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Music therapy in geriatrics, volume II

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Music therapy in geriatrics, volume II

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Editorial: Music therapy in geriatrics, volume II

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Editorial on the Research Topic
Music therapy in geriatrics, volume II

The World Health Organization (WHO) has called attention to the escalating evolution of the aging population such that the number of people over 60 years of age will almost double between 2015 and 2050, representing a change of 12%—22% of the global population. WHO has reported that in the year 2020, the number of people in the world over 60 exceeded the number of people under 5. In response, the United Nations Decade of Healthy Aging (2021–2030) has brought with it an international plan of action, in conjunction with the United Nations Agenda 2030 on Sustainable Development and the Sustainable Development Goals (1). This strategy emphasizes a positive approach to community development that nurtures the abilities of older adults, provides services that address their needs, modifies attitudes of ageism, and promotes accessibility to long-term care, while narrowing gaps of health disparities.

In conjunction with this mission, WHO established an Arts and Health Initiative, under the leadership of Christopher Bailey, in recognition of the ability of the arts to promote health, help manage health conditions, and prevent disease (2). The establishment of this initiative is an important step in heightening awareness of the many significant clinical benefits of music and the arts.

In the United States, "Sound Health," a partnership between the National Institutes of Health (NIH), the Kennedy Center for Performing Arts, and the National Endowment for the Arts, has established a richly-funded research agenda, encompassing basic and mechanistic research, translational and clinical research, methods and outcomes, and capacity-building and infrastructure. The Sound Health Network accompanies this research effort with a web of resources to inform the public about the wide-ranging impact of music, and how it can be applied for health and wellness, as well as improvements for those with neurological conditions (3).

There is a growing body of scientific evidence to support music-based interventions that enhance brain health, emotional and social wellbeing, and even, cognitive improvement (4). The Global Council on Brain Health has articulated the benefits and potential of music to "promote brain health and mental wellbeing" in their report on the subject. They also included practical recommendations for music engagement as well as music-based interventions. It is clear that the potential of the arts is being acknowledged around the world and resources are being devoted to aid implementation and dissemination of empirical findings (5).

The number of people living with dementia has been estimated to be over 55 million and growing rapidly worldwide. Without a cure for Alzheimer's disease or related disorders causing dementia, and lacking treatments for the decline in the associated neurological functioning, the enormous burden and costs to individuals, family, community, and society at large will only increase over time (6).

In its effort to foster rigorous research designs that demonstrate efficacy and effectiveness of music-based interventions, NIH developed guidelines for research on music in addressing brain disorders of aging. With the assistance of experts in multiple disciplines, the NIH created a toolkit to guide research agenda and provide healthcare providers with advice regarding how to prescribe music therapy services (7).

Given the burgeoning research and positive findings regarding the impact of music therapy on older adults, the editors of the Research Topic, "Music Therapy in Geriatrics – Volume I," were asked to update and expand the offerings in this new Volume II. This current Research Topic contains articles from Australia, Denmark, Germany, Israel, Korea, Netherlands, Norway, UK, and the states of Minnesota, Alabama, North Carolina, and Arizona in the USA.

Three contributions address specific interventions for older adults living in the community. Park et al. describe a music-based exercise training program designed for older adults who are experiencing mild-to-moderate cognitive decline. In their feasibility study, the investigators examined how rhythmic auditory stimulation and other strategies can motivate older adults to comply with exercise programs, and ultimately benefit from this multicomponent approach to exercise.

Gilboa and Levy demonstrate the impact of creating musical life reviews with community-dwelling older adults. Their case study and thematic analysis demonstrates the many ways that the process improved functional ability of participants, but perhaps most importantly, provided a very meaningful and enjoyable way to honor their life experiences.

Belgrave et al. discuss some very creative programming crafted during the isolation of the pandemic and provided virtually. A collaboration between a music therapy program and a global music museum forged an asynchronous offering to enhance overall wellness and memory care. The program enhanced engagement and sense of wellbeing.

One age-related condition which has perhaps achieved less attention than other disorders is presbyphagia, a disorder of the swallowing mechanism. Kim et al. offer a scoping review of music-based interventions, and report on the impact of activities like breathing as preparation for singing, and the training of singing with emphasis on controlling the larynx and oral-motor connections.

Two articles are investigations of the influence of music on people with dementia.

In their study, Prick et al. report the findings of a randomized controlled trial that assessed the impact of two interventions, namely active individual music therapy and individual music listening, on neuropsychiatric symptoms and quality of life in individuals with dementia residing in nursing homes. Additionally, the study examined the effect of these interventions on the burden experienced by professional caregivers, comparing them to a control group. The authors, drawing from their results, assert that there is no significant superiority of one intervention over the other. Consequently, they recommend the consideration of both interventions in clinical practice.

Wang et al. present a rationale for implementing a protocolized music teletherapy as a psychosocial intervention to mitigate neuropsychiatric symptoms in individuals with dementia. Their aim is also to enhance accessibility to music therapy for this population. The proposal is grounded in an extensive review of the current literature on music therapy and Alzheimer's disease.

Four articles reflect the need to educate both professional and family caregivers of people with dementia. Three of these describe programs for spouses and families.

McMahon et al. present the outcomes of a HOMESIDE sub-study involving six dyads, each comprising an individual with dementia and a family caregiver. These dyads participated in a 12-week home-based skill-sharing music intervention facilitated by a music therapist. The results, derived from thematic analysis of interviews and participant diaries, underscore the significance of personalized interventions and the therapeutic relationship. The findings reveal the efficacy of personalized music interventions as dyads learned to harness the therapeutic potential of music.

Thompson et al. share the development of the Music Attuned Technology-Care via eHealth (MATCH) mobile application created to train family caregivers on how to support persons with dementia through music engagement. In their content and validation study 10 music therapists with specialties in dementia care and seven family caregivers who had participated in previous training in the HOMESIDE project assessed the app's training modules. The content was seen as beneficial, and with suggestions, the MATCH application will be further adapted and explored in research with family caregivers and persons living with dementia.

Rosenbach et al. share the results of their multiple qualitative case study on a home-based music therapy (HBMT) model that combined weekly joint music therapy sessions and bi-weekly phone counseling sessions with the primary caregivers. Results indicated joint music therapy sessions strengthened the couple's relationships, practicing music together was essential for subsequent use by the personal caregivers, and three other themes point to the importance of the support provided.

Lastly, Ridder et al. detail the process of writing a training manual for music therapists to use when providing guidance to professional caregivers of people with late stage dementia on how to implement person-attuned musical interactions (PAMI). Their manual is the outcome of research that explored how music therapists collaborating with carers can support non-verbal communication in residential care settings.

In conclusion, the studies included in the Research Topic on *Music Therapy in Geriatircs, Vol II* provide further evidence of the efficacy of music therapy and music- based interventions in improving quality of life for those with Alzheimer's disease and related dementias as well as the ease of caring for their care partners. Several studies highlight the impact of training care partners in the use of music-based interventions to enhance interpersonal relationships and reduce social isolation that often occurs in those with neurocognitive deficits. Included too are informative guidelines on implementing music-based interventions. By including evidence based research from international experts,

this volume will expand the knowledge of best practices of music therapy in geriatric care.

Author contributions

SH: Conceptualization, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing. AC-C: Resources, Writing – original draft, Writing – review & editing. MM-B: Resources, Writing – original draft, Writing – review & editing. CT: Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Person-attuned musical interactions (PAMI) in dementia care. Complex intervention research for constructing a training manual

Hanne Mette Ridder[1]*, Julie Kolbe Krøier[1], Jens Anderson-Ingstrup[1] and Orii McDermott[1,2]

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Introduction: Music is of vital importance for cognition, human care, and the formation of social communities throughout life. Dementia is a neurocognitive disorder that affects cognitive domains, and in late-stage dementia, care is needed in all aspects of daily living. Within residential care home contexts, carers play a significant role for the "caring culture" but often lack professional training in verbal and non-verbal communication skills. Thus, there is a need for training carers to respond to the multidimensional needs of persons with dementia. Music therapists use musical interactions but are not trained to train carers. Therefore, our aim was to explore person-attuned musical interactions (PAMI), and additionally, to develop and evaluate a training manual to be used by music therapists when supporting and training carers in non-verbal communication with persons with late-stage dementia in residential care home contexts.

Research process: With a realist perspective and systems thinking and within the framework for complex intervention research, the research group integrated several overlapping subprojects by applying a non-linear and iterative research process. Core elements related to person-centered dementia care as well as learning objectives were considered through the following four phases; Developing, Feasibility, Evaluation, and Implementation.

Results: The result was a training manual for qualified music therapists to use when teaching and collaborating with carers about how to implement PAMI in dementia care. The manual included comprehensive resources, a clear structure for training, defined learning objectives, and integration of theory.

Discussion: With increased knowledge about caring values and non-verbal communication, residential care home cultures may develop carer competencies and provide professional attuned care for persons with dementia. Further piloting and testing to examine the general effect on caring cultures is needed.

KEYWORDS

residential care home, dementia, person-centered care, music therapy, attunement, complex interventions

Introduction

> It is lunch time at the care home, and residents gather at the tables. Anna already sits in her chair. Her hands scrub off imaginary stains, with her movements becoming faster and faster, and the tone of her voice becomes even more shrill. Lis goes to Anna and sits down next to her. She is aware of her own breathing, takes a deep breath, and shortly closes her eyes. Anna's breathing is rapid and shallow. Lis takes another deep breath, then put her hand next to Anna's on the table. Anna touches her hand. Lis turns up her palm, and Anna takes her hand. Then Lis quietly hums Frere Jacque, slowly, with long phrases and with an airy voice. Anna keeps holding her hand, then looks at her. They have eye contact and Lis smiles. Today Anna manages to eat her lunch all on her own, without help—and without shouting. [Composite case example based on (1)].

In this description of working with a person with dementia (Anna), the professional carer (Lis) uses several non-verbal "techniques" and succeeds in making an often chaotic situation safe and calm. Not only for Anna, but also for the other residents. Lis has worked together with a music therapist and seen how the music therapist was able to calm down residents at a late stage of dementia. Lis copies what the music therapist does, but afterwards it is very difficult to tell her colleagues what she did. Mostly they find that Anna disturbs and believe that she should not sit together with the other residents at lunch time.

When Lis interacts with Anna in a slow tempo, inviting gestures and a gentle tone of voice, she uses non-verbal communication. Guidelines for dementia care recommend the use of positive body language and describe non-verbal communication as crucial. For example, the Alzheimer Society (2) explains that "As the disease advances, the person with Alzheimer's may rely on non-verbal communication, such as facial expressions or vocal sounds."

In a scoping review on communication between nurses and older adults, non-verbal communication is described as an integral part of the nurse-patient relationship (3). The review showed that nurses most frequently use space and distance, touch, body movement, and aspects of the voice, when communicating with older adults. The researchers conclude that nurses should be self-aware of their non-verbal communication behaviors and should identify their own style of non-verbal communication and understand how to modify their interactions. In the review, music, singing, or humming were not included as a means of communication, however *vocalics* were described. Vocalics were associated with "elderspeak" including oversimplifying the language, speaking at a slow rate, loud, and with a demeaning tone, or speaking too fast or too loudly or in a too soft tone (3). In elderspeak, similar vocal cues as in infant-directed speech are used; shorter sentences, slower speech, and higher pitch (4). Both elderspeak and infant-directed speech are described by concepts such a pitch, tempo, timbre, tone, and dynamics, and according to a study by Hilton et al. (5), there are acoustic regularities in infant-directed vocalizations across cultures, and they consist of speech and song simultaneously. However, unlike infant-directed speech, elderspeak arises from implicit ageist stereotypes and carries goals of patronizing care (6). Research suggests that elderspeak negatively impacts the person in contrast to the positive impact of infant-directed speech on infants (7). Using familiar, preferred music, as Lis did in the example, can be a way to utilize the beneficial elements of infant-directed speech (such as pitch, tempo, timbre, tone, and dynamics), without adopting a patronizing tone. Below we will explore the links between the science of music and communication styles, in order to explain how using music can support non-verbal communication.

Music and non-verbal communication

There are numerous definitions of what music is. We find the definition by the Dictionary.com (8) relevant: music is "an art of sound in time that expresses ideas and emotions in significant forms through the elements of rhythm, melody, harmony, and color". Music in the form of songs shape a unified whole with many elements of predictability. Rhythm and tempo in a song creates a form or a gestalt in the way stanzas, lines and phrasing are shaped, which in turn affects our breathing. Therefore, in regard to rhythm and structure, music and speech have much in common, also when it comes to tonality. Music and speech are explained as two parallel systems in human development, with a system for language and one for music, and with the same basic mechanisms (9).

The early characteristics of communication in human development is by Mithen explained as holistic, multi-modal, manipulative, and musical. As infant-directed speech is described as a mixture of music and speech, musical terms such as intonation, rhythm and phrasing become useful designations of so-called non-verbal communication. Unique aspects of musical communication and intrinsic musicality are seen across cultures, and intrinsic musicality is therefore considered an innate competence. Such communicative musicality is crucial for the child's further cognitive development (10), and even with advanced Alzheimer's disease, musical memory is surprisingly well preserved (11). In this perspective, music is of vital importance for human care, attachment, and language development, but also for the coordination of movement (e.g., gait function, dance, and physical, repetitive work), the passing on of cultural knowledge, and the formation of social communities. The importance of music for cognitive development applies throughout life, also as a means to prevent dementia (12).

Dementia and the residential care home context

Dementia is a global health challenge, but although dementia is the 7th leading cause of death, dementia research accounts for <1.5% of total health research output (13). While the world is searching for a cure against dementia, the WHO states that research on dementia care has shifted from a focus on cognition and behavior changes to study quality of life, positive living with dementia, community participation and social and emotional communication [(13), p. 40]. Dementia is an umbrella term for various neurocognitive disorders and affects the following

cognitive domains; attention, planning (and working memory), learning (and long-term memory), language, perception, and social cognition (14).

Persons with late-stage dementia need care in all aspects of daily living which is often an impossible task for spouses and relatives, therefore residential care is required. In care homes, qualified nurses provide medical care, and trained staff provide personal care and support. The majority of residents in care homes have dementia, but are undiagnosed (15). Globally, the true prevalence of dementia is underestimated which is likely to lead to inadequate planning for health and care services and has strong implications for public policy (16). When care home staff are educated and trained in person-centered care practices and work in a person-centered care (PCC) environment, job satisfaction improves, and both job-related stress and employee turnover is reduced (17). According to Rajamohan et al. (17), the culture shift toward PCC was first initiated in the United Kingdom and is a promising global innovation and important for staff for improving the quality of care delivered to care home residents. With PCC the person is central, rather than the disease, and carers integrate a number of defined positive interactions (18, 19).

When staff describe what motivates them to meaningfully engage with residents with late-stage dementia, they refer to a caring culture. A caring culture is an environment which promotes relational working and staff well-being, which is carried out with positive attitudes toward dementia and expresses caring values and the ambience of the environment. A caring culture also prioritizes the relationships between residents and staff, teamwork, and input from managers and supervisors (20). Based on semi-structured interviews with 21 staff members from seven nursing homes, Haunch et al. conclude that effective leadership and teamwork is crucial for facilitating staff to understand "their role to connect, understand, accept and empathize with residents, understand the importance of getting to know residents and express their own caring attributes" [(20), p. 11]. Nurses play a significant role for the caring culture, yet a systematic review reveals that nurses lack knowledge about dementia and PCC, verbal and non-verbal communication skills, and strategies to manage residents' coexisting behavioral and mental health problems. Thus, when training care home staff, Evripidou et al. (21) point at the need to include nurses in the training in order to respond to residents' multidimensional needs and be aware of new approaches to care and management.

Effect of music therapy on dementia symptoms

In late-stage dementia, non-verbal communication may be overlooked or underestimated by busy care staff, and to prevent this, Clare and colleagues recommend music interventions as they offer fundamental, emotion-based opportunities for connecting with others (22). The positive effect of music interventions and music therapy in dementia care is documented in a number of meta-reviews and meta-analyses and show reduction in behavioral and emotional dementia symptoms (23), in depression (24, 25), in depression, anxiety and apathy (26), in aggression and agitation (27), and in reduction of anxiety and agitation along with increases in cognition and quality of life (28–30).

In a single case study on music therapeutic caregiving, Hammar et al. (31) explored caregiver singing and found that singing during morning care of persons with dementia may decrease negative expressed emotions and increase positive emotions. In a cross-sectional study with 285 nurses, Sung et al. found that most nursing staff held positive attitudes toward the use of music for people with dementia in long-term care facilities, but only a third had used music in practice and reported that they lacked resources and time to implement music therapy in practice (32). Sung et al. refer to Munro and Mount (33), when they define music therapy as the "controlled use of music and its influence on the human being to aid in physiological, psychological and emotional integration of individual during treatment of an illness or disability" [(32), p. 1777]. In this study, we define music therapy as "the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional [...]" (34). As we do not expect staff to train in music therapy, we suggest that staff are trained in how to carry out *musical interactions* within in a person-centered perspective.

A phenomenological study by Melhuish et al. (35) showed that the relationships between care home staff and residents with dementia were improved when staff took part in music therapy and dance-movement therapy for residents, and Isaac et al. (36) found that person-centered music intervention training workshops led to a decline in behavioral and psychological symptoms of dementia and a reduction in staff stress.

The music therapist Beer developed a 1-h training for caregivers and offered suggestions to guide music therapists in educating other professionals in the care of persons with late-stage dementia (37). In a study by Hsu et al. (38) of individual music therapy for managing neuropsychiatric symptoms in care home residents with dementia, it was additionally explored whether the intervention could serve as an ongoing training of carers. After each music therapy session, carers were presented with two selected video clips. The clips aimed to address how neuropsychiatric symptoms were minimized, and how the music therapist enhanced the residents' expressions, mood, and cognitive and sensorimotor functioning. After the programme, carers reported enhanced caregiving techniques which point at a promising learning outcome from the music therapist-carer communication. Further, Ray and Götell (39) found improved well-being and significant decreases in depression symptoms in nursing home residents with dementia after an intervention that combined music therapy and the training of nursing assistants to lead music activities. Their study showed that music therapy skills can be shared to extend music therapeutical benefits when a music therapist first achieves primary goals and then transfers instruction and facilitation to caregivers.

Aim: manualising a training intervention

The culture shift toward PCC is important for carers[1] for improving the quality of care delivered to care home residents. A caring culture prioritizes the relationships between residents and carers, teamwork, and input from managers and supervisors. Concepts drawn from the science of music may assist carers in understanding their non-verbal communication and communication styles in the care of residents with late-stage dementia. Unique aspects of musical communication and intrinsic musicality are innate competencies and of vital importance for the formation of social communities, attachment and care, and form an underlying theoretical understanding of music therapy. Further, as mentioned above, there is strong evidence for music therapy to reduce behavioral and psychological symptoms of dementia (23, 24, 26, 27).

With this study, we therefore wanted to explore how music therapists in collaboration with carers can support the use of non-verbal communication in dementia care. As non-verbal communication is a broad concept, our focus is on *musical interactions*. Interactions are reciprocal communicative actions by means of non-verbal information, such as body language, gestures, facial expressions, rhythm or sound [(40), p. 346]. In order to emphasize our theoretical understanding of dementia care, these musical interactions are *person-centered* according to PCC. However, we understand interactions as reciprocal, and that they should be attuned to the person with dementia, which we therefore term *person-attuned*.

Music therapists are trained to apply musical interactions, but they are not trained to train carers. To support them in this endeavor, we find it important to integrate aspects of transformative learning (41) in the training of carers, for example by not only relying on teaching theory, but by combining the training with action learning sessions and counseling in groups as well as directly at the workplace. In addition, we emphasize that, although already qualified, the music therapists should be trained to train.

In summing up, our aim is both to explore *person-attuned musical interactions* (PAMI), and further to develop and evaluate a training manual to be used by music therapists when supporting and training carers in non-verbal communication with persons with dementia in a residential care home context. The overall scope of the study is to stimulate a culture shift in caring cultures where carers are supported in a meaningful way to improve non-verbal communication through PAMI.

Research process

Researching complex interventions

In this study we address interactions carried out in daily practice from a specific theoretical perspective (PCC), we explore the meaning of these interactions and their context with the aim to distill knowledge to an overall theoretical perspective for music therapists to use when they collaborate with and share knowledge with carers. By exploring perspectives from the literature, as well as our own perspectives from practice, we intend to systematize knowledge into a concrete training manual and to test if it works and how it works.

According to the UK Health Technology Assessment 2021 (42), interventions are actions taken to make a change. Interventions are complex when we are dealing with several intervention components, when a range of behaviors, expertise and communication skills are required in complex settings, and when the interactions between interventions are dynamic and adaptive (43).

In the framework for the development and evaluation of complex interventions, the research process is divided into four phases: development, feasibility, evaluation, and implementation and includes both the content of the intervention and the context in which it is conducted (42). By including real world residential care home contexts and perspectives from carers and clinicians, we aim to emphasize interventions that are co-developed by carers and to include systems thinking methods (44). With a theory-based perspective, we seek to adopt PCC and music therapy theory and explore these perspectives in the context of residential dementia care, and with a systems perspective to explore how PAMI are interventions already existing in the system as tacit knowledge and caring values but suppressed by structural factors in the care home system. We expect that permitting PAMI as a part of professional care in some cases will disrupt rigid and dehumanized caring systems and lead to positive changes. Although our evaluation perspective regards systems, we set out with a realist perspective in order to answer what works in which circumstances and for whom (45).

Following the main phases and core elements of complex intervention research [(42), p. 26], we apply non-linear and iterative pathways through the research process. In Figure 1 we give an overview of the subprojects in the process of development, feasibility, evaluation, and implementation. In our reporting of the research, we are led by the SQUIRE 2.0 guidelines (46) that provide us with a framework for reporting new knowledge about how to improve healthcare and to describe system level work.

