6 and 12 week) Side effects and 1 Mo after monitored (Psychiatrists) Cognition (MMSE: ACE-Dimitriou PwD (AD; VaD; 30-50' R) Music Therapy: listening to preferred music chosen by caregivers. Community The most effective et al FTLD: PDD: Mixed sessions Settina Exercise: intervention was Dementia; AIDS Depression 2018 (Patients' Massage/Aro Music Therapy: Dementia) 2-3 days (GDS) homes) No details Weak matherapy significant or MCI (M&A) reductions of NPI-c Greece During 1 W Functional Room details scores n=60 Ability ? 2 not specified Poor Crossover design ? (FRSSD) (13/27) BPSD (NPI-c) PwD Active Music Therapy (AMT): Non-verbal approach with free sound-music interactions, using rhythmical and melodic (MMSE > 15: no instruments. Patients invited to choose an instrument and play it freely and to appreciate the sounds produced by each Mood and social Non-Acute Giovagnoli Coanitive aphasia: no unilateral movement, associating the movements and the sounds and sharing the movement/sound associations with others. Group relationships Hospital 45' sessions assessment et al spatial neglect; no sessions with 3 participants. improved in the 3 setting battery stroke: no Epilepsy: Cognitive groups, with greater 2017 (General **Bi-Weekly** no TBI: no Maior Training (CT); changes after AMT Hospital No details Weak Psychological Psychiatric disorder) Neuroeducati or NE Italy outpatient During 12 Ws assessment Xvlophones, glockenspiels, triangles, windchimes, MT on (NE) unit) (BDI; STAI Yn=50 maracas, small woods, guiros, and ethnic percussions. (dementia care experience) Positive cognitive Fair ? 1. STAI Y-2: CT: 17 effects only after (19/27) Room details LSNS) AMT: 17 СТ not specified NE: 16 Ho et al Group Music Intervention (GMI): Breathing and relaxation exercise; hello song involving greeting and engaging each 30' sessions Significant member individually; participants freely engaging and moving/dancing; social interaction stimulated; pauses between songs Lona Term PwD Standard reduction in BPSD 2019 to share thoughts; 4 familiar Cantonese songs from the 1950's to 1970's and an extract of a Chinese opera song consisted Bi-Weekly Setting (Moderate Dementia) training BPSD for MT group of the main part of the intervention; final breathing exercise and a closing song at the end. Two song lists used alternately. (Residential Standard (NPI) The 2 pieces of relaxation music, hello and goodbye songs kept consistent. Group sessions with 8 participants. China During 8 Ws No details Homes) n=73 Regular Care (SC) No significant GMI: 40 supervision Mood (VAMS) effects on irritability Fixed Poor SC: 33 Activity Room Percussion instruments Music therapy master student & a social worker contacts and subjective schedule (12/27) mood (3 to 5 p.m.) PwD Hsu et al Long Term Music Group (MG): 1:1 active music therapy. Therapists utilize their musical, vocal, bodily and facial expressions. These 30' session Intervention Potential sustained BPSD (age ≥ 40 Y; ≥ 2 Standard Setting made up the auditory and visual inputs provided to the residents within sessions. based on the live benefits on Weak (NPI) 2015 Weeklv Care (SC) (Care Homes) neuropsychiatric - Auditory Cues: well-known songs; improvisation; reminiscence. interactive music residents' wellbeing

symptoms of

- Visual Cues: Facial and bodily expressions providing non-verbal contextual cues.