Collaborative human science research

The Velux foundation is a philanthropic foundation that among others supports research in gerontology and cultural, social, and environmental projects. With a so-called core-group programme, the foundation funds research in the humanities and allied social science disciplines with the aim to advance collective projects. In 2014 our group applied for the PAMI-project, we were granted funding in 2015, and the research project finally started in 2016 and ran until April 2022. With additional funding from the Danish Alzheimer Society, the project included a team of a PI, a postdoc, two PhD fellows and a 1-year research position. The original 4-years research period was extended due to maternity and paternity leaves and the lock-down period due to the COVID-19 pandemic. Each researcher in the team integrated their individual

1 In our description of the state of art, we have included literature on both nurses and formal and informal caregivers. In the following, we focus on professional residential care home staff, and use the wording *carers*.

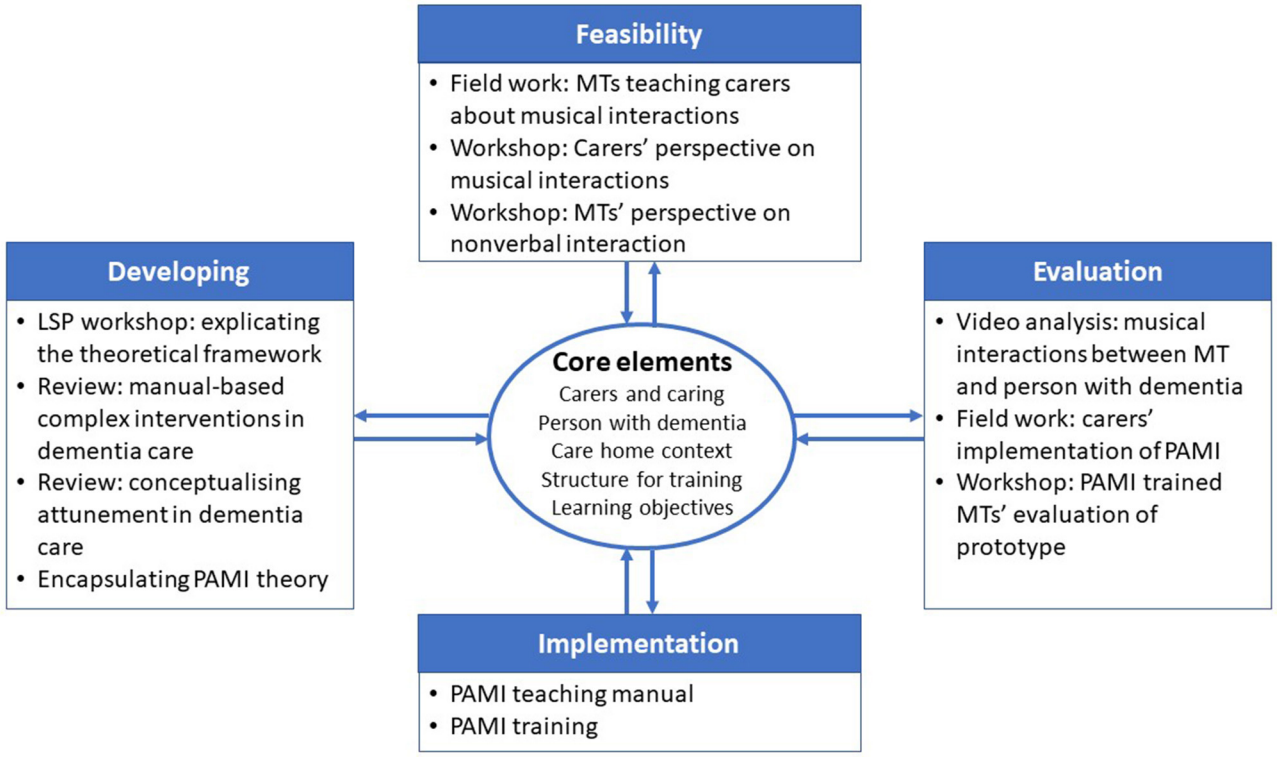

FIGURE 1
The iterative pathway through the phases of the PAMI research process based on the framework for complex intervention research by Skivington et al. [(42), p. 26].

research projects in the core group project, with all projects aiming at exploring PAMI and developing a training manual for music therapists to use in the training of carers.

Ethics

The study was granted exemption from the Danish regional ethics committee (Den Videnskabsetiske Komité for Region Nordjylland, January 25, 2016, project N-20160002) and was registered at The Danish Data Protection Agency through Aalborg University. The study adheres to the Danish Code of Conduct for Research Integrity, Ministry of Higher Education and Science, 2014, and participants signed an agreement on the terms of participating in the study based on written and oral information provided by the researchers.

Overview of the iterative research process

With non-linear and iterative pathways through the research process and with overlapping projects, we illustrate the 12 most important subprojects leading to the PAMI-manual guiding music therapists (MTs) to teach carers. Figure 1 is based on the framework for complex intervention research (42) and illustrates how core elements are considered in any phase of the process. In the following we describe each of the four phases (Developing, Feasibility, Evaluation, and Implementation), and the 12 associated subprojects.

Developing

To develop something is an act of advancing or elaborating. Our aim was to develop a new intervention, however neither music therapy methods nor music therapists' training of carers is new. Several music therapists train carers as part of their work, either formally with planned courses or workshops, or informally when they collaborate with carers about daily practice. This part of the process was therefore also about identifying examples of interactions of relevance for PAMI theory, practice and training with the common goal to develop a manual that integrates theory, practice and research. In the following, we will provide a brief overview of four subprojects that informed the development of the PAMI manual.

Subproject 1. LSP workshop: explicating the theoretical framework

The objective of this subproject was to explore, articulate and conceptualize professional caregiving from a person-centered perspective and to identify essential components and their

implications of positive person work between carer and person with late-stage dementia. Based on a hermeneutic constructivistic approach we used Lego Serious Play™ (LSP) as a method for exploring, articulating, and conceptualizing caregiver interactions. Five panelists with expertise in dementia care and/or musical interactions participated. The result was a co-created, condensed model suggesting an ideographic understanding of person-attuned interactions in caregiving, emphasizing knowledge about personhood and reciprocity, and the development of caregiver interactions skills. The conclusion was that caregivers represent an essential value in dementia care by introspection and mentalisation and by providing a feeling of safety through person-attuned interactions. Caregiver competencies depend on resources, culture, and interdisciplinary collaboration, which puts a strong demand on continuous training and supervision, and for political and societal priorities (47).

Subproject 2. Review: manual-based complex interventions in dementia care

A scoping review was carried out to investigate how manuals published in refereed journals explain procedures of complex interventions in dementia care, how they are structured, and their content disseminated. Nine manuals were identified and analyzed using a template analysis. The manuals allowed for tailored actions, and two-thirds showed a medium degree of flexibility. The types of dissemination elements varied, but all used written text, and none used illustrations or audio/video material. Based on this, recommendations for future manuals for complex interventions where non-verbal elements are important were provided, suggesting the inclusion of illustrations and audio/video material to describe actions, and for ways to tailor, structure, describe, and disseminate (48).

Subproject 3. Review: conceptualizing attunement in dementia care

Based on a meta-ethnographic review, findings from six dementia care studies applying the term attunement were synthesized. This showed that attunement in dementia care is understood as a dynamic process between carers and persons with dementia. Attunement is linked to the person-centered approach to care and understood as an emotional phenomenon where carers relate to the needs and emotions of the person with dementia. In addition, adjustments in tempo and timing within the interaction between carers and person with dementia are described as essential for attunement to happen (49).

Subproject 4. Encapsulating PAMI theory

As one of the last subprojects to be finalized, the theoretical understanding of PAMI was explained in book format. It started as a chapter in the training manual, however it was necessary to expand and elaborate, and the chapter became increasingly comprehensive. A Danish publisher was interested in publishing this theoretical content as a book for music therapists and educators, but also for informal and professional caregivers. In the first chapter of the book an introduction is given to non-verbal communication, reciprocal musical interaction, dementia, and loss of cognitive functioning. In chapter two each part of the acronym PAMI is explained: Person(hood), attunement, music(al) and interaction, and chapter three elaborates on the function of music in three parts, covering how music in very different ways is important for framing a setting, regulating arousal, and for reciprocal relationship. Chapter four gives examples from practice by presenting lived experience descriptions and ethical considerations, and chapter five focuses on transformative learning theory and the practical use of music care plans (1).

Feasibility

In this phase of the research, the feasibility and acceptability of PAMI was explored and evaluated to prepare for the evaluation phase. We therefore consulted with music therapists and carers and carried out field work, workshops, and interviews. At this stage of developing a PAMI manual, we did not carry out an actual feasibility study but considered preparatory work to qualitatively explore real world implications and uncertainties.

Subproject 5. Field work: MTs teaching carers about musical interactions

Each of the research team members shared and integrated their own experiences from teaching carers and other music therapists. This included contexts from Denmark, the Faroe Islands, and Norway. In an ongoing, collaborative process, the group integrated their experiences and constructed teaching material (e.g. PowerPoint presentations) that was used, reused, and refined each time someone from the group used the material for teaching during the project period. This practical starting point revealed which theoretical understandings were necessary to include and expand upon. Apart from the groups' own teaching material, we interviewed music therapist Niseema Munk Madsen, who had developed a specific training programme, the Music Ambassadors model. With this programme, carers took part in five training sessions over 8 months (all together 16 h) where they were taught how to integrate music in daily care aiming to increase quality of life. The music therapist/course facilitator emphasized the active engagement of carers in the training, that the aim and structure of the training should be clearly negotiated with care home managers, and finally to take into consideration the previous training of the carers. In this context, the facilitator observed that the majority of the carers had limited previous training which did put demands to how to introduce theory (50).

Subproject 6. Workshop: carers' use of musical interactions

In a 4-h workshop with 11 carers and a music therapist, we introduced participants to a number of action learning exercises. One exercise featured carers to role-play in a dyad where carer A was required to guide carer B (who was in the role of a person with dementia) to rise from a chair and walk along with A. Carer A was instructed not to use verbal language, and to be either empathic or

to be in a hurry. This very simple exercise was discussed vividly in the subsequent focus groups as for some carers, it was a highly thought-provoking experience to be guided non-verbally, and they reflected on how difficult it was to describe what worked and what did not. The workshops and the three focus group discussions were recorded, transcribed, and analyzed. Several carers used music in caregiving and explained the importance of feedback from the local music therapist, as it helped them to become conscious about their actions, and how actions could be named as a technique. For example, carers felt it helpful to learn how to down-regulate arousal to help someone relax (51).

Subproject 7. Workshop: music therapists' perspective on non-verbal interaction

With the aim to understand how music therapists use musical interactions in dementia care, explorative workshops were conducted to study such interactions through the music therapists' lived experience descriptions. The workshops included focus group interviews, and transcripts from these were analyzed by using a phenomenological approach. The findings were then further elaborated and peer validated through musical improvisation as an arts-based analytic approach. The results suggested that music therapists are guided by the vitality of persons with dementia, are aware of their own reactions, and sense the needs of the other through disciplined subjectivity and by attuning to non-verbal musical parameters (e.g., tempo, pitch and volume). The five overall themes from the analysis were: vitality, disciplined subjectivity, attunement, therapeutic presence, and validation (52).

Evaluation

Evaluation in research is used to obtain unbiased estimates of effectiveness, however, it is equally important to assess the usefulness of information for decision-making. Our ambition with this study was to explore and explain PAMI and to provide clear guidelines and contextualized understandings about how to interact non-verbally in care home contexts. We evaluated how music therapists carry out PAMI in clinical settings, how carers implement PAMI, and how music therapists, who were trained according to a prototype of the PAMI-manual, evaluated the content and structure of the PAMI training programme.

Subproject 8. Video analysis: musical interactions between music therapist and person with dementia

With video data from a music therapy session, a detailed sequential analysis of music therapy interactions was carried out following principles from conversation analysis, including a phenomenological transcription of the video and extraction of data concerning musical parameters. The results showed how different types of tempo variations are applied in the process of connecting with a person with late-stage dementia. The process was described as a person-attuned musical arousal regulation process (PAMAR), leading to person-attuned musical interactions where the person with dementia and the music therapist interacted reciprocally and with greater equality regarding the initiation of their interactions (53).

Subproject 9. Field work: carer's implementation of PAMI

For 4 months a music therapy researcher visited a care home weekly and worked together with six carers to explore how they used and understood musical interactions in dementia care. By interpreting narratives with thick descriptions of musical interactions and transcripts from a series of workshops based on a draft PAMI manual, an understanding of musical interaction incorporating the perspective of the six participating carers was constructed. The findings illuminated how musical interactions create vitality, communication, and connectedness through attunement. In addition, the musical interactions served as a soundtrack of the life story of the person with dementia and could transform anxiety into reassurance. It was concluded that musical interactions such as listening to music, dancing, singing, playing instruments, and paying attention to musical parameters such as tempo and timing of movements, may provide carers with new approaches to meet the psychosocial needs of persons with dementia (54).

Subproject 10. Workshop: PAMI trained MTs' evaluation of prototype

Six expert music therapists with long experience in dementia care took part in four one-day workshops where they were introduced to a prototype of the PAMI training manual. As part of this, they taught each other in the group, and participated in focus group interviews that were recorded and transcribed. Their evaluation of the prototype was integrated in the final version of the PAMI training manual (55).

Implementation

Intervention implementation is about adapting and transferring theory to practice and practice to theory. For an intervention to be successfully implemented, sustainability in the real-world context is necessary. The implementation of interventions in dementia care should be based on sufficiently testing for feasibility and acceptability, and according to Skivington et al. (42), implementation questions should be considered alongside evaluation questions from the outset.

Subproject 11. PAMI training manual

All subprojects added material to the final PAMI training manual, either to the content, to the organization and structure, or to learning objectives and didactics. In the results section, we will present the details of the manual. Throughout the process of constructing the manual, core elements were considered to assure that, for example, the structure was realistic for the learning process and that theory and exercises were meaningful.

Subproject 12. PAMI training

The implementation of the PAMI training manual started in September 2021 with a training course for six music therapists for two times 2 days. In April 2023, 19 experienced music therapists working in care homes in different parts of Denmark had completed PAMI-training. Trained music therapists were certified once their report was approved. The report documented the training process of a group of carers following the guidelines of the PAMI-manual. A list of certified music therapists is available at the website www.pami.aau.dk, indicating the ongoing training of not only music therapists, but also of carers.

Core elements

Throughout the research process there were numerous matters to consider and continually revisit, with each phase connected to the following core elements that are relevant in general for complex intervention research; context, developing and refining programme theory, engaging stakeholders, identifying key uncertainties, refining the intervention, and economic considerations. In addition, ethical considerations were important for us to relate to throughout the process. We continuously needed to consider whether musical interactions are meaningful to the residential care home context and discussed many questions related to how to understand dementia and personhood, the caring culture, caring values, and learning objectives for carers. For example, we considered the following dilemmas and questions: Will it be realistic to ask carers to work with their voice and to hum and sing? How can we best present theory about sensorimotor perception or neurocognition so it is clear and understandable? What is the best way to engage managers in the training course? How do we engage carers and keep them motivated to learn new ways of interaction and to focus on personal awareness? How do we include the perspective of the person with dementia? What is the role of the individual person with dementia in a care home system, but also of relatives? How is it possible to change care home cultures, and even the broader society? How is it possible to balance individual psychosocial needs with structural systems and including needs from relatives? How do we balance the PAMI training course to the economic situation in general for care homes? How do we create a transformative learning culture focusing on non-verbal communication and subjective knowledge? How do we facilitate carers' critical reflexiveness and insight in caring values? As illustrated in Figure 1, these considerations were central to the research process and spurred constant critical reflection.

Results

The result of the research process was the explication of a theoretical understanding of person-attuned musical interactions, PAMI, as well as the construction of a training manual for music therapists to use when teaching and collaborating with carers about how to implement PAMI in dementia care. During the training, carers work with two tools; the *music care plan* and *lived experience descriptions*. We elaborate on these tools below, but first we describe the combined results of the subprojects.

Theoretical understanding of PAMI

PAMIs are interactions that we all know from everyday life, but that we seldom use consciously and intentionally. They are termed under the umbrella of non-verbal communication but can be explicated with the use of concepts from the language of music. The key components of PAMI are Person (personhood, personal needs, preferences, identity, caring), Attunement (tuning in, tone of voice, trust, perspective, empathy), Musical (cuing, pitch, tempo, volume, musicking, listening, playing, resonance), and Interaction (moving, sensorimotor integration, communication, mutuality) which are each described in depth in the book Stemning [Attunement] (1).

In care situations where non-verbal communication is crucial, there is a need to describe what happens in a mutual professional language that is agreed upon in the caring culture. Otherwise, what happens easily becomes invisible and with no value. We suggest PAMI as a way to understand caring interactions and to develop the culture of care. PAMIs are used intentionally in music therapy and can be used in caring when carers initially are guided by music therapists. This may help carers to understand their interactions, describe them in the collaborative team, and to implement them as a professional way of interacting in care situations.

Carers do not need to know the full theoretical underpinnings of the PAMI theory, but they do need to understand the basic concepts and to recognize when PAMIs are happening. Such understandings are not learned by reading books, but by experiencing how it is to interact with someone. Therefore, it is important that carers throughout the training relate PAMI to practice and experience how PAMI work in practice. As an example, carers will learn about musical cuing by experiencing it, understanding how it affects the body, and further how to use it as a technique to facilitate safety.

In the understanding of PAMI, it is important to see the main differences of why music is used. The impact of music can be very strong, and if used in the wrong way, it will influence the person with dementia negatively. Carers are therefore instructed to distinguish between Framing, Regulating, and Relating which is elaborated upon throughout the training course in both theory, action learning and counseling. Table 1 gives an overview of the main differences between these uses of music.

Training manual with resources

The training manual is a book of 43 pages with introduction to the idea, content and teaching resources, explaining the structure of the training course, and providing guidelines for the hands-on action learning sessions as well as group and individual counseling. In addition to the training manual, the following resources are provided:

1) PowerPoints for the four teaching modules (for music therapists)
2) Action learning guidelines for the four teaching modules (for music therapists)
3) Booklet (for the participating carers)
4) Theory book (for professionals, managers, and relatives)

TABLE 1 Music has three overall functions in PAMI (Framing, Regulating, Relating) with the overall purpose to provide safety, balance arousal, and meet psychological needs.

	Music	Musical interaction	Purpose
Framing	Selected background music. Songs to start/end. Music-routines. Soundscape	Musical cuing	Safety, predictability
Regulating	Humming, singing. Care-songs. Stimulating/calming music	Arousal regulation with body, voice, music (pitch, volume, tempo)	Balanced arousal. Concentration and contact
Relating	Personal songs. Music to trigger memories and match emotions. Music-reminiscence	Empathic attunement via personal, well-known music and by holding and validating the music experience	Attunement and connectedness. Spontaneous memories. Psychological needs

By continuously considering core elements for complex intervention research such as learning objectives, economy, and the engagement of stakeholders, we ended up with a training course consisting of four teaching modules, with each module containing 1 hour theory, 1 hour action learning, 1 hour group counseling, and 1 hour direct counseling at the residential care home for each carer. For learning outcomes to be integrated in daily experiences, the 16-hour training course was not intended to be held intensively in just 2 days but should take place as single sessions over a longer period of 8–16 weeks. Each of the four teaching modules involved the overall learning outcomes as listed in Table 2.

Music care plan

The music care plan is a tool to directly implement PAMI in daily care. It provides the carer with suggestions for how to structure initiatives in an easy way and how to follow up with a simple evaluation of the perceived effect. This enables carers to share, develop, and critically evaluate initiatives in the professional team. The music care plan includes information about which, when, and where a care situation is initiated, which musical interaction, and with which function. The assessment of effect consists of a 5-point scale ranging from very negative, negative, non-observable, positive, and very positive and with the possibility to add further comments. A downloadable version of the music care plan is available at www.pami.aau.dk.

Lived experience descriptions

If meaningful non-verbal caring interactions are not explicated, it is difficult to value them and to evaluate them. Inspired by van Manen's phenomenological approach on subjective descriptions of human experiences (56), the carers are trained to put into words their interactions in a way where they capture the instant moment and what the experience is like. The purpose is to uncover tacit knowledge, emotions, images, body sensations, and associations, and with help from the music therapist, the experiences are transformed to short written narratives. These are used throughout the learning process to facilitate verbalisation and the writing of short texts about PAMI experiences. In each session, lived experience descriptions are developed, with the aim that the carers will continue to describe meaningful non-verbal interactions. The short narrative about Anna and Lis in the introduction is an example of a lived experience description. It is written in third person language, whereas carers are encouraged to write the narrative in first person language. The lived experience descriptions focus on one specific moment, are written in present tense and with details of sensory and emotional experiences in order to connect them as much as possible to practice, although narratives with this quality are different from what is mostly understood as professional language messages.

Discussion

Summary

The research group carried out several subprojects, going through four phases of complex intervention research; Developing, Feasibility, Evaluation, and Implementation, continuously considering Core elements related to the carers and caring, the person with dementia, the care home context, structure for training, and learning objectives. The result was a training manual for music therapists to use when teaching and collaborating with carers about how to implement person-attuned musical interactions in dementia care.

Interpretation

Based on a systematic review and a meta-analysis on the effectiveness of person-centered care on people with dementia, Kim and Park (57) conclude that PCC reduces agitation, neuropsychiatric symptoms, and improves quality of life. They also stress the need of an educational strategy that promotes learning and skill development of carers. In line with this and with the training of carers in PAMI, focusing on caring values, non-verbal communication, and support into how to carry out person-centered care, we expect the PAMI training to lead to changes in the caring culture, such as less behavioral and psychological symptoms of dementia, increased quality of life, and consequently a reduction in, for example, psychotropic medication.