and symptoms over

therapy methods

Anxiety

United Kingdom Fair (16/27)	Quiet room within the care home unit	dementia; no significant health problems) n=17 MG: 9 SC: 8	MT ? (at least 2 years' experience in dementia care)	During 5 Mo	akin to the work of Odell-Miller 1995 and Ridder <i>et al</i> 2013 - Adaptation process not described			Well-being and quality of care (DCM) Physiological data (HR, skin conductance) Staff percention	the 5 Mo period of intervention and 2 Mo post- intervention Practicable and acceptable intervention for care home residents and staff
Janata et al 2012 USA Poor (10/27)	Long Term Setting (Assisted Living facility) - Resident's room	PwD (moderate to severe dementia; no significant hearing impairment) n=38 IMP: 19 SC: 19	Individualized Music Program (IMP): Brief 30' interviews with a MT to access music preferences and listening history. Further considerations in program design: participant's age, activities of daily living, and where they grew up, among other variables. Music streamed through a wireless system from playlists maintained on a centralized server. Music selections for any given day's programming drawn from a large pool of selections deemed appropriate for that individual and therefore did not repeat exactly from day to day. Programs designed to be appropriate for the time of day (arousing in the morning and calming in the evening) by considering factors such as tempo, instrumentation, and presence of vocals. Music Players MT?	Sessions 1 st : 21-25' 2 nd : 50-65' 3 rd : 50-65' 4 th : 21-25' 4x/day During 12 Ws Prescribed times adjusted to match PwD daily rhythm	Goals of the intervention: (1) decrease in wandering; (2) increase in long- term memory through reminiscence (3) maintaining cognition. - No other background theory details	Intervention partially protocolized	Standard Care (SC)	BPSD (NPI; CMAI) Depression (CSDD) Cognition (MMSE) Assessment of sundowning	Sustained reductions in composite scores of CMAI, NPI and CSDD in both groups
Kwak et a/ 2018 USA Poor (13/27)	Long Term Setting (Nursing Homes) - Room details not specified	PwD (long term residents) n= 59 Crossover design	"Music and Memory Intervention" (M&M): Individualized music listening program developed by Music & Memory, Inc. iPod® Nursing home staff	Duration? Frequency? During 14 Ws ?	No details	Standard training Protocol reported elsewhere	Standard Care (SC)	BPSD (CMAI)	No statistically significant differences found
Lin <i>et al</i> 2010 Taiwan Fair (17/27)	Long Term Setting (Nursing Homes) - Quiet room within care home unit	PwD (age ≥ 65 Y; Mandarin or Taiwanese speaker) n=100 MG: 49 SC: 51	Music Group (MG): Previous evaluation of subjects' fondness for music, the frequency and type of music-related activities in which the subjects were involved, and preference in music genres before the onset of dementia. Main topics for each therapy session: (1) rhythmical music and slow-tempo instrumental activities-I, (2) rhythmical music and slow-tempo instrumental activities-II, (3) therapeutic singing-I, (4) therapeutic singing-II, (5) listening to specially selected music-II, (7) glockenspiel-I, (8) glockenspiel-II, (9) musical activities and traditional holidays-I, (10) musical activities and traditional holidays-I, (10) musical activities and traditional holidays-I, (11) music creator-I, and (12) music creator-II. Number of participants per group not specified. ? Researcher with music therapy courses but not a registered MT	30' session Bi-weekly During 6 Ws ?	Modified version of the protocol developed by Clair and Berstein 1990 - Adaptation process not described	Researcher attended music therapy courses Protocol mentioned not detailed Intervention monitoring (2 senior MT)	Standard Care (SC)	BPSD (CMAI)	Group music intervention decreased agitated behavior
Lyu <i>et al</i> 2018 China Fair (19/27)	Non-acute hospital setting (Geriatric Hospital) - Room details not specified	PwD (AD at any stage) n=298 SC: 99 GMT: 100 LyG: 99	Group Music Therapy (GMT): Singing familiar and favorite songs from the participants' twenties and thirties. Participants encouraged to sing but allowed to only listen to music. Songs specially picked up by musicians, most being classic and soothing. Group sessions with 5 to 6 participants. Lyric Singing Group (LyG): Reading lyrics without the melody of their familiar and favorite songs from their twenties and thirties. No materials/instruments described MT	30-40' sessions 2x daily During 3 Mo Fixed schedule (morning and afternoon)	No details	Standard training	Standard Care (SC) Lyric reading group (LyG)	Cognition (MMSE; WHO-UCLA; AVLT) BPSD (NPI)	GMT more effective for improving verbal fluency and alleviating the psychiatric symptoms and caregiver distress