Mohr et al. (58) pointed at the challenges in evaluating the effects of PCC and psychosocial interventions as they consist of multi-component interventions. For example, they recognized music interventions as either arts/creative activities, sensory enhancement, or cognitive training. Therefore, in their systematic review of key intervention categories to provide PCC, Mohr et al. (58) suggest to evaluate "relationship-centered" interventions, as an

TABLE 2 Learning outcomes from the training course in terms of increasing knowledge and developing carers' interaction competencies.

Module	Knowledge	Learning outcome: competencies to …
1. Music and dementia	• Dementia and communication • Body language and voice • Music and singing • The voice as instrument • Research in music and dementia	• Assess own and others' vocal expressions with musical parameters • Assess advantages and disadvantages of using song and music
2. Framing	• Music, brain, and the senses • Hearing and sensing • Perception, perspective, and reality • Safety and predictability • Musical cuing	• Use song and music to create safety and for frame-setting an activity • Use simple care songs for guiding • Use music for activities
3. Regulating	• Cognitive functions • Sensorimotor approach • Arousal regulation • Musical regulation • Care singing	• Assess how arousal, preferences and degree of dementia affect how music is experienced • Use song and music for arousal regulation
4. Relating	• Person-centered care • Psychosocial needs • Empathic attunement • Personal music • Music care plan	• Combine PCC with the use of music • Attune to the person with dementia and adjust communication • Use song in mutual communication • Use music and song to meet psychological needs • Plan, implement, and evaluate interventions as formulated in the music care plan

explicit focus on how to engage in relationships during PCC may yield an added benefit, not just for the person with dementia but also for the carers. Consequently, they recommended the training of carers. In line with this, we expect that PAMI training will lead to a higher level of relational competence and expertise for carers if their communication competencies are developed in a culture where everyday interactions are valued. This may lead to increased job satisfaction and less stress. Therefore, we see an urge to identify core elements of positive, non-verbal interactions between carers and persons with late-stage dementia, and we suggest the training in PAMI as a solution to changing care home cultures. By offering the structure and content for training, we see the need for further research in cooperation with carers, persons with dementia, relatives, music therapists, care home managers, and researchers in psychosocial methods. Apart from understanding the processes, there will also be a need to evaluate the changes in care home cultures due to PAMI-interventions.

In accordance with Bunn et al. (59), we agree that the organizational context will impact on the successful implementation of healthcare initiatives in care homes. They found that a positive culture of care was defined by giving time and resources to staff education and reinforcement of learning, and that feedback on progress encouraged a sense of shared ownership of a given change. A positive culture of care also gave value to being with residents rather than engaging in task-based care. Bunn's framework addresses the gap between implementation theory and practice, and it provides a range of questions to initiate dialogue between researchers, practitioners, and commissioners, which we find useful also in the implementation of PAMI. In this regard, it is clear how much care home cultures vary in all aspects of, for example, organization, expertise, capacity, staffing level, and services. Carers are involved in washing, lifting out of bed, helping with feeding, and in monitoring health, implementing care plans, and maintaining health records. Still, across the OECD, less than half of surveyed countries require that carers hold a license or certification (60).

For PAMI to be successfully implemented, we expect that carers are trained and have worked in dementia care based on the principles of PCC. Thus, the PAMI training demands previous training and competencies. The 16-h inhouse training is designed to be integrated in daily practice which makes it cost effective and less challenging logistically, but it cannot replace the needed primary training of carers. Further, we also expect that the facilitator of the PAMI training is a credentialed music therapist with a least 2 years of work experience in dementia care. PAMI may be viewed as indirect music therapy practice, and its type of skill-sharing is multidimensional which according to McDermott et al. (50) includes not only promoting informed and safe use of music, but also to enable carers to develop self-awareness so they can be attuned to the needs of persons with dementia, promote cross-professional dialogues, and contribute to organizational change (50).

Limitations

Non-verbal communication is often unconscious and is ambiguous to describe in words. Despite this, we have strived to put the meaning and relevance of musical interactions into words. In this way, we translate interactions to another dimension where they may lose facets of the original practice-imbedded meaning. However, a translation to spoken and written language is needed for developing clinical contexts and disseminating research. Critical thinking in a group is necessary for understanding the reality, and therefore it is crucial to construct a langue for paralinguistic modalities. Still, there is an inborn limitation in describing real life contexts and discussing them at a meta-level of reasoning.

In this study we included the perspectives of carers and of music therapists. As an integrated part of PAMI, the carers worked on how to integrate the perspective of the persons with dementia through the music care plan and the lived experience descriptions. In the research process, we did not include the perspectives of

persons with dementia, relatives, and dementia experts, or did a cost-benefit analysis, and we recommend this for future research. In this regard, we find it highly relevant that Franco et al. (61) provided insights into person-centeredness and quality of care by interviewing persons with dementia and their care partners. They found that PCC is essential to the quality of dementia care, and that quality indicators in general over-emphasize technical and disease-specific medical aspects instead of emphasizing quality of care that values the person.

We also want to point out a limitation related to the ideographic nature of the research project, as we constructed PAMI and developed the training manual in a few local care home cultures. Therefore, we cannot generalize from our findings, and see a need for translation and adaptation to a broader cultural reality where, for example, caring values, workplace structure, stakeholder involvement, and economy are different.

Perspectives

The PAMI core group research took place from 2016 to 2022, with a related project in the UK finalizing in 2023. In Denmark, PAMI training of both music therapists and carers is continuing which enables collection of data from the implementation of PAMI and evaluation of the process and quality on a wider scale. Further implementation, evaluation and piloting will give ground for protocol registration for future RCTs. With a thoroughly developed and tested training manual where its preliminary usefulness has been examined, the initial ideographic approach will feed into a nomothetic design. Relevant outcomes to measure would be the prescription of psychotropic medication, behavioral and psychological symptoms, and quality of life for persons with dementia, as well as job satisfaction and stress level for carers.

Conclusions

A major part of our non-verbal communication components can be explained in musical terms: such as the tone of voice, the rhythm in speech, and accompanying gestures. Meaningful interactions between people happen when we make attuned relational connection with each other. For persons with late-stage dementia, non-verbal communication is crucial for person-centered care to succeed in meeting their psychological needs. Music therapists have clinical insights into how successful Person-Attuned Musical Interactions can work in dementia care and can train carers in an intentional and systemic use of PAMI. Based on a complex intervention study model, we developed, explored, evaluated, and implemented a PAMI training manual. The PAMI manual includes comprehensive resources, a clear structure for training, defined learning objectives, and integration of theory. With increased knowledge about caring values and non-verbal communication—here in the form of a fully developed PAMI training course—residential care home cultures are offered possibilities to develop carer competencies and to provide professional attuned care for persons with late-stage dementia.

Data availability statement

Participants identifiable data (audio and video recordings, transcripts) are only available to data managers and are deleted after completion of each of the studies. Datasets are not available, but resources from the research are available at www.pami.aau.dk.

Ethics statement

The study was granted exemption from the Danish Regional Ethics Committee (Den Videnskabsetiske Komité for Region Nordjylland, January 25, 2016, Project N-20160002) and was registered at the Danish Data Protection Agency through Aalborg University. The study adheres to the Danish Code of Conduct for Research Integrity, Ministry of Higher Education and Science, 2014, and participants signed an agreement on the terms of participating in the study based on written and oral information provided by the researcher.

Author contributions

HR contributed to conception and design of the study together with OM, JA-I, and JK, and all contributed to selected subprojects. HR wrote the manuscript draft. All authors contributed to manuscript revision, read, and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Content development and validation for a mobile application designed to train family caregivers in the use of music to support care of people living with dementia

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Background: Music therapy is increasingly recognized as an effective support for people living with dementia. However, with incidences of dementia increasing, and limited availability of music therapists, there is a need for affordable and accessible ways that caregivers can learn to use music-therapy based strategies to support the people they care for. The MATCH project aims to address this by creating a mobile application that can train family caregivers in the use of music to support people living with dementia.

Methods: This study details the development and validation of training material for the MATCH mobile application. Training modules developed based on existing research were assessed by 10 experienced music therapist clinician-researchers, and seven family caregivers who had previously completed personalized training in music therapy strategies via the HOMESIDE project. Participants reviewed the content and scored each training module based on content (music therapists) and face (caregivers) validity scales. Descriptive statistics were used to calculate scores on the scales, while thematic analysis was used to analyze short-answer feedback.

Results: Participants scored the content as valid and relevant, however, they provided additional suggestions for improvement via short-answer feedback.

Conclusion: The content developed for the MATCH application is valid and will be trailed by family caregivers and people living with dementia in a future study.

KEYWORDS

dementia, technology, music therapy, eHealth, caregiver

Background

According to The World Alzheimer's Report, there are over 50 million people living with dementia worldwide, with this figure predicted to double every 20 years (1, 2). Approximately 84% of people living with dementia reside at home and are supported by informal caregivers (usually close family members) (3). Most care provided by informal caregivers relates to activities of daily living (ADLs), which can average approximately 5 h per day (3).

Dementia symptoms relating to changes in mood, agitation, and subsequent behavior are often regarded as distressing, and can adversely impact the wellbeing of both the person with the diagnosis and their caregiver (4–6). These symptoms, often referred to as Behavioral and Psychological Symptoms of Dementia (BPSD) or neuropsychiatric symptoms, include depression, anxiety, and agitation, and can affect up to 90% of people living with dementia over the course of their illness (4, 7). Managing moderate to severe agitation and other changed behavior in people living with dementia can overwhelm informal caregivers' capacity to cope, leading to potential for depression, burnout, and increased morbidity and mortality in caregivers (4, 8). Further, the costs of informal care can rise with increasing severity of agitation/aggression, affective changes and psychosis-related symptoms over time (9, 10). Therefore, interventions or supports are needed that can reduce and regulate these symptoms in order to improve and maintain quality of life and psychological wellbeing for people living with dementia and their caregivers, as well as reducing economic costs relating to these symptoms (10, 11). Pharmacological interventions are often employed to manage neuropsychiatric symptoms for people living with dementia, however, these can be of limited benefit as they can lead to worsening agitation and other adverse health outcomes (12, 13) or contraindications due to polypharmacy (14). There is therefore also a need for more interventions or supports that are able to address neuropsychiatric symptoms and support positive wellbeing for people living with dementia (15) as well as the wellbeing of informal caregivers (16).

Music therapy and dementia

Music therapy programs are a promising non-pharmacological approach to address the regulation of BPSD including agitation, and support care provision and transition (17, 18) Reviews report compelling evidence that music interventions delivered by a qualified music therapist can reduce levels of depression, enhance quality of life, and promote social connectedness for people living with dementia and their informal carers (19–21). Within these programs, music therapists draw on the potential of music to orient, engage, calm, and evoke memories and emotions (22). The increasing incidence of dementia, and the small number of credentialed music therapists available to support care suggest that scalable innovative options that involve caregivers and make use of the unique power of music to support care are in urgent need of development and validation.

HOMESIDE, a program that provides informal family caregivers with training in the intentional use of music to support care, has preliminary evidence to support its effectiveness (23), and a large trial has recently been completed (24, 25). The approach trains caregivers on principles of musical attunement to regulate arousal and agitation. Attunement is defined as sensitively and musically responding to a person's musical and non-musical expression to tune in empathically (26) (Figure 1). However, even with this train-the-caregiver model, there are not enough music therapists to deliver this program for the vast numbers of people living with dementia worldwide.

The MATCH app

To partially solve this workforce shortage, we have translated the content being taught by music therapists during these caregiver-training sessions into digital content for a bespoke mobile application titled Musically Attuned Technology–Care via eHealth (MATCH). This mobile application is referred to as the MATCH app. eHealth adaptations of established in-person interventions are common and offer opportunities to scale up access (27). However, the development of any eHealth intervention needs to be rooted in empirical evidence, clinical experience, and clearly defined mechanisms of change (28). A meta-analysis of eHealth interventions designed to impact changes in behavior found that interventions that linked theoretical constructs to intervention techniques had larger effect sizes (29). Our MATCH initial prototype (MATCH-P) applies the same theoretical construct of musical attunement (24) utilized in the therapist-delivered HOMESIDE music intervention (Figure 1), and trains caregivers through a mobile application to implement music-based techniques.

Developing eHealth solutions

Kramer-Jackman and Popkess-Vawter (30) outline five steps involved in developing eHealth applications: (1) establish content; (2) establish eHealth literacy; (3) establish technology delivery; (4) establish expert usability; and (5) establish participant usability. The current study reports on the development of the MATCH app content and assessment of the validity of this content, based on an evaluation of both face and content validity (step 1).

Face validity is the process by which participants judge items on a measurement instrument to confirm whether the items proposed in the tool are congruent with the constructs and objectives of the instrument (31). However, it has also been used in eHealth development and validation to confirm that the content delivers what it is intended to (27, 32). Real life simulations embedded within eHealth applications, such as video demonstrations and case studies, can be tested to see if they are able to replicate real-life situations (30).

Content validity refers to the extent to which the components of the intervention activities are related to the underlying target construct and, therefore, most likely to be effective in achieving the intended goal (30, 33). In the case of MATCH, this relates to the extent to which the proposed learning objectives of the digitally delivered training content connect with relevant music therapy theories. Assessments test the relevance, likely effectiveness, representativeness of the content domain, accuracy, and clarity of the content. In our study, we aimed to evaluate whether the series of digital training modules met face and content validity with respect to our learning objectives, and in comparison with the HOMESIDE therapist-delivered training program. Specifically, we aimed to determine whether:

1. the modules within the MATCH prototype reflect the HOMESIDE training and whether they are engaging, clear, and

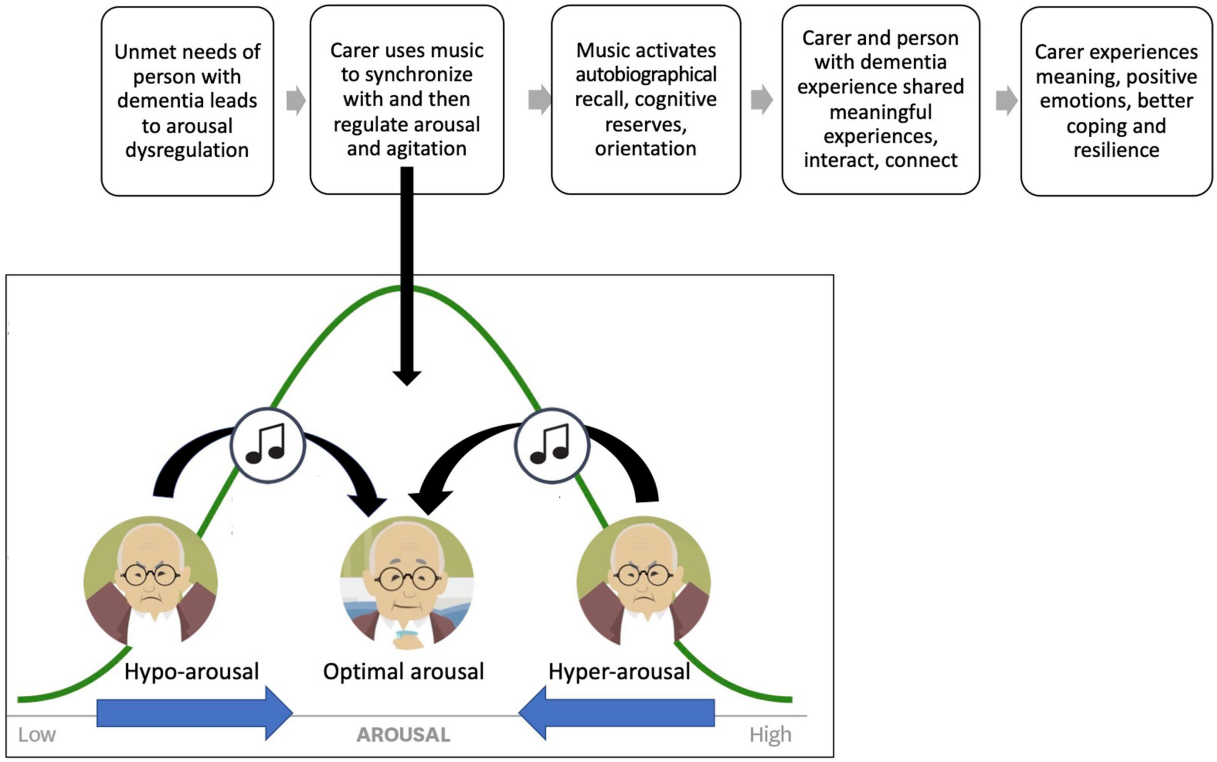

FIGURE 1
Musical attunement for arousal and agitation regulation.

relatable to people with lived experience of caring for someone with dementia (face validity);
2. the training modules adequately describe concepts of music-stimulated reminiscence, music attunement and music for care (content validity);
3. the training modules adequately provide instructions for safe and effective use of music for movement, music for relaxation, reminiscence, care, and music attunement (content validity);
4. the content is sufficiently comprehensive (no omissions, over-explanations, and irrelevant information; content validity);
5. the learning objectives of the training are clear to the user (content validity); and
6. the design of the modules is engaging, including the right mix of video, and textual information (content validity).

Methods

Development of content

The online training content was developed following several iterations of the original protocol published by Baker et al. (23). This caregiver training program, originally titled "Meaningful Musical Moments," was informed by clinical experience and music therapy research, and comprised three modules: song singing, gentle movement to music, and listening to quiet, relaxing music. This program was later revised and expanded by the HOMESIDE research team, informed by consumer perspectives, clinical experience, and recent research (25). The revised HOMESIDE music intervention included four primary activities: (1) singing familiar songs with facilitated meaningful discussion; (2) movement to music; (3) music for relaxation; and (4) playing musical instruments using existing or homemade musical instruments (24, 25).

To address the need for a scalable approach, the team embarked on developing a program that could be delivered via a digital app. We subsequently developed specific learning objectives and additional learning modules, incorporating further input from people with lived experience of dementia or caring for a person with dementia, who were part of the HOMESIDE Public and Patient Involvement committee.

Personas were developed that represented the typical characteristics of the caregivers enrolled in the HOMESIDE study (34). Personas are fictional but realistic characters created based upon the synthesis of different participant-character types, which help researchers and designers understand participants' or users' needs, experiences, behaviors, and aspirations (35). Personas were developed by reviewing demographic information, participant diary entries, and transcripts of participant interviews. An example of a persona is detailed in Figure 2. From these personas, scripted demonstrations of music intervention implementation were constructed and organized into training modules.

The final set of content comprised eight training modules, with each including a series of scripted videos, case studies modeling the use of music-based strategies, a problem-solving tab (listing scenarios of unanticipated reactions and suggested responses), and safety

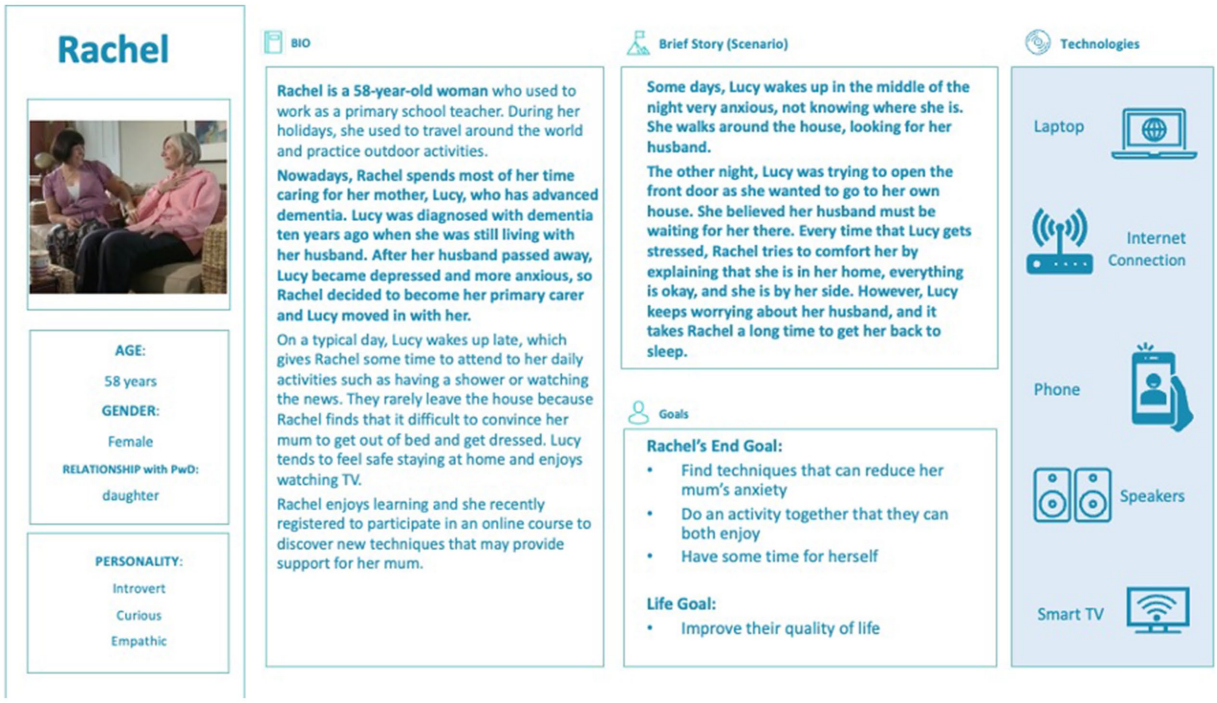

FIGURE 2
Example of a persona developed for MATCH, based on HOMESIDE data.

checklists. The modules included information on how to use the MATCH app, the science behind the therapeutic effects of music, music for relaxation, music attunement, music for reminiscence, music to support personal care, and movement to music.