Maseda et a/ 2018 Spain Fair (16/27)	Long Term Setting (Day Care and Nursing Home) - Quiet room	PwD (Severe or very severe cognitive decline) n= 21 IMG: 11 MSSE: 10	Individualized Music Group (IMG): each session p at an appropriate level for each participant. Activi considering the preferences and interests of the partic through, and winding the session down. Computer	resented "free field" on a computer; volume or loudness of music set ty coordinator followed a directive approach, selecting the music ipants. Internal structure involved an introduction, carrying the session Professionals in the field of psychology or occupational therapy	30' sessions Bi-Weekly During 12 weeks ?	Evidence-Based Guideline (Individualized Music for Persons with Dementia, 5th Edition - Gerdner 2013) - No details on intervention development	Standard training Protocol mentioned but not detailed	Multisensory Stimulation Environment (MSSE)	Mood and Behavior (Interact Short Scale) Heart Rate and Oxygen Saturation (SpO2)	Immediate positive effects on mood and behavior and improved physiological rates in both groups
Narme et al 2014 France Fair (18/27)	Long Term Setting (Nursing Hone) - Room details not specified	PwD (AD or Mixed Dementia; MMSE ≤ 20; French native speakers; no high musical expertise) n=37 MG: 18 CG: 19	Music Group: Excerpts played covering different style 80s), including major and minor keys, calming, with sl arousing with a higher tempo at the middle of the ses by using percussion instruments to accompany the m session. During the intervention, receptive (listening t hand-drums with music) were alternated and part autobiographical memories evoked by the activity. Gr CD player Percussion instruments	es of music (e.g., classical instrumental; familiar songs from the 1950– low or moderate tempo at the beginning and the end of the session or ssion. Participants asked to listen and to participate by singing and/or usical track. Same playlist was used in the same order for each music to music) and productive phases (e.g., to clap one's hands or playing icipants were encouraged to express their feelings and to recall oup sessions with up to 8 participants. 2 Supervisors without music therapy education (1 psychologist)	60' session Bi-weekly During 4 Ws ?	No details	Weak	Cooking Group	Emotional state (Facial expressions and discourse; STAI-A) Cognition (SIB) BPSD (NPI; CMAI) Caregivers' distress	Both interventions: positive changes in emotional state, severity of behavioral disorders and caregiver distress No benefits on cognitive status
Narme et al 2012 France Fair (11/27)	Long Term Setting (Nursing Home) - Room details not specified	PwD (Moderate to severe dementia; French native speakers; no high musical expertise) n=22 Music Atelier: 12 Painting: 10 n=11 Music Atelier: 5 Cooking: 6	Music Atelier: Music chosen by the animators, regard styles, such as classical music ("Spring" by Vivaldi), p Adamo), including both instrumental samples and so workshop, "Con te partiro" by Andrea Bocelli or "Le Dalida, "La Cucaracha" by Gipsy King). Each worksl although a piece could be presented twice if the patie and improvise. Number of participants per group not a Pre-recorded music Percussion instruments Maracas Bell bracelets	dless of patients' preferences, and played on a loud speaker. Different bieces from the 1950s to the present day (i.e. "You allow Monsieur" by ongs with lyrics. Some were calming (i.e. for the start and end of the manège" by Stanislas) and others more dynamic (i.e. " <i>Bambino</i> " by hop was made up of the same extracts presented in a similar order, ents so wished. Participants encouraged to use the instruments, sing specified. 2 psychologists	120' session Bi-weekly During 3 Ws ?	No details	Weak	Painting Cooking	Emotional state (Facial expressions and discourse content; STAI- A) Cognition (SIB) Functionality (PSMS) BPSD (BEHAVE-AD)	Facial expression, discourse content and mood improved; Significant Positive effects up to 4 Ws after intervention <i>Music Atelier</i> more effective and with longer effects than painting/cooking