Recruitment and participants

Ethics approval for this study was granted by The University of Melbourne Human Ethics Committee (ethics ID: 2280). People who are familiar or unfamiliar with the topic can help evaluate clarity, comprehensiveness of content, engagement, and understanding (30, 31). Informed by previous research (33, 36, 37), we aimed to recruit 10 expert music therapists and 10 people with lived experience of caring for a person with dementia (expert caregivers) via purposive sampling. Expert caregiver participants (CGs) were randomly selected from a pool of 30 participants who had completed the HOMESIDE intervention at the time of recruitment for this study. CGs were contacted via email with a plain language statement and consent form and were offered compensation in the form of a gift voucher for their participation.

Expert music therapist participants (MTs) were randomly selected from a pool of music therapy researchers with at least 5 years clinical experience and who had published at least two peer-reviewed articles on music therapy with people living with dementia and/or caregivers of people living with dementia (38). A list of potential expert MT participants was generated through database searches of published music therapy studies of people living with dementia, noting the primary author, commencing with the most recent publications (2021) and working backward until we had reached a total of 30 experts. We randomly selected 10 MTs from the total pool, and continued to do so until we had obtained 10 consenting participants. The selected MTs were contacted via email with a brief invitation to participate and a link to the plain language statement and online consent form. Expert MT participants were also offered compensation in the form of a gift voucher for their participation.

Data collection

Face validity

Consenting participants were provided with links to review the content of each module via an online survey. Study data were collected and managed using REDCap (Research Electronic Data Capture) tools hosted at The University of Melbourne (39, 40). REDCap is a secure, web-based software platform designed to support data capture for research studies, providing: (1) an intuitive interface for validated data capture; (2) audit trails for tracking data manipulation and export procedures; (3) automated export procedures for seamless data downloads to common statistical packages; and (4) procedures for data integration and interoperability with external sources.

Consenting CGs were asked to review the introductory modules (modules 1–3) via short-answer responses only, as these modules outlined music therapy principles and science behind the music that were not features of their HOMESIDE training. CGs were then asked to score content in the remaining modules (modules 4–8) using the Face Validity scale. Specifically, we asked CGs to:

1. Rate how the introductory videos compared to their therapist-delivered training that they received during HOMSIDE.
2. Rate case examples to determine whether they were (a) engaging to view; (b) understandable in terms of language use and clarity of presentation; and (c) relatable to people with lived experience (41).

3. Rate the written material of each module to determine whether they found it useful in relation to their own experiences of caregiving.

Each criterion within the modules reviewed was rated using a four-point Likert scale (strongly disagree = 1, disagree = 2, agree = 3, and strongly agree = 4). CGs were also asked to provide general feedback for each module and item via short-answer response.

Caregiver participants were randomly assigned the order of modules 4–8 to review; this was adopted to ensure that all modules were reviewed should any participants withdraw prior to completing all modules. All responses were entered directly into a REDCap database (39, 40).

Content validity

Consenting MTs were provided with links to review the content of each module via an online survey. All MTs reviewed the introductory modules (modules 1–3) and were randomly assigned other remaining modules (modules 4–8). This process ensured that all modules were reviewed should any participants withdraw prior to reviewing all modules. MTs were asked to score the content for each module via an online survey version of the Content Validity Survey Tool, adapted from the Suitability Assessment of Materials tool (42). MTs rated each module according to how accurately the learning objectives were represented in the content, how comprehensive the content was, and how clear it was, using a four-point Likert Scale (1 = strongly disagree to 4 = strongly agree). MTs were reminded that this content had to be digestible and understandable to a lay person. They were also invited to provide general feedback for each module via short answer responses. All responses were collected via a REDCap online survey form (39, 40).

Analysis

Face validity

All items scoring 3 or 4 (agree or strongly agree) were considered face valid for those criteria, and those scoring 1 or 2 (strongly disagree or disagree), were considered face invalid. Each module needed to have at least four of the five criteria rated as face valid by at least 80% of CG participants to be retained (43).

Content validity

All items were scored using a calculation of an adapted content validity index (CVI) (44). The CVI is typically used to measure relevance, clarity, and necessity on individual items (I-CVI) and for the whole scale (S-CVI). While the S-CVI/Universal agreement $\geq$0.8 and a S-CVI/Average $\geq$ 0.9 have both been found to have excellent content validity (45, 46), we chose to use the more conservative Universal agreement (S-CVI/UA). Based on previous examples (44, 46), we chose to rate each learning objective (I-CVI) according to three criteria: *accuracy* of the content, *comprehensiveness* of the content, and *clarity* of the content using a four-point Likert scale from (1 = strongly disagree to 4 = strongly agree) (47). All items scoring 3 or 4 were considered content valid, and those scoring 1 or 2, content invalid (43). The proportion of MT experts who rated the content as valid for each criterion within each learning objective was calculated by dividing the number of experts who rated that content as valid by the total number of experts. If the proportion of raters for I-CVI was >0.79 for a criterion on an item, the content was considered valid. If the proportion of raters rating the item as valid scored between 0.70–0.79, then the item would be categorized as requiring revision. If a value was below 0.7, the content would be categorized as requiring major revision or removal from the content (46). To calculate the content validity of the whole MATCH app content (S-CVI), the proportion of valid criteria was calculated by summing the number of criteria scored as valid (that is, the number of I-CVI items that obtained a score of >0.7) and dividing this by the total number of criteria assessed.

Short answer responses

Short answer responses were grouped by participant type (CG or MT) and module, producing 12 data groups. Data were then analyzed using a six-step deductive Thematic Analysis method (48) via MAXQDA software (49). Data were coded by author 1 and confirmed by the last author according to three pre-specified overarching themes (step 1): (i) Content is Appropriate and Well Received; (ii) Content that Requires Changing/Adapting; and (iii) Design/Esthetic Aspects that Require Improvement. Data for the first data group were read for familiarity (step 2), and then coded under one of the three overarching themes (step 3). Similarly coded data under each theme were grouped and subthemes were created (step 4). This process was repeated for each data group, until all groups were completed (step 5). Data from the CG and MT groups were compared and grouped to provide a final set of subthemes (step 6). Once the analysis was completed, we used these findings to identify potentially problematic or redundant content and to refine the remaining intervention content as needed (44).

Results

Between January and April 2022, we invited 18 MTs and 10 CGs to participate; of these, 11 MTs and nine CGs consented to participate in the study. One CG withdrew before commencing, while two CGs and one MT only partially completed the study. Both participant groups rated the content and face validity of items as high overall. MTs assessed *overall* content validity as 100% for each domain. When assessing each module, high scores were ascribed for accuracy, comprehensiveness, and clarity across most items (Table 1).

Overall Face Validity was also scored highly by CGs (Table 2). Two items (Items 3c and 4 in Module 4) scored lower than 80%; however, as the overall score for the module was over 80%, the module was deemed face valid and retained.

Qualitative results

Analysis of the short answer responses revealed nuanced feedback relating to the three predefined themes: (1) Content is appropriate and well received; (2) Content that requires changing/adapting; and (3) Design/Esthetic aspects that require improvement. These themes and subthemes are reported below.

Theme 1: content is appropriate and well received

Responses to open ended questions from CGs and MTs indicated that the training content designed for the app was well received and appropriate. In particular, the CGs provided nuanced responses, which were synthesized into five subthemes.

TABLE 1 Content validity assessed by expert music therapists.

	Accuracy	Comprehensiveness	Clarity
Total scores for MATCH music training program content (S-CVI)	1.000	1.000	1.000
Module 1: introduction to MATCH App (I-CVI; $n = 11$)			
Item 1.1: responses to music	0.909	1.000	0.909
Item 1.2: impact on mood	1.000	1.000	0.818
Item 1. 3: when to implement	1.000	1.000	1.000
Module 2: the science behind the music (I-CVI; $n = 11$)			
Item 2.1: music and memory	1.000	0.909	0.909
Item 2.2: memory and emotions	0.909	0.909	1.000
Item 2.3: engagement with music	1.000	1.000	1.000
Module 4: music for relaxation (I-CVI; $n = 10$)			
Item 4.1: contexts for relaxation	1.000	1.000	1.000
Item 4.2: musical characteristics	1.000	1.000	1.000
Item 4.3: assessing suitability	1.000	1.000	1.000
Item 4.4: environmental awareness	1.000	1.000	1.000
Item 4.5: guided relaxation	1.000	0.900	1.000
Item 4.6: music and imagery	1.000	0.900	1.000
Module 5: music attunement (I-CVI) ($n = 10$)			
Item 5.1: identifying energy levels	1.000	1.000	1.000
Item 5.2: selecting appropriate music	1.000	1.000	1.000
Item 5.3: adapting music	0.900	1.000	1.000
Item 5.4: applying attunement	1.000	1.000	1.000
Module 6: music for reminiscence (I-CVI; $n = 10$)			
Item 6.1: selecting appropriate music	1.000	1.000	1.000
Item 6.2: recognizing non-verbal responses to music	1.000	1.000	0.900
Item 6.3: identifying and responding to distress	0.800	0.900	0.900
Item 6.4: initiating conversation	1.000	1.000	1.000
Item 6.5: managing conversation	0.900	0.900	0.900
Item 6.6: repetition	0.900	0.900	0.900
Item 6.7: including other media	1.000	1.000	1.000
Module 7: music to support personal care (I-CVI; $n = 10$)			
Item 7.1: selecting appropriate music	1.000	1.000	1.000
Item 7.2: improvisation skills	1.000	1.000	1.000
Module 8: movement to music (I-CVI; $n = 11$)			
Item 8.1: recognizing escalation	1.000	0.818	1.000
Item 8.2: initiating music response	0.909	1.000	0.909
Item 8.3: selecting appropriate music	0.909	0.818	0.909
Item 8.4: environmental safety	1.000	1.000	0.909
Item 8.5: positioning	1.000	1.000	0.909
Item 8.6: engagement strategies	1.000	1.000	1.000
Item 8.7: suitability of exercises	0.909	0.909	0.909
Item 8.8: recognizing negative responses	0.909	0.818	0.909
Item 8.9: adapting music to maximize engagement	1.000	0.909	1.000

S-CVI, scale–content validity index; I-CVI, item–content validity index.

Content is accessible

Caregiver participants felt that the way that the content was delivered was accessible and easy to understand. CGs felt that the videos were "*easily relatable for lay people, family and caregivers alike*" and that the "*videos were of perfect length and demonstrated the scenarios effectively*" (CG05).

TABLE 2 Overall face validity—assessed by expert caregivers.

	Comparability to HOMESIDE	Engaging	Understandable	Realistic	Usefulness
Overall face validity of training modules	0.970	0.980	0.980	0.950	0.870
Module 4: music for relaxation ($n = 8$)					
Item 4.1: instructional video	1.000				
Item 4.2: case study 1		1.000	1.000	1.000	
Item 4.3: case study 2		0.875	0.875	0.750	
Item 4.4: written content					0.625
Module 5: music attunement ($n = 8$)					
Item 5.1: instructional video	0.875				
Item 5.2: case study 1		1.000	1.000	1.000	
Item 5.3: case study 2		1.00	1.000	0.875	
Item 5.4: written content					1.000
Module 6: music for reminiscence ($n = 6$)					
Item 6.1: instructional video	1.000				
Item 6.2: case study 1		1.000	1.000	1.000	
Item 6.3: case study 2		1.000	1.000	0.875	
Item 6.4: written content					1.000
Module 7: music to support personal care ($n = 6$)					
Item 7.1: instructional video	1.000				
Item 7.2: case study 1		1.000	1.000	1.000	
Item 7.3: written content					1.000
Module 8: movement to music ($n = 8$)					
Item 8.1: instructional video	1.000				
Item 8.2: case study 1		1.000	1.000	1.000	
Item 8.3: case study 2		1.000	1.000	1.000	
Item 8.4: case study 3		1.000	1.000	1.000	
Item 8.5: written content					0.875

Benefits to caregivers

Caregiver participants commented on how they could imagine using the app to support their daily care routines. CGs reported that the idea of providing "suggested playlists" targeting specific care needs was helpful as they sometimes did not know what to select when engaging the person with dementia. For example, one CG explained: "*some examples of suitable classical music for relaxation will be appreciated as I find it difficult to find classical music with consistent slow tempo without sudden surprises*" (CG08). Another CG felt that the proposed activities could effectively integrate music into their already busy routines:

> "*Integrating music into the day and not being seen as a task is a strong point. Some would see it as ' one more thing' caregivers need to do. After walking in from an 8 or 12 hour ICU shift and [then] having to continue having my 'care factor' turned on, perhaps just playing some music in the background will be beneficial*" (CG05).

More comprehensive than HOMESIDE training

Some CGs commented that they found aspects of the MATCH content to be more comprehensive than the training that they received during the HOMESIDE study. Some participants commented that they "*learned new methods and techniques*" (CG08) and that "*there was more content in these modules than I recall with our [HOMESIDE] Zoom sessions*" (CG03).

Content is realistic and helpful

Caregiver participants reported that the content was reflective of their own situations and that the content was "*realistic and helpful… case study is perfect—absolutely identify with it!*" (CG10). However, several participants noted across several modules, that the case examples were not reflective of their current experiences of caring for their family member with dementia. This was most prominent in the responses relating to the "Relaxation" module, which may explain the lower score for this module (item 3, case study 2). One CG noted that the focus on agitation and re-directing in the "Attunement" module, was not relevant to them "*at this stage, however the tips are useful for future reference*" (CG03). This highlights the need to reinforce that some content may have more relevance for use during different stages of the disease progression.

Theme 2: enhancing existing content

While CGs and MTs each scored the existing content highly, and felt that no major changes were essential, they also provided detailed

feedback on ways that the content could be further enhanced. Three subthemes were developed based on where feedback from both CGs and MTs converged (*Diversify Examples; Additional Uses for Attunement; and Module on Caregiver Needs*). Two additional subthemes relate only to feedback from CGs (*Ensuring Consent/Person-Centered Care*) and MTs (*Simplifying Language*).

Diversify examples

Caregiver participants and MTs acknowledged that the current case examples lacked diversity in age, gender, relationship, diagnosis, stage/symptoms, and cultural background. "*I wondered whether diversity has been considered in the case studies, particularly in terms of ethnicity, but perhaps also in terms of other caring relationships,* e.g., *same sex couples*." (MT03). One CG highlighted that people with multiple conditions may need additional strategies: "*[The person in the case example] only has dementia—if patient has other conditions, it is not so easy!*" (CG07).

Some CGs perceived that the case examples only illustrated positive responses to music, neglecting to demonstrate examples of negative responses and what to do when these occurred. One CG explained how several of the training videos "*make it all look easier than it actually is*" (CG10). This sentiment was echoed by MTs, who felt that "*it would be worth mentioning that sometimes [strategies] might not work, and it's not because the caregiver should have done anything differently—the same approach might produce the desired effect next time*" (MT01).

One CG noted that having examples of how to include other family members would be helpful in future iterations of the MATCH app:

> *"It would also be good if there are younger kids around or another person to make it a group activity. Sometimes if kids are involved it also helped"* (CG07)

Additional uses for attunement

Caregiver participants and MTs reported that the attunement module would benefit from additional examples of how to use attunement to impact mood-states other than agitation. MTs made suggestions for additional ways that attunement could be exemplified, for example:

> "*Maybe having one or two more examples of different energy levels would be useful—for example, high energy level but without distress/agitation, or low energy level but not relaxed but sad/preoccupied/indifferent.*" (MT06)

Module on caregiver needs

Music therapist participants highlighted a lack of content related to supporting caregivers directly. The relaxation module was highlighted as a space that could include specific strategies for caregiver self-care. Another MT commented that they "*wondered if it's possible to acknowledge how much the caregiver might need this relaxation and perhaps suggest they could do this by themselves without the person when they have a chance, to self-care*" (MT15). This sentiment was echoed by CGs: "*I can relate as well as a caregiver. I put music on for my own relaxation*" (CG06).

Ensuring consent/person-centered care

Some CGs observed that as each of the case examples presented depict a "successful" session, there was a lack of content demonstrating how to respect a person with dementia's autonomy to reject an activity. One CG noted that care recipients *"may not like lyrics"* that are created by caregivers, and that *"some activities are not relevant"* depending on circumstances (CG07). Another CG highlighted the importance of following the lead of the care recipient:

> *"I wouldn't press on with my agenda for 'relaxation' if he wasn't ready—I think it works best to let him set the pace—do what he wants to do—then try again in say half an hour…"* (CG10).

Simplifying language

Several MT participants commented that they felt some of the language used in the training videos could be simplified and de-jargonised:

> *"Some words in the introduction may be too complicated: noticed 'sedative', 'cognition', 'tempo', 'evoke'. Just wondering if simpler words might be helpful?"* (MT15)

This was highlighted as especially important for caregivers where English is not their first language:

> *"I was just wondering whether the term 'imagery' is a commonly understood term in English or whether it should be accompanied by a very brief description when first mentioned."* (MT06)

Music therapist participants also suggested more clarity regarding the terminology used to describe emotions, suggesting that the language used may oversimplify how care recipients may experience different emotions while listening to music:

> *"Many relevant tips are given concerning different types of distressful behaviors. However, I think it would be beneficial to address more clearly, that sometimes crying is a good thing to share, and not necessarily a response where the caregiver immediately should stop the song and change activity."* (MT04)

Theme 3: improving esthetics and design

Music therapist and CG participants highlighted concerns regarding the quality of some of the training videos, as well as potential improvements in how accessibly the information was presented.

Length of training

Participants commented that some videos were quite long, and could be repetitive at times. One CG felt that there was "*…some redundancy in the first and second module with repeated information*" (CG03). One MT raised that signposting the length of videos would help with accessibility:

> *"I think if I was the caregiver, I would like to know approximately how long each video is, how long I should spend on it."* (MT01)

Clarity of video recordings

Some participants noticed that the way the videos were recorded reduced the accessibility of the information being presented. One CG found that a video that featured a mirror was "*distracting*" due to reflections (CG03). Several MTs commented that, at times, they found the background music to be "*…too strong and loud…*," which at times made it "*…hard to hear the narrator…*" (MT04). MTs also suggested that videos should have a "*text overlay…to help [anchor]…attention and understanding during the video*" (MT04). Another MT also noted that some of the visuals used were too complicated:

> "I welcomed the visual aide—however, there were too many labels on the brain, and the narrative did not highlight exactly what the visual aide did. I would recommend simple images of the brain highlighting areas or pathways being discussed as it is viewed." (MT10)

Clarity of written information

Music therapist participants also commented on the format of the written information (summary of the video content and suggestions for what to do when things go wrong); they felt that the information was too lengthy:

> "Some texts (e.g. for Tips) are pretty long—perhaps you can consider clearer signposting e.g. bold font for key points, use of bullet points" (MT17).

Discussion

Results of our study indicate that all of the MATCH online training modules met minimum face and content validity requirements to be retained in their current form. That said, qualitative feedback still enabled our participants to share suggestions for improving the training content and presentation, including suggestions for additional information to be included. Former HOMESIDE participants (our expert CG raters) reported that the modules were comparable with the training they received in HOMESIDE, and that the content was engaging, understandable, realistic, and useful for their contexts. Further, some commented that they experienced learning additional content from this training that they had not learned in their HOMESIDE training. There may be a few explanations for this: firstly, the HOMESIDE training was delivered live and tailored to participants' needs (24, 25), while the expert CGs in the present study reviewed the entire training content (even modules that were not relevant to their current situation). Therefore, it is possible that the CGs reviewed content that was not presented to them during the HOMESIDE training. Secondly, the MATCH training content is arranged by presenting needs/outcomes, whereas HOMESIDE training was arranged by intervention method, with the intention of the person with dementia being present during the training (24, 25). It is possible that the different organization of content, framing of the science behind the music and intervention strategies, and targeting of CG only may have made the content easier for CGs to absorb. Finally, while the content for the MATCH training in the current version was based on the HOMESIDE protocol, additional iterations, including the integration of consumer input, may have led to a stronger, more comprehensive program.

This feedback suggests that delivering this training digitally was comparable to the in-person delivery.

The findings highlight that complex concepts, such as music-stimulated reminiscence, music attunement and music for care, were adequately conveyed to caregivers. However, qualitative feedback from MT-participants suggests there is a need to simplify the terminology used so it is understandable to a broader audience. Notably, this issue was not raised by CG-participants, although it is possible that this may be due to selection bias (participants who have an interest in participating in research may have been familiar with scientific terminology), or because CGs had some familiarity with music and dementia terminology from their experience in the HOMESIDE study. Furthermore, research indicates that use of jargon or specialized terminology can be a barrier for patient or informal caregiver education and decision making (50). Culturally responsive communication has also been found to be crucial in reducing barriers for people accessing healthcare support (51). Therefore, we feel it necessary to acknowledge the feedback from the expert MTs and further refine the language used in the modules so that it is more accessible for people who may be less familiar with the terminology, especially those for whom English is an additional language or those who have a low level of literacy. This feedback calls for the research team to invest considerable time with end users to ensure the terminology selected is well recognized, comprehensible, and has little likelihood of being misunderstood (51).

The only module to receive a face validity rating from expert CGs below 80% ("excellent") was the relaxation module, which scored 75 and 62%, respectively, for "realistic" and "useful" domains. Although our initial method called for modules with scores below 80% to be re-evaluated and below 70% to be removed, the qualitative feedback highlighted that the reason for these scores was not because CGs felt that the module was unnecessary, but that it did not reflect their current personal circumstances. CGs commented that they felt they could see how these modules would be helpful for others, or even for themselves further down the track. This reflects previous research that found that informal caregivers of people with dementia find value in learning from others in similar circumstances so that they can prepare for what is to come (52). Therefore, we feel that no revision is required at this stage, as CGs continued to see value in the module even though it did not relate to their specific circumstance.