Perez-Ros et al 2019 Spain Fair (18/27)	Long Term Setting (Nursing Home) 	PwD (age ≥ 65 Y; annual permanent residence in nursing home) n=119 PMLG: 47 OT: 72	Preferred music listening Group (PMLG): Patients them throughout their lives. A list of free-access son and residents chose songs from the list in order of pr the following criteria: a minimum of two songs selecte for each session. Two lists of 60 minutes each we intervention was used: played to all residents at once Number of participants per group not specified. MP3 player and loudspeakers	¹ relatives asked about the type of music and songs that had pleased gs was elaborated and made available to the staff. Family members eference. A playlist of the preferred music was compiled according to ad by each older person; playlist length could not exceed 60 minutes ere created, with alternation of these lists. An active music-based e in the same room, allowing them to interact, sing, dance, clap, etc. Nurses & physiotherapists?	60' sessions 5 days/week During 8 Ws Fixed schedule (morning)	No details	Weak	Occupational Therapy (OT) without music	Functionality (BI; Tinetti Scale) Cognition (MMSE) Mood (Yesavage GDS; CSDD)	Improvements in functional and emotional condition in PMLG
Pongan et al 2017 France Fair (15/27)	Non-Acute Hospital setting (Memory Clinics in University Hospitals)	PwD (age ≥ 60 Y; minor cognitive disorder or mild/major cognitive disorder) n=59 SG: 31 PG: 28	Singing Group (SG): PwD asked to fulfil a question choir conductor selected the songs according to the personalized welcome, PwD performed a body and chosen were practiced across the different sessions. choir conductor. Number of participants per group no Piano	naire collecting their musical preferences among several songs. The patients' preferences. Structure of an intervention session: after a voice warm-up before song learning. Four different songs previously Songs worked by the PwD with piano accompaniment made by the t specified. Professional choir conductor & a Psychologist	120' sessions Weekly During 12 Ws No fixed schedule	No details	Weak	Painting group (PG)	Pain (NRS; PSVS; BPI) Anxiety (STAI) Mood (GDS) Quality of Life (EuroQol-5D)	SG and PG: reduced pain and improved mood, quality of life and cognition

	Poom dotails								
	not specified							Cognition	
								(neuropsychol	
								ogical battery)	
Raglio et		PwD	Group Music Therapy (GMT): Utilization of a non-verbal model based on sound-music improvisation. The relationship has great importance and it is considered the core of the intervention. The MT intervention aims at favoring the moments	30' session					
a		(AD; VaD or Mixed	of attunement that help organize and regulate the patients' behaviors and emotions. Patients and MT can interact and		Based on inter-			BPSD	GMT more effective
2010 (a)	Long Term	Dementia; MMSE ≤	express their feelings and emotions through non-verbal behaviors and using musical instruments.	Tri-weekly	subjective	Intervention		(NPI)	than SC in reducing
	(Nursing	18; presence of	The sharing of emotional states and the processes of attunement and mutual calibration, envisages a process of change,	3 Cycles of 12	psychology	monitorina		Cognition	DF 3D
Italy	Homes)	behavioral	raising self-awareness and introducing new ways of expression and communication. Group sessions with 3 participants.	sessions,	theory	(monitoring by	Standard	(MMSE)	Delusions, agitation
Poor	-	uistui barices)		followed by 1	Adaptation	independent	Cale (SC)		and apathy
(13/27)	Room details	n=60	Musical instrumente Therapists	Mo washout	process not	MT)		Functioning	significantly
	not opcomed	GMT: 30	(MT training/experience not mentioned)	pened	described			Index)	experimental group
		SC: 30		?				,	
			Music Therany: Individualized sessions. Active intersubjective approach, based on sonorous-musical improvisation						Non-significant
Raglio et			implying non-verbal aspects in the PwD/MT relationship. PwD and MT play rhythmic melodic instruments co-building non-					BPSD	reduction in NPI
al			verbal communication through the free sound music improvisation.	30' session	Sound and	Standard		(NPI)	scores in MT group
2010 (b)	Long Term	PwD		Bi-weekly	instruments as	Training		Cognition	No changes in
_0.0 (0)	Setting	(AD; VaD or Mixed		Di nooniy	effective	Droto col not		(MMSE;	cognition and
Italy	(Nursing Homes)	Dementia)		During 15 Ws	channels	detailed	Standard	ADAS-cog)	functionality
Fair	-	n=20	Musical Instruments	Total of	-		Care (SC)	Functionality	
(16/27)	Room details	MT: 10	(percussions, glocken-spiels, xylophones, etc.)	30 sessions	No other details	Intervention		(ADL: IADL)	both groups
()	not specified	SC: 10			on intervention	Monitoring not		· · · /	5 - 1
				?	development	reported		HR	Non-significant
								HR variation	Increase in HRV in MT group
		PwD	Individual Music Therapy (IMT): MT followed the PWDs' rhythm and music production (also introducing variations) to						ini gioup
Raglio et	Long Term	(age ≥ 65 Y;	create nonverbal communication. MT built a relationship with the PWD by singing and using melodic and rhythmic	20-30'		Standard			
aı	(Nursing	residents for more	instruments (improvisation), facilitating the expression and modulation of the PWD's emotions and promoting "affect	sessions		training		BPSD (NPI)	
2015	Homes and	than 2 Mo; moderate to sovere	allunement moments.	Biwookly		Intervention		()	The addition of MT
	Geriatric	dementia and BPSD)	Individual listening to music session (LtM): PWD listened to music from a preferred playlist without any interaction with	DI-WEEKIY	No details	monitorina	Standard	Mood (CSDD)	or LtM to standard
Italy	Departments)		a MT or formal caregiver. PWDs did not wear earphones and remained in their rooms or in a quiet, private place during the	During10 Ws		(4	Care (SC)	Quality of life	care did not have a
Fair	Quiet,	n=120	session. MT had created the playlists on the basis of interviews with the PWD and formal or informal caregivers.			independent		(CBS-QoL)	significant enect
(17/27)	medium-sized	IWI1:40	Musical Instruments MT	schedule		IMT sessions)			
	room	SC: 40		conocalo					
Ridder of			Individual Music Therapy: The overall aim of the music therapy is to facilitate initiative, engagement, self-expression and			Standard			
al		PwD	mutual understanding and hereby fulfil psychosocial needs through positive person work and by enhancing personhood.	No fixed		training		10000	
	Long Term Setting	(Moderate to severe	Person-centered and relational approach integrated with various therapeutic techniques. Five types of activity: vocal or instrumental improvising (either 'free' improvisation or based on songs/melodies), singing (to well-known songs, unknown	duration	Person-Centered	mentioned		ABPSD (CMAI)	Music Therapy
2013	(Nursing	dementia; referral to	songs or pre-recorded music), dancing/moving (to live or pre-recorded music), listening (to live or pre-recorded music), and	33.80')	Care model	Intervention		(OMAI)	reduced agitation
Denmark	Homes)	symptoms of	other activities (talking, going for a walk, etc.).		- Protocol	partially	Standard	Quality of life	and disruptiveness
Norway	- Participanta'	agitation)		Bi-weekly	designed in	protocolized	Care (SC)	(ADRQL)	and prevented
	own living			During 6 Ws	collaboration	MT filling self-		Use of	increases
Fair (18/27)	room	n=42 Crossover design	? MT (Dementia Care experience)		with clinicians	evaluation		medication	
(10/21)		Crossover design		?		form after			
Sakamoto		D/mD	Passive Music Group (PMG): a caregiver and music provider cheaple participants from a distance: participants listaning	30' session		each session		Autonomic	
et al	Long Term	(AD; CDR level 3; no	to selected music via a CD player. Number of participants per session not specified.	00 36331011		o	Active Control	Nerve Index	PMG and IMG
	Setting	hearing disorders; no		Weekly	No details	Standard	condition (interaction		caused short-term
2013	(Group	experience of playing	Interactive Music Group (Int.MG): conducted individually by a music facilitator who directly interacts with each participant;	During (2.11)		mentioned	with a career	Faces Scale	dominance
Janan	Homes	musical instruments; no history of heart	PWD listen to the selected music via a CD player but also participate in interactive activities (e.g., clapping, singing, and dancing) quided by the music facilitator. Number of participants per session not specified	During 10 Ws			without music)	BPSD	
								05	

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Good (21/27)	and Special Dementia Hospital) - "familiar rooms"	disease, hypertension, or diabetes; age ≥ 65 Y;) n=39 PMG: 13 Int.MG: 13	To select the music, participants' behavior is analyzed to determine the period of their life that was recalled most frequently. After closely interviewing each participant and their family, individualized music that was related to special memories for each participant is selected. Specifically, music that was likely to evoke positive emotions such as pleasure or joy is chosen. Music facilitator CD player (including 2 MT, 4 OT and 6 nurses with experience in	Fixed schedule (from 10-11 a.m.)				(BEHAVE-AD)	IMG caused the greatest improvement in emotional state Greater long-term reduction in BPSD
Sanchez et a/ 2016 Spain Fair (19/27)	Long Term Setting (Specialized Dementia Center) - Quiet Room	Control: 13 PwD (severe or very severe dementia) n=22 IMS: 11 MSSE: 11	Severe dementia symptoms) Individual music sessions (IMS): Group intervention, presented in a "free field" on a computer, with volume of the music set at an appropriate level for each participant. MT following a directive approach, selecting the music for each session and considering the preferences and interests of the participants. The internal structure involved an introduction to the session, holding the session, and winding the session down. Family members were asked about their relatives' music preferences using the "Assessment of Personal Music Preference (APMPQ) (family version)". Computer Psychologist or OT	30' sessions Bi-weekly During 16 Ws No fixed schedule	No details	Standard training	Multisensory Stimulation Environment (MSSE)	BPSD (CMAI) Anxiety (RAID) Mood (CSDD) Functionality (BANS-S) Cognition (SMMSE)	following IMG MSSE group significantly improved RAID and BANS-S scores compared with IMS group Agitation (CMAI) improved in both groups