No concerns were raised by expert MT-participants with respect to the comprehensiveness, clarity, and accuracy of the instructional content. In particular, no concerns were raised about safety. As we are developing a "medical device," it is critical that our training does not pose any risk (53), and safety is an aspect of app design that the research team place high priority on. Including a needs assessment, and a physical safety assessment within the app helps caregivers to identify which modules are most relevant (and safest) for their use. For the movement to music module, we have consulted with a physiotherapist and placed a disclaimer on all instructional videos, as well as providing regular cautionary statements about safety throughout that module. Each module provides a section on "what to do in scenarios where the person being cared for does not respond in the ways intended or anticipated" in written form. Such content was deemed clear and useful by participants via the content and face validity scores. However, several participants (both MT and CG)

suggested further video case examples depicting scenarios where people living with dementia did not respond as expected or responded negatively to suggested interventions. CG-participants particularly requested examples relevant to their own experience, notably related to highlighting how to respect the person with dementia's autonomy to decline an intervention. The HOMESIDE music interventions were designed using principles of person-centered care and validation (24, 54), which have long been established as important factors of maintaining psychological wellbeing and quality of life of people living with dementia (55). The feedback from participants highlights the importance of providing multiple examples to demonstrate how person-centered care can be enacted in various scenarios, and to compensate for the lack of personalized advice that the app offers.

Strengths and limitations

A strength of this study is that we were able to recruit a range of expert caregivers and music therapists, who provided important insights based on their expertise and lived experience. However, there is a limitation that both MTs and CGs were aware of who the research team were due to their association with the HOMESIDE study, as the lead researcher (FB) is a prominent presenter in the training videos. This may have caused participants to respond favorably. Although we were initially concerned that the high scores on the face and content validity scales might indicate a response bias, we feel that the inclusion of qualitative data has helped to provide depth and nuance to the feedback and demonstrate that participants were not simply selecting high scores to appease the researchers.

An important limitation of this study is the lack of diversity among participants, particularly expert CGs. We did not collect demographic data for this particular study; therefore, we cannot report on the diversity of participants. However, it should be noted that all expert CG participants were Australian residents and were fluent in English. While expert MTs from a range of countries were included, as we did not collect demographic data, we cannot report on the diversity of these participants either. As one subtheme for Enhancing Existing Content related to the lack of diversity (cultural, linguistic, gender, sexuality, and dementia type/stage), collecting this information is essential in future research to ensure that diverse perspectives are captured and that future iterations of the MATCH app are informed by and accessible to people with diverse backgrounds and lived experience.

Implications for future app development and research

Changes in mood and behavior associated with dementia are often experienced as distressing, and can adversely impact the wellbeing of both the person with the diagnosis and their caregiver (4–6). Further, managing agitation and other neuropsychiatric symptoms can overwhelm a family caregiver's capacity to cope. There is a need for interventions and supports that can reduce and regulate these symptoms in order to improve and maintain quality of life and psychological wellbeing for both the person with dementia and their caregivers (15, 16).This preliminary study suggests that the training modules developed for the MATCH app are acceptable as a way of conveying music therapy principles to support caregivers of people living with dementia. While several studies have found music interventions to be a suitable alternative to (potentially harmful) pharmacological approaches, further research is required to test whether the app can deliver the training in a format that caregivers can understand, relate to and use in their daily lives. The MATCH team plans to implement the training via the MATCH app in pilot studies and will compare the effectiveness of this format compared to the personalized delivery that HOMESIDE offers.

Data availability statement

The datasets presented in this article are not readily available because as this data relate to review of confidential content, the data are not publicly available. Requests to access the datasets should be directed to ZT, zara.thompson@unimelb.edu.au.

Ethics statement

The studies involving human participants were reviewed and approved by The University of Melbourne Human Ethics Committee (ethics ID: 2280). The patients/participants provided their written informed consent to participate in this study.

Author contributions

FB initiated and led the study. FB, TV, KL, AL, NL, JW, AV, and JT obtained funding. FB, JT, LF, ZT, PS-S, KM, RC, RW-K, and JW developed the module content. ZT and TV recruited participants and monitored the data collection. ZT and FB were responsible for qualitative data analysis and ZT and TV for quantitative analysis. ZT, JT, TV, RC, LF, KL, AL, NL, KM, JW, AV, RW-K, PS-S, and FB had access to the data and contributed to interpreting the data, drafting the manuscript, and approving the final version of the manuscript and had final responsibility for the decision to submit for publication. All authors contributed to the article and approved the submitted version.

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Conflict of interest

AV was employed by Redenlab Inc.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Learning to use music as a resource: the experiences of people with dementia and their family care partners participating in a home-based skill-sharing music intervention: a HOMESIDE sub-study

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An increasing number of people with dementia receive informal care from family members to help them remain living in the community. Music therapy is particularly beneficial for supporting the wellbeing of people living with dementia. However, little is known about how music therapy might support people with dementia and their family care partners as dyads. This study explored the experiences of six dyads participating in a 12-week home-based skill-sharing music intervention facilitated by a music therapist. We examined their experiences during the intervention period and in the 3–6 months following. This study was conducted within a larger randomised control trial, HOMESIDE. Data was collected through video-recorded music-based interviews, participant diaries, and a semi-structured interview. Data was analysed using an abductive and relational-centred research approach in consideration of the *Contextual Connection Model of Health Musicking for People Living with Dementia and Their Family Care Partners*. The study found fifteen themes that describe dyads' supported experiences of sharing music in their homes. These were organised into three global themes: (1) experiences were shaped by complex influences; (2) a connected musical ecosystem; and (3) music was a resource for wellbeing. This study highlighted the important role of personalised facilitation and the therapeutic relationship as dyads learned to use music as a resource through a process of trial and error. The implications for skill-sharing, indirect music therapy and direct music therapy practice are discussed.

KEYWORDS

music therapy, dementia, family caregiver, caregiving dyad, skill-sharing, family care partner, living in the community, indirect music therapy

1. Introduction

Dementia is a global health priority with more than 55 million people currently living with a diagnosis and cases increasing by nearly 10 million per year (1). To support people with dementia to remain at home, family members and friends provide increasing amounts of informal care (1). While providing care can be fulfilling, it also presents numerous challenges (2) and is a risk factor for stress (3). Within caring relationships, the wellbeing of the person with dementia and their family care partners as dyads is interconnected (4, 5). In light of this, dyadic approaches to care are increasingly recommended to support dyads individually and collectively (4, 6). Therapeutic music interventions, including music therapy, are uniquely helpful for people living with dementia, supporting memory, mood, communication and social connection (7, 8). There is an emerging body of research exploring the effects and experiences of therapeutic music interventions for individuals with dementia and/or their family care partners (9–12). A recent qualitative systematic review found that shared musical experiences may support dyads' individual and collective wellbeing through fostering experiences of connection (13). Based on these findings, the authors developed the *Contextual Connection Model of Health Musicking for People Living with Dementia and Their Family Care Partners* (13). The term *musicking* (14) refers to dyads' engagement in active and passive shared musical activities (15), and *health musicking* (16) is the intentional use of musicking for health. This model outlines factors that impact dyads' experiences of connection through musicking (the setting, facilitation, changes over time and the supportive aspects of music) and suggests a relationship between these experiences and dyads' wellbeing. It also presents multiple types of connection experienced through musicking including: connection to self, music, memories, the here and now, each other, shared dyadic identity, original relationship roles, group members, family members, and community. However, there are notable gaps in the literature. Firstly, there is limited research in home-based settings (13, 17) and there is a lack of perspectives from people with dementia (18, 19). Additionally, the *Contextual Connection Model of Health Musicking* has not been tested for validity, warranting further investigation.

In the context of growing demand and the limited number of music therapists, *music therapy skill-sharing* is increasingly recognised as a way to provide timely access to therapeutic music interventions (20, 21). Within skill-sharing approaches, music therapists work with formal and/or informal caregivers to help them use music safely and therapeutically in dementia care (20). Within the literature, the terms *indirect music therapy* and *music therapy skill-sharing* are often used interchangeably (20, 21), however the term *skill-sharing* may be more suitable for family contexts as it allows for the broader use of music to benefit both members of the family dyad. Early research into skill-sharing with family dyads was conducted by Clair (22), Hanser et al. (23) and Baker et al. (24), suggesting mutual benefits for the wellbeing of people with dementia and their family care partners. Building on these findings, the HOMESIDE music intervention was developed within the HOMESIDE randomized control trial (RCT) (25, 26). The HOMESIDE RCT aimed to examine the effects of therapeutic music interventions delivered by family care partners on the behavioural and psychological symptoms of dementia. The HOMESIDE RCT recruited 432 dyads across five countries (Australia, United Kingdom, Germany, Norway, and Poland), and compared music therapy interventions, reading interventions and standard care. The full protocol is presented in a separate paper (25). The current study was a sub-study of HOMESIDE, utilising qualitative data collected through the RCT alongside additional data collected by the authors. To address the noted gaps in the literature, this study aimed to explore the shared musical experiences of dyads participating in HOMESIDE (26) relative to the *Contextual Connection Model of Health Musicking* (13).

2. Methods

This study aimed to gain insights into how dyads experienced shared home-based music in the context of HOMESIDE's 12-week music therapy skill-sharing intervention (26). We examined their experiences during the 12-week HOMESIDE program and in the 3–6 months after HOMESIDE was completed. This paper outlines an abductive and relational-centred approach to a hermeneutic phenomenological analysis of interview and diary data collected from participants. The study gained ethics approval prior to commencement (University of Melbourne; HASS 1: 2022-14112-25430-8).

2.1. Music intervention

The music intervention followed the standardised HOMESIDE protocol (26). The HOMESIDE music intervention was designed to support family care partners to use musical activities mindfully to support the person they cared for. Across 12-weeks, dyads received three training sessions with a music therapist online via Zoom (27). In these sessions, dyads were introduced to four musical activities (singing, music listening, movement to music, and instrument-playing) and family care partners were guided to use these activities to support their family members' needs. These needs included but were not limited to enhancing connection and communication, regulating agitation and mood, and promoting meaningful occupation. Dyads were encouraged to use these musical activities in their home at least two times per week for approximately 30 min per session. Family care partners also received fortnightly follow-up phone calls with the music therapist. These phone calls allowed family care partners to clarify their understanding of the intervention, resolve any issues or negative responses to music, and gain access to further resources. The phone calls were also used to monitor adherence, check on the wellbeing of dyads and provide support as needed. Dyads completed a diary recording their music use across the 12-week program. Author 1 provided the music intervention for the six participants in this study as part of the HOMESIDE RCT.

2.2. Participants

Following their completion of the HOMESIDE program, six dyads were invited to participate in this study. Four dyads were spousal couples and two dyads were mother/daughter pairs. Within these, five of the family care partners were female, and one was male. Due to the importance of rapport within dementia research (28–30), we recruited dyads who had worked with author 1 as their music therapist in HOMESIDE. Dyads were identified as potential

participants after completing their final HOMESIDE follow-up assessment, at least 13 weeks after their completion of the program. They were invited to participate by a researcher who had no previous relationship with the dyads. All invited dyads agreed to participate and provided written informed consent (or proxy consent where necessary). In keeping with the HOMESIDE inclusion/exclusion criteria, participants also met the following criteria: one member of the dyad had a diagnosis of any type of dementia; the other member of the dyad was a family member or friend of the person with dementia, and not a formal paid caregiver; dyads were cohabiting; dyads scored ≥6 on the Neuropsychiatric Inventory-Questionnaire (NPI-Q) (31); participants did not have a significant hearing impairment that limited their ability to enjoy musical experiences; dyads had access to an internet connection and a computer, smartphone or tablet (25).

2.3. Data collection

This study utilised existing qualitative data from the HOMESIDE RCT, including dyads' diary entries and transcripts from a semi-structured interview conducted in week 12 of the intervention. To gain further insights into their experiences, we invited dyads to participate in a video-recorded *music-based interview* at least 13 weeks after they completed HOMESIDE. This music-based interview was a semi-structured interview that incorporated active and/or receptive music plus dyads' reflections on their immediate and prior musical experiences. This interview was conducted and recorded by author 1 online via Zoom (27) to align with the HOMESIDE intervention. Further data was collected through reflexive notes completed by author 1. Data was stored securely on a password-protected computer.

2.4. Data analysis

Hermeneutic phenomenology was the guiding theoretical framework for the analysis, where we acknowledged our understanding of participants' experiences as an interpretation influenced by our own perspectives and beliefs (32). Alongside this, a relational-centred research approach (33) was selected to recognise and learn from the relational knowledge developed by author 1 through working with dyads as a music therapist. To maintain rigour within qualitative research, reflexivity was an essential practice (34). Author 1 engaged actively in cycles of reflexivity including introspection, intersubjective reflection and social critique (35) and engaged the other authors in discussions of emerging ideas. An abductive approach was selected to examine the data relative to the *Contextual Connection Model of Health Musicking for People With Dementia and Their Family Care Partners* (13). Within this abductive approach, data were examined in the context of the model, and new insights were also sought from the data (36). We used some techniques drawn from codebook thematic analysis (37) to guide the coding and analysis process from within a hermeneutic (38) and relational-centred (33) position.

The procedure of analysis began with a coding framework based on the *Contextual Connection Model* and author 1 coded the data abductively through a series of 13 hermeneutic cycles (39). This involved a repeated shifting of focus between individual dyads and the larger data set (39). Data was coded both inductively and deductively with detailed notes and memos recorded using MAXQDA 2020 analysis software (40). Following coding, author 1 developed initial themes based on the final codes while considering the *Contextual Connection Model* abductively. These themes were developed and refined through gaining new perspectives of the data and themes using a variety of data engagement techniques including: immersion, zooming in and out, seeking connections, thinking outside the box, and dialogue within supervision with author 2. The final stage of analysis involved writing up the final themes (37).

3. Results

This study identified 15 themes that captured how dyads experienced sharing music during and after the HOMESIDE program, and the meanings of these experiences for dyads (see Table 1). Themes are identified as either a common theme (applied to all dyads) or a significant theme (applied to many or most dyads). The themes are interrelated, they interact in multiple and complex ways, and are organised into three global themes: (1) *Experiences were shaped by complex influences*; (2) *A connected musical ecosystem*; and (3) *Music was a resource for wellbeing* (see Table 1). The terms *musicking* (14) and *sharing music* (41) are used interchangeably to capture dyads' broad use of music and music-related activities (14, 42). The term *affordances* (43) refers to what music offers dyads in their unique contexts. Where examples are provided, the person living with dementia is positioned centrally, with their family care partners identified in relation to them (e.g., Ray's wife, Lynn).

3.1. Experiences were shaped by complex influences

Dyads' experiences of sharing music were influenced by who they are (theme 1) and the context they live in (theme 2). This context was continually shifting as dyads experienced changes to their health and life circumstances. Over the course of the HOMESIDE program, dyads' experiences were further shaped by changes in how they thought about and used music (theme 3). These changes to their relationship with music were fostered through the personalised, collaborative and structured facilitation they received through HOMESIDE (theme 4). These complex and interacting factors influenced how dyads *engaged* with music and how they *interpreted* their experiences.

For instance, dyads responded differently to musicking based on their personalities and relationship dynamics (theme 1). This was highlighted by Ray's wife, Lynn, who reflected on how they responded differently during a live music concert:

> "So while Ray has never been the one to get up and dance, he was jiggin' in his seat and singing the whole time, I was up dancing."

Professional identities and cultural backgrounds also influenced dyads' expectations of musicking. Myrtle associated musicking with relaxed social gatherings due to her Irish background, while Susan's Chinese background informed her view of singing and dancing as activities reserved for children or professionals.

TABLE 1 Themes and global themes.

Experiences were shaped by complex influences	A connected musical ecosystem	Music was a resource for wellbeing
1. Dyads' musical experiences were shaped by **who they are**: complex people with complex relationships and histories (common theme)	5. Musicking afforded **moments of connection** for dyads (common theme)	9. Dyads appreciated the **affordances of music** (common theme)
2. Dyads' musical experiences were influenced by their **ever-shifting context** (common theme)	6. Musicking **revived** and **strengthened** existing connections (common theme)	10. Dyads learned to **intentionally use music** as a resource for wellbeing (common theme)
3. Dyads' relationship to music **changed over time** (significant theme)	7. Musicking **facilitated new experiences** (common theme)	11. "It's not a magic pill": health musicking **did not always "work"**, and it took effort to find what did (significant theme)
4. Dyads benefitted from **personalised, collaborative, and structured facilitation** (common theme)	8. Musicking provided opportunities for dyads to **witness** and **be witnessed** (common theme)	12. Sharing music was **enjoyable in the moment** (Common theme)
		13. Sharing music was **helpful** for dyads (common theme)
		14. Sharing music supported **confidence** for people living with dementia (significant theme)
		15. For some dyads, when music helped, it was **instant, amazing, incredible, fantastic** (significant theme)

Dyads' ever-changing contexts also influenced their experiences (theme 2). Several dyads reflected on the influence of Covid-19, describing musicking as a "replacement" for other activities during Covid-19 restrictions. In the context of dementia as a progressive condition, some dyads needed to adjust their musical activities as their needs changed. For example, as Vicki's dementia progressed, her husband Geoff increasingly used music to help her feel connected, centred, and calm in the moment.

Across the 12-week music intervention, dyads' relationship to music changed, further influencing how they experienced musicking (theme 3). Firstly, dyads changed how they *thought about* music as they recognised and appreciated its affordances. RH's wife, LM, reflected on this in their interview, stating "I've enjoyed the whole process as far as understanding about music more and the impacts that music can make on a life." Dyads also changed how they *used* music. Overall, dyads used music more *intentionally* and more *frequently*, and many dyads integrated musicking into their daily lives. This was shown by Myrtle's daughter, Kath, who incorporated music into their daily tasks: "Come dinner time, (music) was really helpful for me with preparing food … It certainly helped mum engage in the kitchen."

All dyads reflected on the helpful role of facilitation in supporting positive musicking experiences (theme 4). In particular, dyads valued the personalised, collaborative and structured nature of the facilitation. The therapeutic relationship and structure of the program were key to maintaining motivation, highlighting the centrality of the scheduled sessions and follow-up phone calls. As reflected by Ray's wife, Lynn, "I think it would be very easy, if you were not contacting us, it would be very easy just to fall off the wagon." The personalised and collaborative aspects of facilitation enabled dyads to find solutions to challenges they encountered at home, and helped them identify which activities were most helpful and/or suitable. Richard's wife, Meg, reflected on this in their interview:

> "The (musical activities) that you came up with were so pertinent to us. I think you listened, and you knew something about us and knew what we were capable of. So you came up with the idea (of songwriting) … Your coaching us was really, really beneficial."

3.2. A connected musical ecosystem

Dyads experienced multiple levels of connection through musicking as they connected to themselves, each other, friends, family members, and sometimes the broader community. Dyads' experiences of connection were experienced temporally as *moments* (theme 5). Within these moments, dyads experienced the revival and strengthening of their existing connections to self, memories and each other (theme 6). Some dyads also developed new connections through songwriting, learning new songs, and making new social connections beyond the home (theme 7). Additionally, sharing music provided opportunities for dyads to experience each other relationally, inhabiting familiar and new roles, and understanding themselves within an ecological context as they witnessed others and were witnessed themselves (theme 8).

Vicki's experiences of sharing music with her husband, Geoff, highlight the temporal and meaningful nature of moments (theme 5). While Vicki experienced difficulties with focus and verbal communication, she often became more engaged and animated during musicking. For Vicki, this was meaningful and enjoyable in the moment, as she appeared to connect with Geoff through smiling, increased eye contact, and physical affection. For Geoff, while these moments were "very much few and far between," he valued the "rekindling" of their connection, reflecting that "anything is a blessing." This rekindling or reviving aspect of connection was a common experience across dyads (theme 6). Through sharing music, dyads revived and strengthened existing connections to music, memories, each other, the self, memories and the *ability* to remember. These reconnections were meaningful to dyads in the context of lost connections due to symptoms of dementia.

Musicking supported people with dementia to reconnect to a sense of self, and re-identify with their musical identities. For instance, Susan reflected that she enjoyed singing, reflecting on her role as "lead singer" in her middle and high school classrooms. Others, such as RH, viewed music as "just part of my life." All dyads experienced reconnections to memories through musicking, and reminiscing became a rich source of conversation for many. This supported reconnections to each other as dyads, particularly for

spousal couples, who revisited positive shared memories through music.

Musicking also supported *new* connections for dyads. This included connecting to music in new ways through various HOMESIDE activities, and creating new neural connections through songwriting, learning songs, building social connections and creating memories. The creation of new memories was particularly meaningful for family care partners as they recognised the ongoing value of these. Myrtle's daughter, Kath, reflected on the significance of new memories, as Myrtle passed away before their final interview. Kath reflected:

> "There is one image that always (comes back), Mum and I just sitting on the couch and laughing and she just put her hand out, and we'd hold hands just quite naturally. And that's something that she did a lot when the music was playing … My mum just hold(ing) my hand is such a simple gesture, but … it's invaluable to me. It's a beautiful memory to have."

Sharing music also allowed dyads to experience each other relationally as they witnessed each other playing, singing and remembering (theme 8). Family care partners experienced pleasure at seeing their loved ones' strengths through music, frequently commenting on their ability to remember songs and lyrics. Being witnessed was an equally powerful experience as participants with dementia were seen through their strengths (theme 8). The dynamic of witnessing and being witnessed through music also highlighted dyads' relational knowing of each other, with each able to comment on the preferences of the other. This provided opportunities to recapture original relationship roles as demonstrated by Richard and his wife Meg:

Meg: The dancing. I love dancing. I looooooove dancing.
Richard: Oh you sure do.