Sarkamo et al 2013 and 2015 Finland Fair (15/27)	Long Term Setting (Day Activity Centers and Inpatient Centers) - Room details not specified	PWD/Carer (CDR score 0.5–2; no prior severe psychiatric illness or substance abuse; no changes in psychotropic medication during the last 3 Mo; speak Finnish; physically and cognitively able to take part in the study) n=89 dyads (30 nurses; 59 family members) SG: 30 MLG: 29 SC: 30	Group-based music coaching program: Sessions aiming to encourage, motivate, and guide the caregivers to use either singing or music listening regularly with the PWD to enhance mood, increase reciprocal communication, and support the cognitive abilities of the PWD. In both SG and MLG, the music (6–10 songs/ session) consist primarily of traditional folk songs and popular songs from the 1920s to 1960s. Songs selected based on the individual musical preferences of the PWDs (highly familiar and autobiographically and emotionally important to them). Each session has a specific theme, focusing, for example, on music from certain era of life (e.g., childhood or adolescence) or on how to utilize music in everyday life for different purposes (e.g., for relaxation, reminiscence, or vitalization). After sessions 4–9, participants given weekly "musical homework assignments", involving either singing (SG) or listening to music (MLG), with the aim of rooting the music activity to the everyday home setting. Singing Group (SG): singing songs in a group accompanied by the music teacher on the piano, guitar, or kantele (Finnish zither), as well as occasionally performing physically activating vocal exercises and rhythmical movements during the singing (e.g., clapping, playing maracas). Group sessions with 10 participants (5 dyads). Music teacher (SG); MT (MLG)	90' session Weekly During 10 Ws ?	SG: Finnish KeyToSong method MGL: methods akin to the work of Ridder 2005	Protocol: Themes, sub- themes and activities of Music Coaching Sessions detailed	Standard Care (SC)	Cognition (Neuropsychol ogical testing battery) Mood (CBS) Quality of Life (QQL-AD) Caregiver well-being and burden (ZBI)	Both interventions improved mood, orientation, remote episodic memory, attention, executive function and general cognition SG enhanced short-term and working memory, contributed to maintaining executive function and orientation and to caregiver well- being MLG was beneficial in, working
Sung <i>et al</i> 2011 Taiwan Fair (18/27)	Long Term Setting (Residential care Facility) - Room details not specified	PwD (≥ 65 Y; Taiwanese or Chinese speaker; no severe hearing impairment; presence of BPSD; no acute pain or infection) n=60 MTG: 30 SC: 30	Music Therapy Group (MTG): Participants' music preferences assessed by asking the participants, caregivers, families or nursing staff prior to the intervention, so that the music selection reflects the majority of the participants' preferred or familiar music (Taiwanese and Chinese songs from the 1950–1970s with pleasant moderate rhythm and tempo). Participants asked to follow the instruction of the research assistants to move their extremities and play various kinds of percussion instruments with the familiar music. Structure: 5-min warm-up session of static stretch of major muscle groups and breathing; 20-min session of active participation (use of percussion instruments); 5-min cool-down session of stretching with soft music. Number of participants per session not specified. Percussion instruments (such as hand bell, tambourine, maracas, guiro tone block, flapper and loop bell)	30' session Bi-weekly During 6 Ws Fixed Schedule (mid- afternoon)	No details	Weak	Standard Care (SC)	Anxiety (RAID) BPSD (CMAI)	Significantly lower anxiety scores in MTG No significant differences in agitation between groups