It is important to note that witnessing and being witnessed was not always a positive experience. Musicking also reflected changes to people with dementia's abilities as their condition progressed, and this was sometimes challenging for dyads. For example, as Vicki became less responsive to music over time, her husband Geoff reflected that this lack of response was "fairly representative of where she's at the moment." This made witnessing challenging for Geoff as he expressed grief around changes to Vicki's abilities.

3.3. Music was a resource for wellbeing

As dyads changed how they thought about music (theme 3) they gained an appreciation of its affordances (theme 9), drawing on these more intentionally over time (theme 10). While it sometimes took effort to find what "worked" (theme 11), musicking was broadly experienced as enjoyable (theme 12) and helpful (theme 13). As musicking empowered people with dementia to express and build on their strengths, they became more confident in their abilities (theme 14). Family care partners also gained confidence in their caregiving role (theme 14). While musicking was not *always* helpful, at times it was experienced as "instant," "amazing," "incredible" and "fantastic" (theme 15).

While the affordances of musicking varied due to dyads' individual contexts, music was broadly identified as flexible, accessible and adaptable. This afforded opportunities for social connection, positive mood, reduced distress and improved cognitive abilities (e.g., the ability to remember; theme 9). Several people with dementia commented on music's capacity to support their memory, linking this to improved self-esteem and confidence. Ray commented on this in his interview:

> "It's good having an ability where I can (remember songs) … (I've) still got to go back into the (memory) files, they are not always there, I do not pull the right one up all the time, but the list is still there."

The soothing capacity of music was also valued, with several family care partners reflecting on using music to soothe their loved ones and themselves. Dyads' intentional use of music increased as their participation in the HOMESIDE trial progressed (theme 10), and this was reflected in their interviews and diaries. Dyads used music intentionally to interact and bond with each other, to soothe, to "use the brain" (Richard), and to manage mood and stress. As dyads became more comfortable with using music as a resource for wellbeing, they were able to use it more flexibly as needed, with some integrating musicking into their daily lives.

Importantly, using music for wellbeing did not always 'work' for dyads, and it sometimes required effort to discover what was helpful (theme 11). Definitions of what 'working' meant varied across dyads, and this was often influenced by their expectations of music for dementia. For example, two family care partners referred to videos they had seen on social media of people with dementia's dramatic responses to music. At times, family care partners used these videos as a comparison point for their loved ones' less dramatic responses, which resulted in some disappointment. Susan's daughter Jenny reflected on this more moderate impact of musicking for her mother: "So music has eased its way in to give a little bit of pleasure. It's not a magic pill." For other dyads, it took a process of trial and error to find which musical activities were most helpful. Dyads valued supportive facilitation within this process to help with problem-solving and motivation.

Despite these challenges, musicking was broadly experienced as enjoyable in the moment (theme 12). This was discussed within diary entries and interviews and observed during music-based interviews. In the longer term, sharing music was experienced as helpful for dyads' mood (theme 13). Most people with dementia also experienced music as helpful for their memory, and some family care partners felt better able to cope with the challenges of caregiving (theme 13). Myrtle's daughter, Kath, reflected on several helpful aspects in her interview:

> "Being able to diffuse a stressful situation early on in the piece with music had undoubted benefits for me. But also the happiness part of it, that's good for you as well. When we got into the study, we both had a bounce in our steps."

Knowing how to use music as a caregiving tool boosted the confidence of some family care partners. At the same time, musicking supported people with dementia's confidence as it reinforced their

strengths such as memory and musical abilities. This was shown by Ray, who reflected that remembering is "a bit of an achievement sometimes." This increased confidence supported musical flourishing for two participants with dementia as they embraced musicking as a creative expression of self. With newfound confidence, their self-expression expanded into performing for other family members and in community spaces.

While musicking did not always 'work', at times it was notably impactful and affecting (theme 15). These moments were highly valued by dyads, providing a welcome contrast to experiences of loss and decline. These peak moments captured what is possible for dyads through musicking while serving as a reminder of people with dementia's continuing strengths. For people living with dementia, these are moments of pride, joy and hope. For family care partners, these experiences are furthered through the creation of cherished memories. One of these moments was captured through author 1's observational notes from Richard and his wife Meg's music-based interviews:

> "In this moment, Richard appears to be completely in the moment with the music. There is no hesitation in his movement, just playfulness and confidence. He is confident in his abilities, and in expressing himself. Meanwhile, Meg also seems to be connecting to the music as she joins in and sings, laughing intermittently. These laughs appear to be joyous, and as she later emails me, she gets joy from watching Richard in his confident self-expression."

4. Discussion

The findings of this study shed new light on the *Contextual Connection Model of Health Musicking for People With Dementia and Their Family Care Partners* (13), indicating the need for several changes. Most notably, dyads' experiences of connection through musicking were newly understood as multifaced, ecological and cyclical. This understanding aligns with Ansdell's (15) concept of *musical worlds*, which views musical encounters as ecological and contextual. Additionally, this study highlighted the influence of personalities, relationships and histories on dyads' experiences of connection through music. We also identified challenging experiences such as grief, adjusting expectations and the effort required to use music effectively at home. Further, author 1's understanding of the *supportive aspects of music* evolved to align with concepts of *musical affordances*, where music is understood to offer different opportunities depending on the context (43, 44). To reflect these new understandings, a *Revised Contextual Connection Model of Musicking for People Living with Dementia and Their Family Care Partners* was developed (see Figure 1). The change in terminology from *health musicking* (16) to *musicking* (14) reflects renewed understandings of dyads' intentionality during musicking, where it is recognised that dyads do not *always* use music deliberately to support their health. This revised model reflects the cyclical nature of dyads' experiences of connection through music, as each new musical encounter is shaped by their ever-changing context. We newly frame dyads' experiences of connection within an ecological framework (45), highlighting the interconnected and multifaceted nature of connections. Further, the effects of these connections are expanded, showing that challenging experiences and changes to dyads' relationship to music may occur simultaneously with and/or alongside improved wellbeing. Within this model, *learning to use music as a resource* is identified as an advanced outcome facilitated through personalised and focused interventions (such as HOMESIDE). While it is possible that dyads may develop greater understandings of musical affordances through participation in other settings (such as community music groups or traditional music therapy), we argue that the development of the conscious use of music requires more focused support.

4.1. Conceptualising connection

The results of this study present new insights into dyads' experiences of connection through musicking across settings, plus nuanced understandings of dyads' experiences of connection within home-based settings. Based on these findings, we conceptualised connection through musicking for dyads as: (1) influenced by context; (2) ecological; (3) temporal; (4) embodied; (5) of varying quality and characteristics; (6) supported by the affordances of music; (7) supportive for dyads' individual and collective wellbeing; and (8) not a magic pill.

This paper has a specific focus on discussing the music therapy practice implications of a home-based skill-sharing music intervention for dyads. Therefore, this discussion primarily focuses on the findings relating to the advanced outcome of *learning to use music as a resource for wellbeing* presented in the *Revised Contextual Connection Model of Musicking for People Living with Dementia and Their Family Care Partners* (Figure 1).

4.2. Learning to use music as a resource

The findings of this research highlighted the numerous affordances of musicking for dyads. Musicking may afford opportunities for soothing, connecting, lifting mood and abilities, and offers multiple entry points for increased accessibility. However as argued by Ansdell (15), making use of these affordances is not an innate skill. It must be learned or facilitated by others. This research showed that dyads participating in HOMESIDE learned to use music as a resource with the support of personalised, collaborative and structured facilitation. This supports findings of previous studies where dyads learned to use music to support their practical and emotional needs in their daily lives (17, 46, 47). These studies also suggest positive outcomes for dyads learning to use music as a resource, such as improved coping for family care partners, and improved emotional wellbeing for both members of a dyad. However, insights into the *learning* process for dyads have not previously been explored. The current study contributes novel findings to this area by illuminating core aspects of dyads' process of learning to use music as a resource. This included: (1) changes to how they think about music, (2) appreciating the affordances of music, (3) learning to use music intentionally, (4) trial and error, (5) adjusting expectations, and (6) the importance of personalised, collaborative and structured facilitation.

Through participating in HOMESIDE, dyads changed how they thought about music as they gained an appreciation of its affordances through a process of trial and error. Changes in how dyads thought about and used music occurred gradually as they learned through

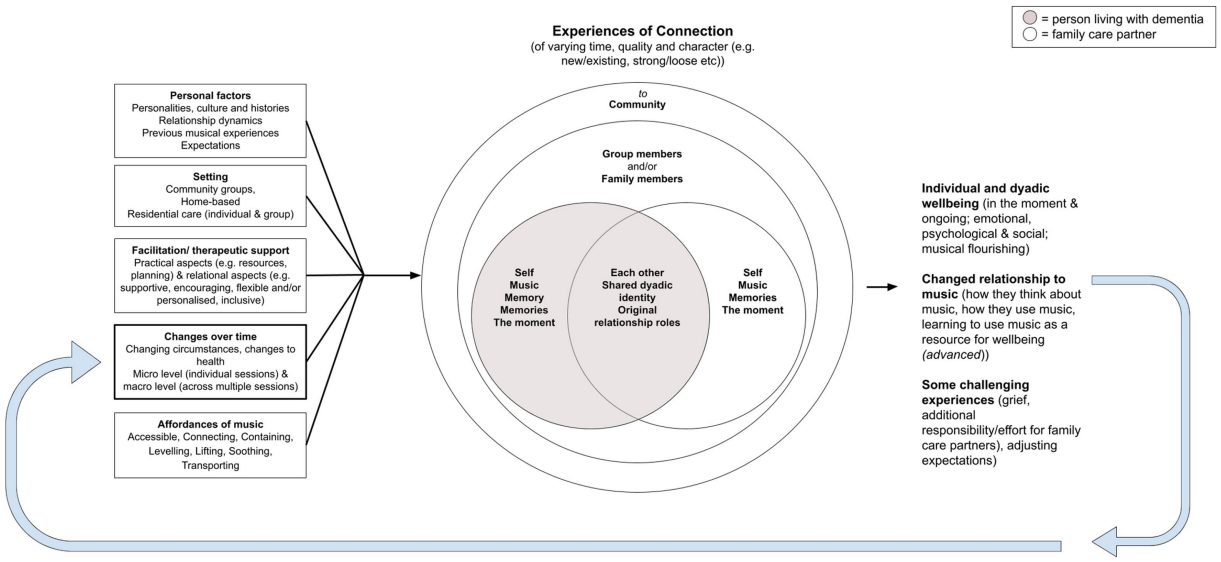

FIGURE 1
Revised contextual connection model of musicking for people living with dementia and their family care partners.

doing and reflecting on their experiences through supported facilitation. The active nature of appropriating the affordances of music is discussed by DeNora (48), who describes the use of music in daily life as recruiting a *technology of the self*. For healthy individuals, appropriating music is largely sub-conscious, but in the context of illness, the use of music to support health may require a more conscious approach (48). This intentional use of music for health is defined as *health musicking* (16). There is limited research examining how dyads may develop an intentional approach to musicking, however Batt-Rawden and Tellnes (49) provide some insights into the skill-development process for people with long-term illness. In their longitudinal ethnographic study, Batt-Rawden and Tellnes investigated how 22 participants engaged with a selection of musical CDs with no formal intervention provided. They describe how participants learned to appropriate music through increasing their awareness of themselves and of music's affordances. This aligns with our findings on the importance of increased awareness in the learning process. In contrast to HOMESIDE, Batt-Rawden and Tellnes' study discusses "indirect learning," leading to findings that knowledge was acquired "obliquely … (and) in ways that elude conscious processing" (49). The authors also argued that this learning required extended periods of time. The current research points to the value of a more direct approach to learning, as we found that all dyads learned to use music as a resource over a 12-week period with the support of a direct skill-sharing approach.

A personalised and collaborative approach was also key to supporting dyads through a process of trial and error as they learned which musical activities were most helpful for their needs. To our knowledge, this process of trial and error has not been identified in previous skill-sharing research, particularly with family dyads. Within this process, dyads valued the expertise of the music therapist who was able to provide personalised and timely musical ideas and information about the common affordances of musicking. This aligns with broader research that identifies timely and personalised information as a core need for family care partners (50). Dyads also valued the therapeutic relationship with the music therapist, sharing this helped them maintain motivation and manage the challenging aspects of the learning process. These challenges included experiences of grief, disappointment and adjusting expectations. In a parallel study investigating HOMESIDE participants' experiences in Norway, Stedje et al. (47) also identified the vulnerabilities dyads face as they learn to use music in their homes, suggesting music therapists may be essential supports in this context. Music therapists may be particularly well-equipped to provide skill-sharing for family dyads who have dual needs of education and emotional support. As noted by McDermott et al. (20) supportive interventions for family dyads may oscillate between direct and indirect music therapy approaches as the needs of the dyads change. Music therapists are uniquely trained in responding to the individual and changing needs of clients (51) and specialise in the use of music for achieving non-musical outcomes. Therefore, to manage the complex needs of family dyads, music therapists may be the most appropriate facilitators for home-based interventions. To support dyads in learning to use music as a resource, therapists should consider the following aspects: the importance of personalised facilitation, the process of trial and error, maintaining motivation, dyads' expectations, the context of continual change, and opportunities to connect dyads to the community. These are discussed below.

4.3. Supporting dyads to appropriate music

4.3.1. Personalised facilitation

As found in this research, dyads benefit from personalised facilitation to meet their complex and changing needs. This aligns with the broadly accepted recommendations for the personalised use of music for people with dementia (52, 53) and the need to consider family dynamics within family-centred approaches to dementia care (54, 55). Due to the heterogeneity of dyads' contexts, music therapists

need to build an understanding of dyads' *musical worlds* (15) to provide the best individualised care. As the results illustrate, these musical worlds are influenced by dyads' personalities, relationship dynamics, previous musical experiences, culture, the setting, and dyads' changing health and circumstances. In practice, much of this information may be gathered during the initial assessment, however an understanding of dyads' relationship dynamics may build over several sessions. Changes to health and circumstances must be continuously assessed. Additionally, in alignment with findings by Dassa et al. (17) and Stedje et al. (47), this research highlights the complex and different needs of family care partners within the dyadic context, indicating the need for awareness and sensitivity around dementia grief (56). While the importance of supporting dementia grief within dyadic contexts is identified in several studies, there is limited discussion on how music therapists might best do this. Melhuish et al. (46) identify the relevance of Blandin and Pepin's framework (56) for music therapists supporting dementia grief in dyadic contexts, however they do not elaborate on how music therapists might incorporate this into practice. Within this research, the creation of new memories played a role in supporting grief for family care partners while some experiences may have highlighted their loved ones' decline. This suggests further research is needed to understand how family care partners experience dementia grief within dyadic interventions, as well as how music therapists might best support them to process and adapt (56).

4.3.2. A process of trial and error

Personalised facilitation is particularly valuable for supporting dyads through a process of trial and error to identify which musical activities are most helpful. As dyads are introduced to new musical activities, their process is facilitated through experiential learning (57) with opportunities for reflection, validation, support to refine activities, motivation and emotional support. The use of experiential learning with opportunities for reflection was effectively used by Beer (58) to train formal caregivers in the therapeutic use of music. The experiential nature of learning is also identified by Ridder and Bøtker (59) in providing Person Attuned Music Intervention (PAMI) training for professional caregivers, who note that "knowledge may seem irrelevant until they experience *how* it works" (59). Krøier et al. (60) also identify helpful areas of focus for learning to attune through music: tempo, timing, and dialogue. For family dyads, this learning process is made more complex by the personal nature of the proposed intervention, and the challenges of integrating intentional approaches to music in the home-based setting. Music therapists are well-equipped to provide validation and emotional support through the therapeutic relationship, and have well-developed skills in adapting musical activities (59). Therefore, music therapists are particularly well-suited to provide music therapy skill-sharing within a family dyadic context as they can support experiential learning with additional problem-solving and emotional support elements.

The pace of introducing activities is another important consideration. In facilitating HOMESIDE, it was helpful to focus on one or two activities per session to avoid information overload. The flexible design of HOMESIDE enabled tailoring the pacing to meet the needs and preferences of dyads (26), and this also aligns with the PAMI training manual for professional caregivers (61). This finding highlights the importance of flexible skill-sharing approaches that allow the pacing to be personalised for each dyad.

4.3.3. Supporting motivation

Study findings also highlighted the importance of structure and external accountability as a source of motivation for dyads. Dyads appreciated the regularity of sessions and phone calls and the reflective nature of completing a diary. The enjoyable nature of musicking was also experienced as motivating, which aligns with previous findings in the literature (18, 62, 63). Within the home-based setting, some family care partners found it difficult to maintain motivation to use music after the program ended, despite their desire to utilise its affordances. This has implications for the sustainability of skill-sharing programs, suggesting dyads may benefit from ongoing support to maintain motivation in the longer term. Considerations of sustainability are imperative for good music therapy practice (64), and have been noted as an area for development in dyadic music interventions (46, 65, 66). While skill-development and knowledge transfer provide a strong foundation for dyads' ongoing use of music, this foundation may need bolstering through additional supports. This aligns with findings by Dassa et al. (17) who specifically explored the sustainability of a home-based musicking program. While Dassa et al. (17) found that the sustainability of an intensive 12-week program was promising, they recognised that one of their participating dyads (out of a sample of two dyads) needed ongoing support due to the progression of dementia. To support this need, they provided continuing monthly sessions and fortnightly phone calls for the dyad. The ongoing sustainability of their approach was not reported on (17).

Bolger and McFerran (64) suggest multiple elements to support the sustainability of music therapy programs, including links to independent ongoing programs, skills/knowledge transfer, links to wider community, and the provision of resources. For dyads learning to use and maintain musicking as a resource for wellbeing, connections to community music groups and the provision of resources may be indicated alongside the provision of ongoing individual supports. Further research into these ongoing supports is needed to assess their feasibility and effectiveness.

4.3.4. Understanding expectations

Alongside this process of trial and error, therapists should aim to understand dyads' expectations around the challenges and benefits of musicking. As highlighted through this home-based study, dyads' expectations may be influenced by videos shared through social media, and these may not realistically reflect what musicking affords within daily life in the context of dementia, nor the effort required to appropriate these affordances. Unrealistic expectations may lead to disappointment for dyads; therefore, music therapists should endeavour to present realistic expectations in public and private communications. Additionally, it may be important to validate and support dyads to adjust these expectations as they may be linked to dementia grief (67). Little has been written about the influence of media on expectations around music and dementia, however critics of media in the broader disability space suggest that viral videos are typically shared without context, and may create unrealistic expectations of people's abilities (68). At a broader level, discussions around client expectations of music therapy are scarce across populations, indicating the need for more research in this area.

4.3.5. Adjusting to continual change

Dyads experience musicking in the context of continual change. For music therapists, this requires ongoing adaptability and knowledge

of symptoms and interventions across all stages of dementia. While music therapists must be prepared for future changes, providing information that is not focused on dyads' current needs and situation may cause unnecessary stress (69). Therefore, it is recommended that interventions focus on supporting dyads in the moment while simultaneously building resources that may be helpful for dyads in the future. These resources might include the development of playlists, musicking routines, and connections to community. This approach aligns with resource-oriented aspects of Community Music Therapy (70) which focus on developing strengths, material resources and social/relational capital. Due to the progressive nature of dementia, dyads may also benefit from access to ongoing support or 'top-up' sessions to help them adjust their use of music over time. As previously discussed, further research is needed to identify which types of support might be most beneficial at different stages of the dementia journey for dyads. This research may extend to exploring the role of musicking in bereavement after a family member has died.

5.3.6 Connecting to community

Supporting dyads to connect to community through music may provide multiple benefits. As found through our earlier thematic synthesis, group musicking provides strong social supports and fosters meaning-making, personal growth, flourishing and citizenship. These aspects contribute to expanded notions of wellbeing for people living with dementia that go beyond coping and surviving (71). Additionally, as highlighted within our home-based research, dyads may benefit from support to maintain their use of music following a period of focused training. Connecting dyads to peers through community musicking groups or online support discussions may function to support motivation and adaptation over the longer term. This supports findings by Clark et al. (63) where the enjoyable aspects of group therapeutic songwriting motivated dyads to "do more with music" beyond sessions.

While some dyads may struggle to attend group musicking in person due to difficulties leaving the house or geographical remoteness, online options are increasingly available due to responses to Covid-19 (72). While there are challenges and limitations in conducting group musicking in online settings (e.g., latency, synchronicity and hesitance/anxiety in using technology) (73), a growing number of studies show that online group musicking is both feasible and beneficial for dyads (74–76). Research shows dyads are increasingly confident and comfortable using technology (73), and online group musicking may offer an accessible option for reducing social isolation and supporting mood (72, 75). As a recent addition to practice, further research is needed to examine the barriers and benefits of online group musicking for dyads.

To further support connections to the community, music therapists may also consider broader music networks available to dyads, such as local concerts, churches, singing groups, workshops and other community music offerings. As found by Hara (77), community music groups may serve as a central activating point for musical and extra-musical care pathways, supporting citizenship for dyads through integrated connections to community.

4.4. Strengths and limitations

This study provided unique insights into music therapy skill-sharing, a developing area of practice, presenting practical and theoretical considerations for music therapists and program developers. The innovative use of video-recorded music-based interviews provided opportunities for people with dementia to share their experiences through musical and non-verbal communication, and these data were strengthened through triangulation with diary and interview data across multiple time-points. The use of video-recording via Zoom (27) also limited our observations to what was captured on the screen. Therefore non-verbal responses outside this frame (such as toe-tapping, fidgeting etc.) were potentially missed. This may have influenced our interpretation of dyads' experiences. While this study offers some insights into dyads with adult children as care partners, more research is needed to identify differences in needs between spousal and adult/child dyads. This study also had limited diversity as all dyads lived in Australia, most participants were born in Australia and spoke English as their first language, and all spousal couples were heterosexual. Future studies would benefit from greater diversity to understand dyads' experiences in different cultural contexts.