Tang <i>et al</i> 2018 China Fair (17/27)	Long Term Setting (Nursing Home) - Room details not specified	PwD n=77 Intervention: 38 SC: 39	Three music interventions provided each session with a step-by-step approach, in groups of up to 9 PwD: 1 - Sensory stimulation with music: After listening to music or songs, participants asked to distinguish the sounds of various musical instruments (e.g., drum, gong, mouth organ, flute), different sounds from the natural world (e.g., wind, rain, thunder), and different sounds of animals (e.g., birds, goats, horses, chooks), aiming to help PwD re-establish a connection with the natural environment. 2 - Singing nostalgic songs: Three groups of nostalgic song selected according to cultural aspects. At the beginning PwD are asked to listen to music. During the listening phase of the process, therapist pays attention to reactions/resonance and then asks PwD to sing together. During this part of the intervention, participants who are unfamiliar with the song or cannot sing at all are given additional support, involving explanation of the lyrics and repeated practice. Therapist encourages PwD to clap their hands following the rhythm of music so that they engage more. 3 - Playing musical instruments: Using an 8 scales xylophone, PwD are taught to play simple songs. The bars of the instrument are numbered (1 to 8) and the participants play them according to the therapist instructions such as 1-2-3 or 1- 2-3-1. 1 - Various musical instruments (e.g., drum, gong, mouth organ, flute) 2 - No materials described 3 - Xylophone	50' sessions 3x/week During 12 Ws ?	Background theory briefly described	Protocol lacking details Intervention monitoring (research assistant)	Standard Care (SC)	Apathy (AES) Cognition (MMSE, HCS)	Decreased apathy scores only in the intervention group MMSE scores declined in the control group but not in the intervention group
			CD player MT						
Thornley <i>et al</i> 2016 Canada Fair (17/27)	Acute Hospital Setting (Psychiatry Unit of Academic Hospital) - Room details not specified	PwD (age > to 50 Y; MMSE < 13; CDR ≥ 2; distressing behaviors; CMAI≥ 4) n=16 AMT: 10 AEI: 6	Active Music Therapy: Individual sessions; PwD provided with specific instructions on how to participate by singing and/or playing simple instruments. Music selected in accordance with participant preferences and of a calming nature. Simple instruments (maracas & small drums) MT	60' sessions Bi-weekly During 4Ws ?	No details	Weak	Active Engagement Intervention (AEI)	BPSD (NPI, CMAI)	Non-significant decrease in the CMAI scores in both the MT and AEI groups
Vink <i>et al</i> 2012 Netherland S Fair (19/27)	Long Term Setting (Nursing Homes) - Separate room in the residential ward	PwD (CMAI > 44) n=94 GMT: 47 GRA: 47	Group Music Therapy (GMT): Sessions started with a welcome song after which residents listened to music selected, sung or played by the therapist (Dutch familiar songs, classical and folk music) and, if possible, actively participated in music activities by singing, dancing or playing a music instrument. The therapist adjusted the level of each intervention to each individual's capacities. The music was selected by the therapist to incite pleasant memories and to reduce agitation based on musical parameters, such as a slow tempo and little instrumentation. Group sessions with up to 5 participants. Music instruments? MT Music player? (minimum 5 Y working experience)	40' session Bi-weekly - During 4 Mo ?	Protocol based on a previous survey study with 33 MT working with PwD - Adaptation process not described	Intervention partially protocolized	General recreational activities (GRA)	BPSD (CMAI)	Short-term decrease in agitation in both groups; no additional beneficial effect of GMT over GRA
Wang <i>et al</i> 2018 China Fair (16/27)	Non-Acute Hospital setting? (University Hospital) - Indoor treatment site with soft lighting and little noise or interference	PwD (Mild AD) n=60 MT: 30 SC: 30	Music therapy (MT): Songs selected by the first author of the article according to patients' pathogenic condition, education level, and personal preferences. Typically, older songs familiar to the elderly were chosen. The sound volume was controlled at 40 decibels, and the patients sang along with the therapist. An indoor treatment site with soft lighting and little noise or interference was chosen. Group sessions with 3 participants.	30-50' sessions 3x/day During 3 Mo Flexible schedule (adjusted to patient condition)	No details	Weak	Standard Care (SC)	Cognition: (MMSE, MoCA) BPSD (NPI)	MoCA and MMSE scores improved in both groups, but MT group had a greater magnitude of improvement NPI scores in the experimental group were significantly lower ate the conclusion and 3 Mo. after the intervention