5. Conclusion

This study offers new insights into dyads' experiences of sharing music across settings, informing the *Revised Contextual Connection Model of Musicking for People Living with Dementia and Their Family Care Partners*. This study also presents insights into dyads' process of trial and error as they learned to use music as a resource. To support this process, dyads benefitted from personalised support to overcome challenges, maintain motivation, adjust to change and connect to community. Music therapists play a crucial role in providing both practical and emotional support for dyads to identify and utilise the affordances of music. Dyads may benefit from follow-up support to adapt as dementia progresses, and connections to broader resources in the community. Importantly, while musicking is largely helpful and enjoyable for dyads, music therapists need to be sensitive to expectations around the benefits of music. While this research provided new insights into dyads' experiences of using music as a resource, further research is needed to understand what approaches are most helpful at different stages, and the role of musicking in dementia grief and bereavement. Additionally, research into ongoing support for dyads is needed, including 'top-up' supports, connections to peers, and musical and community-based resources.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by University of Melbourne, HASS 1 ethics committee. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

KMcM led the design, implementation, analysis, writing and editing of this study, and drawing on the HOMESIDE music intervention protocol (26). FB and KMcF provided supervision for KMcM across these processes. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Music-based multicomponent exercise training for community-dwelling older adults with mild-to-moderate cognitive decline: a feasibility study

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Introduction: This study explored the feasibility and preliminary efficacy of a music-based, multicomponent exercise intervention among community-dwelling older adults with mild-to-moderate cognitive impairment.

Methods: 16 older adults aged 85±9 years with mild-to-moderate cognitive impairment received music-based multicomponent exercise training for 20 weeks at an independent living facility. Participants received aerobic, resistance, and balance training paired with beat-accentuated music stimulation. Participants' adherence to the training was tracked down and their cognitive and physical functioning and health-related quality of life were assessed at pre- and post-test.

Results: 3 participants withdrew due to unexpected issues unrelated to the intervention and thus 13 participants (7 females) attended an average of 4.6 days/week over 20 weeks and reported high satisfaction with the intervention (90.6%). Participants showed significant improvement in global cognition, cognitive processing speed, and walking endurance/aerobic fitness at post-test.

Discussion: These findings support the feasibility of music-based, multicomponent exercise training for older adults in an independent living facility and set the stage for future studies to test the efficacy of music on physical activity and ensuing health outcomes. We conclude that music-based, multicomponent exercise training can be beneficial for community-dwelling older adults with mild-to-moderate cognitive decline. As a form of rhythmic auditory stimulation, beat-accentuated music can be combined with exercise training to manipulate exercise tempo and may provide a source of motivation to help older adults adhere to exercise.

KEYWORDS

adherence, aerobic training, cognitive impairment, dementia, music therapy, physical activity, rhythmic auditory stimulation, resistance training

1. Introduction

It is estimated that 13.8 million United States adults will be living with Alzheimer's disease (AD) by 2050, which will result in $1.1 trillion in health care costs (1). With no curative treatment currently available, lifestyle interventions reducing risk factors are imperative to prevent or delay the onset of AD (2). This is an important direction because delaying the onset of AD by 5 years could lower the prevalence of the disease by 42% and reduce the health care costs by $367 billion (1). Notably, about one-third of AD cases worldwide are related to

modifiable risk factors; the largest proportion of cases in the US is attributable to the lack of physical activity (PA) (3). Hence, it is important to promote PA in the aging population to protect against the progression of cognitive decline and dementia.

The global and national PA guidelines (PAG) prescribe older adults to regularly engage in moderate-intensity aerobic exercise for 150–300 min/week as well as resistance and balance training for 2–3 times/week (4, 5). However, current population data show that only 9–18% of US older adults adhere to the PAG (6, 7). This trend is untoward especially given the meta-analytic evidence that PA interventions with both aerobic and resistance training have shown greater benefits for older adults' cognitive health compared with aerobic training only (8). Despite the cumulative evidence supporting the benefits of exercise training for cognitive and brain health, the rate of citizens maintaining regular exercise is lower than desired (9). Thus, a new approach is needed to promote adherence to the PAG in the growing number of older adults.

Cumulative evidence indicates that music listening can have motivational effects on PA (10–13). A meta-analysis revealed that listening to music prior to or during acute exercise bouts increases positive affective valence (feeling good versus bad; $g = 0.48$, CI [0.39, 0.56]), reduces ratings of perceived exertion (RPE; $g = 0.22$, CI [0.14, 0.30]), enhances physical performance ($g = 0.31$, CI [0.25, 0.36]), and improves oxygen utilization efficiency (VO2max; $g = 0.15$, CI [0.02, 0.27]) among healthy adults (14). These findings support the notion that music helps exercise bouts to be perceived as more joyous, less arduous, and more energizing. These findings are congruous with the view that humans are predisposed to take pleasure in moving with music, as evidenced in preverbal infants' positive affective responses and rhythmic motor reactions when hearing musical or rhythmic stimuli (e.g., Mozart, Saint-Saëns, children's song, or drumbeats) to a greater extent than non-musical stimuli (e.g., adult speech) (15). In-depth interviews of older adults indicate that a negative affective response to exercise is a key barrier to adherence to PA whereas enjoyment is an important motivator for being physically active (16, 17). Therefore, exercising with music may help older adults enjoy exercise more as a motivational stimulant.

Our lab conceptualized a theoretical model to account for how music influences acute and long-term PA based on the theory of hedonic motivation (18). In an acute context, music can help people like a PA session more (or dislike it less) and thus increase wanting (or decrease dread) to exercise more or harder (18). Over the long-term phase, hedonic (affective) responses to PA serve as the inputs into the process of generating hedonic motivation for another bout of PA. In other words, when people experience a PA session as pleasant, this positive hedonic response is linked to enhanced motivation for upcoming PA, which increases the chance of maintaining long-term PA. In our conceptualization, we particularly stressed the importance of beat accentuation and tempo synchronization to facilitate auditory-motor synchronization in music listeners (18). This argument was made based on (1) the neurobiological evidence that affect- and reward-related brain regions are activated when moving in sync with pleasurable music (19–21) and (2) the behavioral evidence that infants' rhythmic motor responses to music coincided with smiles and the duration of smiles showed meaningful correlations with the degree of music-motor synchrony accuracy ($r = 0.42$ and 0.26 in two experiments) (15). Therefore, facilitating auditory-motor synchronization may maximize the effect of music on positive hedonic response to PA and thereby promote adherence to a PA program (18).

We developed an exercise program paired with Beat-accentuated Music Stimulation (BMS) and found its affective and ergogenic effects on an acute bout of exercise compared with exercising without music among community-dwelling older adults (22). We here define BMS as the application of pulsed, tempo-synchronous music stimuli embedded with sonically enhanced beats to facilitate rhythmic body movement. BMS has been employed in cardiac rehabilitation (23) or gait rehabilitation in people with Parkinson's disease (24–26) or stroke (27, 28). A randomized controlled trial (RCT) (23) found that self-directed walking-for-exercise in sync with BMS led to nearly twofold increases in accelerometer-measured weekly volume of PA at all intensities and in caloric expenditure over 3 months among midlife-to-older adults in a home-based cardiac rehab program relative to the same exercise program with beat-unaccented, tempo-synchronous music or without music. These findings suggest that the distinctive combination of music with accented beats can dramatically increase PA above and beyond beat-unaccented music. However, to our knowledge, no study to date has applied BMS to multicomponent exercise training among older adults with cognitive decline.

We conducted a single-arm intervention trial to test the feasibility, acceptability, and preliminary efficacy of a 20-week BMS-based multicomponent exercise training program for community-dwelling older adults with mild-to-moderate cognitive impairment. Outcomes of interest were adherence to and overall satisfaction with the intervention as well as changes in cognitive and physical functioning and health-related quality of life (QoL). Our approach to prevent or delay the onset of AD or other dementias through multicomponent exercise training could be particularly urgent among older adults in early stages of cognitive decline. Given the low rate of PA among older adults in the US and the strong association between low PA and the prevalence of AD, developing and implementing a novel PA intervention for older adults will have implications for dementia prevention. This preliminary study will set the stage for an RCT to fully test the efficacy of BMS-based exercise training in the growing aging population at risk of dementia.

2. Methods

2.1. Participants

Sixteen community-dwelling older adults (9 females) who were 86.2 ± 8.6 years old ($M \pm SD$), previously low-active (< 60 min/week of exercise, determined by self-report and confirmed by facility staff), and with mild-to-moderate cognitive impairment [determined by Montreal Cognitive Assessment (MoCA)] were recruited from an independent senior living facility. Prior to recruitment, approval was obtained from the institutional review board of the university. Eligibility screening was conducted in person by appointment in a designated room at the senior living facility. Individuals were ineligible if they were incapable of walking, unable to hear verbal instructions and music, physically active (> 90 min/week of exercise), had severe cognitive impairment [determined by MoCA total score < 11; 29], or had anxiety or depression (determined by a single-item on the EuroQol Health Questionnaire [EQ-5D-5L] ≥ 4) (29). Participants who could walk with or without an assistive device (walker, cane, etc.) or who could hear using hearing aids were eligible for the study.

Participants also completed the Physical Activity Readiness Questionnaire for Everyone (30) to determine if they had an ongoing medical condition that might put them at risk by engaging in moderate-intensity exercise training. Through this screening procedure, we excluded 1 individual with advanced Parkinson's disease, 1 individual with post-stroke hemiparesis, and 2 individuals with MoCA scores < 11.

We were able to include participants with mild Parkinson's disease, arthritis, or osteoporosis, taking medications to manage heart conditions and/or blood pressure, or using a walker for ambulation. These individuals were instructed to exercise at a light intensity and/or in a seated position within the training protocol. Eligible participants were provided with the study procedure and completed a Brief Informed Consent Test (31) through which we confirmed their ability to understand the study information. All participants provided written informed consent on their own. Among 16 enrollees, 3 withdrew participation due to unexpected lower body injuries or visual impairment (unrelated to the intervention) and thus 13 participants (7 females) with MoCA score ranging from 16 to 25 ($M = 20.38$, $SD = 2.98$) completed the intervention and were included in data analysis.

2.2. Music-based multicomponent exercise intervention

All participants were provided with music-based multicomponent group exercise training at 9:30 AM for 30–35 min/day, 6 days/week over 20 weeks in a designated room at the senior living facility. The exercise goal for all participants was to attend the group exercise training > 3 days per week. The exercise program was open to all members in the residential facility and thus a few additional individuals often attended without participating in the study, but adherence was only tracked for study participants. To be consistent with the PAG, the group exercise program consisted of a dynamic warm-up (5 min), aerobic training (15 min), resistance and balance training (10 min), and cool-down stretches (5 min). See Table 1 for an overview of the exercise program. Most exercises were chair-assisted and thus adaptable across fitness levels and were safely implemented for participants with fall risks. Participants were instructed to exercise in a standing position with at least one hand holding a chair or in a seated position. The exercise program was developed and consistently delivered by two researchers along with three staff members in the facility, who were all CPR-certified and experienced exercise instructors. Participants were instructed to exercise at light-to-moderate intensity based on the Borg RPE Category-Ratio scale (32) which was posted in the exercise room.

Participants were trained to exercise in sync with the tempo of a BMS playlist that was made of 35 music excerpts, which were played in a randomized order. Exercise pace and the music tempo were incrementally increased by five beats per min (BPM) every 5 weeks during the intervention, from 85 BPM to 100 BPM. Participants were not asked to use BMS for their self-directed walking outdoors for safety reasons.

2.3. Beat-accentuated music stimuli

All music excerpts in the BMS playlist were slow-to-medium tempo country and pop songs that were rigorously chosen by a certified music production specialist, in consideration of participants' music preference initially surveyed as well as their unchanging tempos and a clearly discernible rhythm in 2/4 or 4/4 meter. The emotions and lyrics of all songs were scrutinized and therefore any songs with provocative lyrics (e.g., cursing, drugs, alcohol, sexual references, racism, violence) or negative emotions (e.g., sad, anger, fear, regret.) were excluded. More than half of the songs we chose were instrumental music. For the songs selected, we sonically enhanced each quarter note beat by adding lower- and/or higher-frequency drum sounds (kick-drum, snares, hihats, and rides) to correspond with one paced step or muscle contraction when exercising. The beats were added as a secondary track and recorded concurrently with the original music, using musical instrument digital interface (MIDI) keyboard-drum instruments (Pro Tools 2021, Avid Technology Inc., Burlington, MA, United States), in a similar manner with the prior study (23). Our intention was to implement beat accentuation at frequencies and volumes just beyond minimal detection levels without detracting from the authenticity of the original music. The tempo of music excerpts was adjusted without damaging the harmony or pitch via open-source sound-editing software (Audacity 3.0.4, The Audacity Team, available at: audacityteam.org).

TABLE 1 Multicomponent exercise intervention with beat-accentuated music stimulation.

Training goal	Dynamic warm-up	Aerobic step training	Muscle strengthening and balance training			Cool-down
			Upper body	Lower body	Core and balance	
Frequency	6 days/week	6 days/week	2 days/week (M, TH)	2 days/week (T, F)	2 days/week (W, S)	6 days/week
Duration	5 min	15 min	10 min	10 min	10 min	5 min
Exercises	• Marching in place • Elbow to knee taps • Forward taps with punches • Side taps with arm reaching	• Forward taps • Backward taps • Side taps • Forward backward steps • Side steps • Triangular steps • Crossover steps	• Punches • Bicep curls • Bent over rows • Shoulder presses • Front arm raises • Lateral arm raises	• Chair-assisted squats • Lifting buttocks from the chair • Straight leg raises—Front, Lateral, Rear • Calf raises	• Chair-assisted deadlift • Alternate knee raises • Seated abdominal crunches • Russian twists	• Trunk rotations • Neck stretches • Arm crosses • Calf stretches • Quadriceps stretches • Hamstring stretches • Gluteus maximus stretches

All exercises were performed in a chair-seated position or chair-assisted standing position. Participants were encouraged to exercise within light-to-moderate intensity by staying in 2–3 on the Ratings of Perceived Exertion (RPE) CR10 scale. M = Monday, T = Tuesday, W=Wednesday, TH = Thursday, F=Friday, S=Saturday.

2.4. Procedure

Individuals who expressed interest were scheduled for the screening by appointment in a designated area at the senior living facility. After screening, eligible participants completed pre-test to assess cognitive and physical functioning and health-related QoL. The total testing procedure was completed within an hour. Testing was conducted by research staff with the aid of facility staff. After a month of pre-testing all participants, the 5-month exercise intervention started and their adherence to the intervention was tracked down. After the intervention, participants were scheduled for post-test to assess the same outcome measures with the pre-test. At post-test, participants' satisfaction with the intervention was also assessed.

2.5. Outcome measures

Adherence to the intervention was tracked during the intervention through a sign-up sheet that was self-reported by participants and confirmed by the exercise instructor after every session. At the post-test, participants' satisfaction with the intervention was assessed using the Client Satisfaction Questionnaire (CSQ-8), an 8-item 4-point Likert scale with the total possible score ranging from 4 to 32 and a higher score indicating greater satisfaction (33).

General cognitive functioning was assessed using the MoCA, a widely used test to access memory, executive function, and other symptoms of cognitive decline (34). To prevent potential practice effects, version 8.1 and 8.2 of the MoCA were used at the pre- and post-test, respectively. Test scores were calculated based on pre-established algorithms to obtain the MoCA total score and memory index score (MoCA-MIS). The MoCA-MIS is calculated by summing the number of words correctly remembered after a delay in free recall, category-cued recall, and multiple-choice recall multiplied by 3, 2 and 1, respectively (35). There are five words to be recalled and thus a participant can obtain a score ranging from 0 to 15. This new scoring method was developed to reflect encoding memory performance (35).

Inhibitory control and cognitive processing speed was assessed using the Flanker Inhibitory Control and Attention Test and the Pattern Comparison Processing Speed Test in the NIH Toolbox Cognition Battery (2022 Toolbox Assessments, Inc., available at nihtoolbox.org), The Flanker Test requires participants to indicate the left–right orientation of an arrow stimulus presented centrally while inhibiting attention to the potentially incongruent arrow stimuli surrounding the central stimulus. Accuracy and reaction time on the incongruent versus congruent items serve as measures of inhibitory control (36). The Pattern Comparison Processing Speed Test asks participants quickly identify whether two images are the same or not and the number of correct items completed in 90 s is counted (37). Both NIH Toolbox tests were validated in young-to-older adults aged 18–65 years (38) and oldest older adults aged 85–99 years (39).

Health-related QoL was self-reported through the 5-item EQ-5D-5L (29). Validated in older adults with multimorbidity (40), the EQ-5D-5L is based on descriptions of self-perceived health based on 5 dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has 5 response options corresponding to no problems, slight problems, moderate problems, severe problems, and incapability. Participants also reported their overall health on the day on a hash-marked, vertical visual analogue scale (EQ-VAS) marked from 0 (the worst health you can imagine) to 100 (the best health you can imagine).

Physical functioning was assessed through the Timed Up and Go (TUG), 4-Stage Balance Test (4SBT), 6-Minute Walk Test (6MWT), and 30-Second Chair Stand Test (30SCST) performed in that order. The TUG, 4SBT, and 30SCST are part of the CDC's STEADI toolkit for the assessment of fall risks in older adults (41). The 6MWT is found to be a reliable and valid measure of physical endurance and aerobic fitness in older adults (42, 43). We measured the duration to complete a TUG trial (after a practice trial), the sum of durations to maintain the posture required in the first, second, and third stage of the 4SBT, the total distance walked for 6 min (6MWT), and the reps of sit-to-stand maneuvers completed in 30 s (30SCST). Some participants completed the tests using a walker as needed, consistently across the pre- and post-test.

2.6. Data analysis

All statistical analyses were conducted with R 4.2.2 (44). Normality of the data was first checked with descriptive statistics and the Shapiro–Wilk test. For the outcome variables showing normal distribution, we conducted student's paired-sample t-tests to examine the pre- and post-test differences with alpha (α) at <0.05 for two-sided tests of statistical significance. Cohen's d effect sizes were computed and interpreted based on the criterion of 0.2 (small effect), 0.5 (moderate effect), and 0.8 (large effect). For the outcome variables with non-normal distributions, we conducted the Wilcoxon signed-rank test, the non-parametric counterpart of a paired-sample t-test, using the 'wilcox_test' R package with alpha (α) at <0.05 for two-sided tests. For non-parametric tests, effect sizes were calculated using the 'wilcox_effsize' R package, where r value is interpreted to be a small effect (0.10–$<$0.30), moderate effect (0.30–$<$0.50), and large effect ($\geq$0.50).

3. Results

3.1. Feasibility and acceptability of the intervention

Thirteen participants attended 4.6 days/week over 20 weeks in average (min = 3.6 days/week, max = 5.3 days/week; SD = 0.5 days/week). The CSQ-8 total score indicated that participants were highly satisfied with the intervention ($M = 29.1$, SD = 3.1). These results support the feasibility and acceptability of BMS-based multicomponent exercise training for 20 weeks in community-dwelling older adults with mild-to-moderate cognitive impairment.

3.2. Cognitive functioning

Statistically significant changes were found in the MoCA total score ($t = 4.71$, $df = 11$, $p < 0.001$) with a large effect size ($d = 1.36$); the post-test score ($M = 22.3$, SD = 3.31) was higher than the pre-test score ($M = 20.6$, SD = 3.15). Ten out of 13 participants made improvements in the MoCA total score at post-test, whereas 2 participants scored the

same with the pre-test, and 1 participant refused the test at post-test. However, no significant differences were found in the MoCA-MIS ($t = -0.899$, $df = 11$, $p = 0.388$). The results of the NIH Toolbox test indicated statistically significant changes in the Pattern Comparison Processing Speed test score ($t = 2.83$, $df = 11$, $p < 0.05$) with a large effect size ($d = 0.816$); the post-test score ($M = 67.8$, SD = 15.4) was higher than the pre-test score ($M = 60.1$, SD = 9.69). Ten out of 13 participants made improvements in the Pattern Comparison Processing Speed test score at post-test, whereas two participants scored lower than the pre-test, and 1 participant refused completing the test at post-test. Differences in the Flanker score did not reach significance ($t = 1.81$, $df = 12$, $p = 0.098$) although a moderate effect size ($d = 0.522$) was obtained; the post-test score ($M = 77.5$, SD = 12.7) was marginally higher than the pre-test score ($M = 74.2$, SD = 13). See Figures 1A–D for a summary of these results.

3.3. Health-related quality of life

No significant differences between pre- and post-test were found in the EQ-5D-5L summary score ($V = 29$, $p = 0.273$). The differences between pre- and post-test in EQ-VAS was not significant ($t = 1.74$, $df = 12$, $p = 0.107$); post-test score ($M = 86.5$, $SD = 9.32$) versus pre-test score ($M = 82.2$, $SD = 13.1$). See Figures 1E,F for a summary of these results.

3.4. Physical functioning

The ranks of 6MWT total distance were significantly higher ($V = 66$, $p < 0.05$) at post-test (Mdn = 282 m) than at pre-test (Mdn = 249 m) with a large effect size ($r = 0.601$). Eleven out of 13 participants made an improvement in the 6MWT total distance. No significant differences between pre- and post-test were found in the ranks of TUG duration ($V = 29$, $p = 0.273$), 4SBT duration ($V = 43$, $p = 0.398$), and 30CST reps ($V = 24.5$, $p = 0.798$). See Figure 2 for a summary of these results.