Weise <i>et al</i> 2019 Germany	Long Term Setting (Nursing Home)	PwD (moderate or severe dementia) n=20 ILG: 10	Individualized recorded music listening intervention group (ILG): Before the start of every music listening session, project staff or nursing home staff asked the participants with dementia whether they agree to listen to the individualized recorded music. Project staff or nursing home staff monitored the participants during the music intervention period and intervened when a negative reaction was observed. Songs to which participants repeatedly and specifically showed negative reactions were deleted from the playlist and replaced by other songs. Questionnaires and interviews (family members, nursing staff and participants) used to identify personally-relevant music for each participant. Music compiled up	30' sessions Every other day During 4 Ws	Evidence-Based Guideline ("Individualized Music for Persons with	Standard training mentioned	Wait list Control Group	BPSD (CMAI) Well-being, sleep quality, resistance to	Improvements in sleep quality, social participation, agitation, BPSD, well-being and challenging

Fair (19/27)	Room details not specified	CG: 10	to three individualized playlists for each headphones for 30 minutes every othe playlists was checked during the first needed. MP3 players & headph	n participant. Participants lis er afternoon over four week sessions and playlists were ones	tened to the individualized playlists on MP3 players and s for a total of 14 music sessions. The suitability of the a continuously adapted over the intervention period as Social service staff and project staff	(14 sessions) Fixed schedule (afternoon)	Dementia" by Gerdner 2013) - No details on intervention development	Protocol mentioned but not detailed	care, social participation	behavior in ILG group
Legend: ACE AD: ADA ADL ADR AES AEI: AMT BAN BDI: BBH BBH BBH BBH BBH BBS CBS CBS CDR CGR CGR CGR CGR CGS CBS CDR CGS CBS CDR CGS CBS CDR CGS CBS CBS CBS CBS CBS CBS CBS CBS CBS CB	-R: Addenbrooke's Co Alzheimer's Dementia S-cog: Alzheimer's Disea Activities of Daily Livi (QL: Alzheimer's Disea : Apathy Evolution Sca Active Engagement In : Active Music Therapy S-S: Bedford Alzheime Beck Depression Inve AVE-AD: Clinical Ratin ediable Behavioral Syt arthel Index Brief Pain Inventory D: Behavioral and Psys : Challenging Behavior -QoL: Cornell-Brown S : Chincal Dementia Ra Control group M-C: Cohen Mansfield Ag M-C: Dementia Quality of Qol-5D: instrument me SD: Functional Rating D: Frontotemporal Ioba : Geriatric Depression	gnitive Examination R ease Assessment Sca 19 se-Related Quality of le tervention / r Nursing Severity sca ntory g Scale for the Asses mptomatology in Alzhe chiatric Symptoms of I Scale cale for Quality of Life ting itation Inventory - C spression in Dementia bing f Life Scale assuring health-related Scale for symptoms o r degeneration Scale tion apy Profile	evised ale–Cognitive Subscale Life ale sment of Pharmacologically imer's Disease Dementia ommunity	GMT: Group Music The GRA: General recreati HCS: Holden Commun HR: Heart rate IADL: Instrumental Act LG: Individualized Mu IMP: Individualized Mu IMP: Individualized Mu IMS: Individual music o IMT: Individual musics o IMT: Individual Music LSNS: Lubben Social TI LtM: Interactive Music LSNS: Lubben Social TI LtM: Individual listening LyG: Lyric Singing Gro MCI: Mild Cognitive Im MG: Music Group MLG: Music Listening 1 MMSE: Mini Mental St MocA: Months MoCA: Monthal St Mor Months MoCA: Monthal Prose MPD: Deferred Prose I MSSE: Multisensory SI MT: Music therapist MTSG: Music Therapy M&M: Music and Mem NE: Neuropsychiatri NPI: Neuropsychiatri NRS: Numeric Rating § PANAS: Positive and N	erapy onal activities ication Scale ivities of Daily Living Scale orded music listening intervention group sic Group sic Program sessions "herapy sic Group vetwork Scale g to music sessions up pairment Group ate Examination tive Assessment Memory Test Wemory Test Wemory Test Wemory Test Singing Group ory Intervention Inventory c Inventory (Clinician Rating) Scale legative Affect Schedule	PC PA PA PS PS PS PC QC QC QC QC QC QC QC QC QC QC PS PS SS SS SS SS SS SS SS SS SS SS SS	D: Parkinson's Dise 3: Painting Group MG: Passive Music C MG: Passive Music C MG: Preferred musis MS: Physical Self-M SVS: Pain Simple Vis D: Patients with der bAD: Quality of Life 1D: Rating Anxiety in 2: Standard Care 3: Severe Impairmer MSE: Standardized PAN forward: forward: AN reverse: reverses 2: Systematic Review AI: State Trait Anxie AM-Dem: Sound Trait AM-Music Therapy 4: Traumatic brain in D: Vascular Demeni MS: Visual Analogue HO-UCLA AVLT: WHS swaeks years savage GDS: Yesav 4: Zarit Burden Inter	ase Dementia Group c listening Group laintenance Scale ual Scale nentia a in Alzheimer's Disease Scal n Dementia the Battery l digit-span exercise digit-span exercise v ty Inventory (includes STAI Y ixiety Inventory for Adults aining for Attention and Memore Evaluation Scale jury tia e Mood Scales Scales HO-UCLA Auditory Verbal Lea view	e on 11 and STAI Y2) ory in Dementia arning Test ale	

List of Figures

Figure 1 - PRISMA flowchart (modified)