4. Discussion

Our participants demonstrated high adherence and satisfaction with the BMS-based multicomponent exercise intervention for 20 weeks. This finding supports the feasibility and acceptability of the intervention among older adults with mild-to-moderate cognitive impairment in an independent living facility. Our data also provide preliminary evidence in support of the efficacy of BMS-based multicomponent exercise training for cognitive and physical functioning in cognitively impaired older adults. Most participants who completed the intervention showed improvements in general cognitive functioning assessed by the MoCA, visual information processing assessed by the Pattern Comparison Processing Speed Test, and walking endurance and aerobic fitness assessed by 6MWT. These findings are meaningful because we, for the first time, combined multicomponent exercise training with BMS and demonstrated its feasibility and preliminary efficacy for cognitive and physical health among cognitively impaired older adults.

It is possible that music stimulation played a positive role in participants' high adherence and satisfaction with the exercise training. Scientists have demonstrated that listening to music prior to or during acute bouts of aerobic and resistance training have beneficial effects on affective valence, RPE, physical performance, and oxygen utilization, and thus becomes a motivational stimulant to PA bouts [for a review, see (14)]. Despite this body of literature, there is an inadequate level of empirical evidence to substantiate the effects of music on long-term adherence to PA (18, 45, 46). This gap in the literature was partly addressed by a theoretical model accounting for the putative mechanisms through which music acts to promote long-term adherence to PA (18). From the view of the theory of hedonic motivation (47, 48), music can help people like an exercise session more (or dislike it less) and thus increase wanting (or decrease dread) to exercise more or harder (18). When people experience pleasure during an exercise session, this positive affective response is linked to enhanced motivation for another bout of exercise, which increases the chance of long-term adherence to PA (18). Therefore, it is possible that participants in this study could benefit from positive affective responses to exercising with music. This is a tentative assertion at the moment because we did not measure affective response to PA nor did we include a control condition. Social interactions and the environmental factors in the independent living facility could have also made positive impacts on adherence. Future researchers may conduct an RCT to investigate the unique effects of BMS on exercise adherence among older adults by including a non-music exercise control group and to identify psychological mechanisms underlying such effects.

Recent systematic reviews identified a few RCTs that demonstrated small but beneficial effects of music on long-term adherence to PA among older adults in a cardiac and pulmonary rehabilitation setting (45, 46). The methodologies employed in this study, beat accentuation and tempo synchronization, may have played an important role in the observed high adherence rates given that music had little effect on long-term PA behaviors in RCTs without such methodologies. Specifically, older adults in a cardiac rehabilitation who were prescribed to walk-for-exercise with beat-unaccented, tempo-asynchronous music stimuli demonstrated trivial differences in the rate of meeting the PAG and accelerometer-measured PA over 26 weeks compared with controls who received the same exercise prescription without music (49). In another RCT, people with COPD who received an 8-week walking intervention with beat-unaccented, tempo-asynchronous music stimuli showed little difference in pedometer-measured and self-reported PA compared with controls in the same intervention without music (50). However, in the RCT (23), walking-for-exercise with BMS led to nearly twofold increases in accelerometer-measured PA and in caloric expenditure over 3 months among midlife-to-older adults relative to the same exercise program with beat-unaccented, tempo-synchronous music and without music. This view would be supported by prior evidence that beat accentuation facilitates beat perception and auditory-motor synchronization when moving with music (51, 52). Acknowledging the limitation of a single-arm intervention study, future studies may be conducted using an RCT designed to decompose the unique effects of beat accentuation on exercise behaviors by including a beat-unaccented music control group.

BMS is a form of rhythmic auditory stimulation (RAS) that refers to an application of pulsed rhythmic auditory stimuli (e.g., metronome and/or music) for the facilitation of body movements that are intrinsically rhythmic (53). RAS have been frequently implemented to

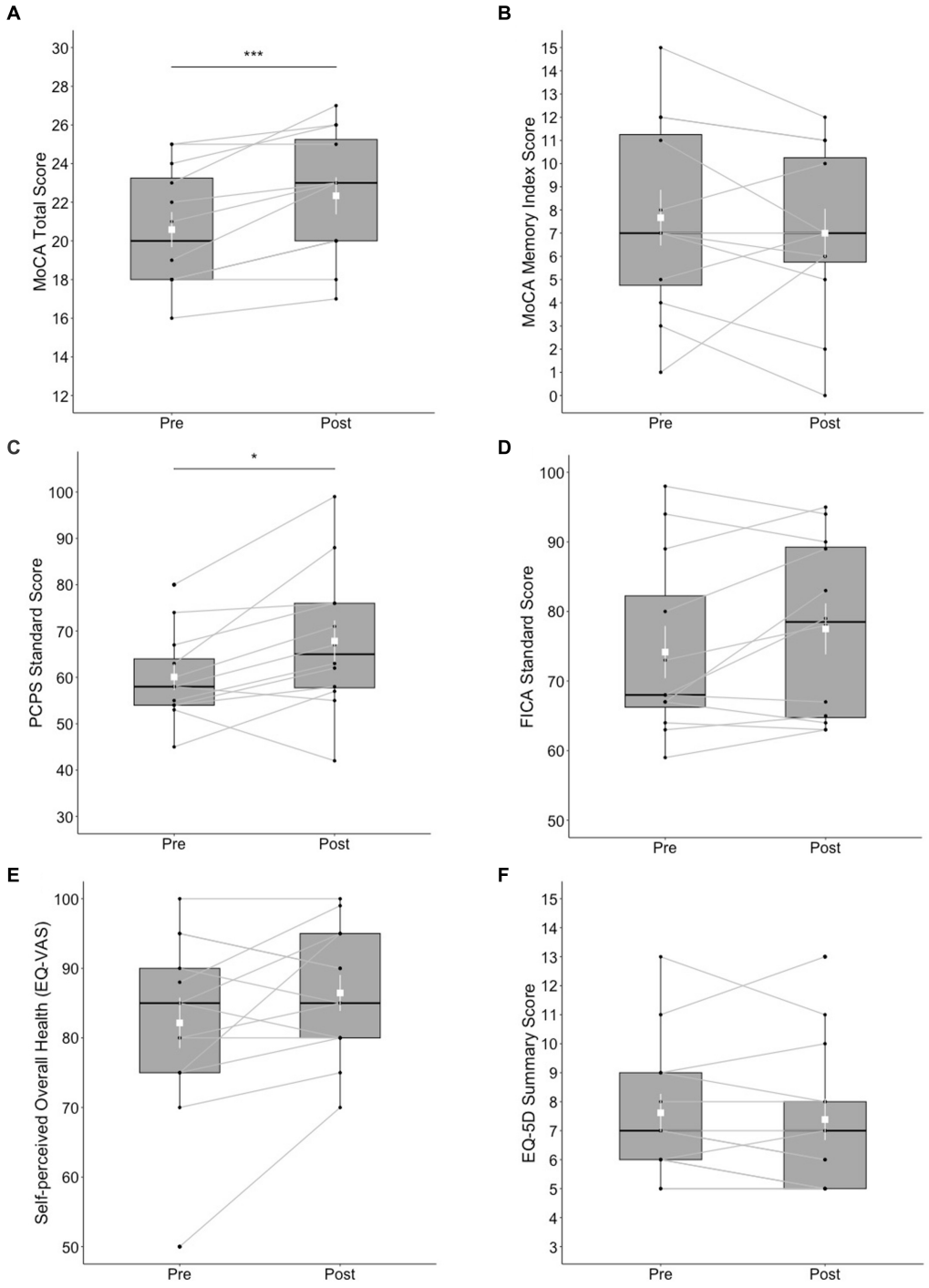

FIGURE 1
Box plots of cognitive and mental health outcomes at pre- and post-test; **(A)** MoCA total score, **(B)** MoCA Memory Index Score, **(C)** NIH Toolbox Pattern Comparison Processing Speed (PCPS) test, **(D)** NIH Toolbox Flanker Inhibitory Control and Attention (FICA) test, **(E)** self-perceived overall health reported on the EQ visual analogue scale (VAS), and **(F)** EQ-5D Summary Score. The shapes of the distribution are shown on the boxes and whiskers. The box bounds the IQR divided by the median (solid horizontal line) and whiskers extend to a maximum of 1.5 × IQR beyond the box. Mean and standard errors are indicated by small, white squares and appended lines. Significant differences between pre- and post-test are indicated by $*p < 0.05$, $***p < 0.001$.

foster motor behaviors—especially walking—mostly in people with movement disorders [for reviews, see (54–59)] and occasionally for cardiovascular rehabilitation [for reviews, see (45, 46)] and also for people with Alzheimer's disease (60). RAS interventions have used varying forms of tempo-synchronous stimuli such as metronome pulse [for reviews, see (59, 61, 62)], contemporary music (63–65), or contemporary music with sonically-enhanced (accentuated) beats (24–26)—referred to as BMS herein—mostly for older adults with Parkinson's disease. The evidence that RAS facilitates motor behaviors implies its beneficial application for exercise training, yet no study to

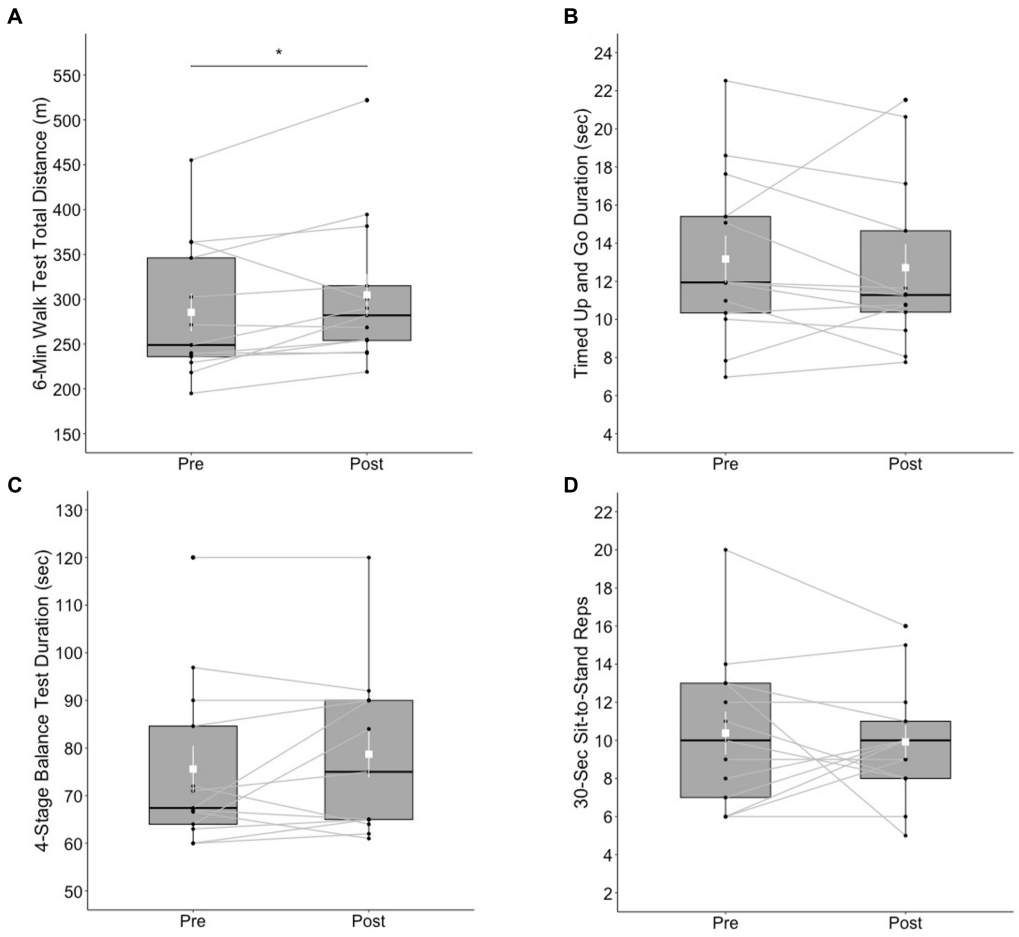

FIGURE 2
Box plots of physical functioning outcomes at pre- and post-test; **(A)** 6-Minute Walk Test total distance (m), **(B)** Timed Up and Go test, **(C)** 4-Stage Balance Test, and **(D)** 30-Second Chair Stand test. The shapes of distribution are shown on the boxes and whiskers. The box bounds the IQR divided by median (solid horizontal line) and whiskers extend to a maximum of 1.5 × IQR beyond the box. Mean and standard errors are indicated by small, white squares and appended lines. Significant differences between pre- and post-test are indicated by $*p < 0.05$.

date has made such approach. Therefore, the novelty of this study comes from the combination of RAS with exercise training following the PAG for cognitively impaired older adults.

It is promising that BMS-based multicomponent exercise training for 20 weeks led to improvements in general cognition, cognitive processing speed, and walking endurance/aerobic fitness in cognitively impaired older adults. These findings are consistent with previous findings that exercise training has beneficial effects on cognitive functioning among older adults with normal cognition (66, 67), self-reported memory complaints (68–70), mild cognitive impairment (71–73), and dementia (72, 74). Although two different, validated versions of the MoCA were used in pre- and post-test to prevent potential practice effect, it is possible that improved general cognition is due to repeated testing. This suggest that future studies should include a control group to determine if the observed cognitive benefit is attributable to exercise training and/or BMS. Moreover, the multicomponent nature of exercise training may have played a role for the positive outcomes in this study and thus has implications for future interventions to help older adults comply with the PAG. Our approach to prevent or delay the onset of AD or other dementias through multicomponent exercise training would be particularly urgent among older adults in early stages of cognitive decline. Given the low rate of PA among older adults and the strong association between low PA and the prevalence of AD, developing and implementing a novel PA intervention for older adults will have implications for dementia prevention. This preliminary study will set the stage for an RCT to fully test the efficacy of BMS-based exercise training in the growing aging population at risk of dementia.

It should be noted that our intervention led to no changes in verbal memory (MoCA-MIS) and only nearly significant improvements in inhibitory control of attention (Flanker test). These findings are partly coherent with the meta-analytic findings that, in older adults with mild cognitive impairment, multicomponent exercise training has resulted in improvements in global cognition, attention, and executive function but not in memory (72) and aerobic training strongly improved global cognition but weakly improved memory (73). We also attribute the lack of changes in the Flanker test to the lack of validity in some of our oldest-old participants at +90 years of age who had difficulties in understanding the test instructions and practice trials as well as the small sample size. This interpretation may be supported by the recent study which validated the NIH Toolbox Cognition Battery among healthy oldest older adults

at 85–99 years of age who had MoCA total scores of 22–30 (39), which is higher than the participants in this study. We also note that our intervention led to no changes in balance (TUG, 4SBT) and lower-body strength (30CST). We attribute these results to the limited capacity for balance training and lower body strength in the intervention. Due to the risks for falls and limited mobility, some oldest-older participants performed all exercises in a seated position, which minimized the training benefits for balance and lower body strength.

Limitations of this study are acknowledged. The small sample size and mild-to-moderate cognitive impairment of our participants and the convenient selection of an independent living facility might limit the ability to generalize these findings to the broader older adult population with and without cognitive decline. Furthermore, given the small sample size, we included all participants in the single-arm exercise intervention and were not able to include a control group. Future studies may conduct an RCT to rigorously test the efficacy of BMS for exercise adherence by having a no-music exercise control group or to test the efficacy of BMS-based exercise training for physical, cognitive, and mental health versus a no-exercise control group among older adults with varying clinical conditions. Despite these limitations, the findings of this study are of value because they demonstrate the feasibility and acceptability of this intervention for cognitive impaired older adults and providing promising effect sizes that can be used to design future research. We conclude that multicomponent exercise training can be beneficial for general cognition, cognitive processing speed, walking endurance, and aerobic fitness of older adults with mild-to-moderate cognitive decline in an independent living facility and that beat-accented music can be paired with exercise training to manipulate exercise tempo, which may be associated with good adherence to the training regimen by older adults.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by UNC Greensboro Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

KP designed the study with input from LB, JH, and JE. LB contributed to the development and implementation of the intervention and testing sessions. JH contributed to the arrangement of music stimuli and its implication for exercise training. KP, LB, and JH drafted an early version of the manuscript. JE revised and completed the writing of the manuscript. All authors read and approved the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Home-based music therapy for persons with dementia and their spouses as primary caregivers

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Music therapy has been found to be an effective intervention for persons with dementia (PWD) and their primary caregivers (PC), yet the implementation of musical strategies to improve daily care in the home environment requires further exploration. This study developed and examined a home-based music therapy (HBMT) work model that offers weekly joint music therapy sessions, and additional bi-weekly phone-counseling sessions with the PC. This was followed by an additional 12-week support period that included 3 therapy sessions and 3 phone counseling sessions once every other fortnight, so that the same type of session occurred at a frequency of once a month. Participants were five couples (PWD + spouse as PC) who live in their home. Findings based on the qualitative multiple case study research method showed the importance of the music therapist's (MT) continuous support. The MT's presence made it possible to address the needs of both spouses, separately and together, while maintaining the required balance. Moreover, the MT's presence enabled better implementation of the musical strategies independently and this was maintained during the intervention and the support period.

KEYWORDS

dementia, primary caregiver, spouse, home-based, music therapy, musical strategies

Introduction

The number of persons with dementia (PWD) has increased parallel to the increase in life expectancy. Most live at home and are supported by a primary caregiver (PC) (1). Spouses who become the PC of a PWD cope with multiple challenges. The caregiver role they take on often becomes their main, and exclusive, identity, while their personal identity and needs are neglected (2). This adversely impacts the PC spouses' quality of life, and they often feel emotionally overwhelmed, stressed, guilty, and burnt out (3).

Music therapy has been found to be a positive and beneficial intervention for both PWD and for their spouses as PCs. In recent years, various studies engaged in developing musical strategies for PCs have been conducted so that they can employ these strategies independently and daily without the ongoing presence of a music therapist (MT) (4). These strategies provide the PCs with musical tools that can help to reduce anxiety, depression, restlessness, confusion, and preserve existing capabilities of PWD (5). In most cases, guidance was provided in a limited number of sessions and the MT neither attended the caregiver-administered sessions nor provided further support. As a result, the spouses had difficulty implementing musical strategies over time, and more extensive support and counseling by the MT were necessary (6). In an international study, negative emotional reactions were also observed due to the lack of professional support of a MT during the intervention (7).

There is a large number of based-music interventions that are not conducted by a MT. However, studies in which the intervention included a MT's presence indicate better implementation. A more extensive presence can be seen in Melhuish's study (8) where a series of weekly music therapy sessions was conducted with spouses, with an emphasis on using music outside of the session as well. The results of the study showed that music helped to stimulate the PWD, improved mood, encouraged interaction, and strengthened the sense of connection and intimacy between the spouses. The MT's presence, and therapy that was customized to the spouse's needs, helped to better implement the musical strategies on a daily basis (8). A MT was also consistently present in another study (9) in which 12 weekly sessions were conducted with spouses at home, and concurrent phone counseling sessions were conducted with the PC every 2 weeks. The intervention was clearly positive and beneficial, but musical strategies were only used independently during the intervention period.

The purpose of the current study was to examine whether a work model that includes extensive support enables the independent implementation of music used in daily life and over time. Although the frequency of the support was gradually reduced to increase independence, we believe it is important to continue providing the couple with ongoing assistance.

Methods

The current study employed principles of the qualitative multiple case study research method, which gathers a collection of specific cases and gleans insights using similarity or contrast (10). The study included five case studies so that they could be compared, conclusions reached, and the model examined from various aspects: from the MT's, the PWD's, and the PC spouse's. Due to the need for brevity, the case studies will not be presented in full but the main themes that emerged from the data analysis will be presented.

This study was approved by the ethics committee of the Department of Music at Bar-Ilan University (E.MUS.2018-7), and the PCs signed their consent to participate in the study together with their spouses. Pseudonyms were used, identifying details were omitted, and the remaining information was kept confidential.

Participants

The participants were recruited through organizations in Israel that provide home services to PWD. An explanation about the proposed program was given to the study participants. Criteria for participation included: (1) An individual with a diagnosis of dementia who lives at home with a spouse as a PC. (2) The spouse expressed their willingness to be involved in therapy and/or to receive phone counseling. (3) The spouse had difficulty coping with caring for the PWD at home. (4) The participants spoke Hebrew or English.

Five couples (a PWD + spouse as PC) participated in the study, ages 73–95. A diagnosis of dementia was given 3–7 years before the study began. Four spouses lived in assisted living and one couple lived at home. They were all assisted by a paid caregiver.

Music therapy intervention

According to the model, the MT met with each couple at their home over 26 weeks, including a follow-up period, as follows: The intervention of 10 joint weekly music therapy sessions with both spouses, and five phone counseling sessions, which were held concurrently with the caregiving spouse. This was followed by an additional 12-week support period that included three therapy sessions and three phone counseling sessions once every other fortnight, so that the same type of session occurred at a frequency of once a month. Approximately 4 weeks after the support period ended, a follow-up session was held. Figure 1 presents the study's schema with the therapy sessions and phone counseling sessions.

The intervention included singing, listening to music, dancing, or playing percussion instruments, according to the couple's preferences. The musical strategies were personalized and tailored to each couple's needs.

Data collection tools

Recording the joint therapy sessions

All therapy sessions were recorded and transcribed. Transcriptions of the sessions included verbal and musical content and they enabled an inside look at what occurred in the intervention.

Recording the phone counseling sessions with the PC

All counseling sessions were recorded for documentation purposes. The talks were conducted in order to offer musical

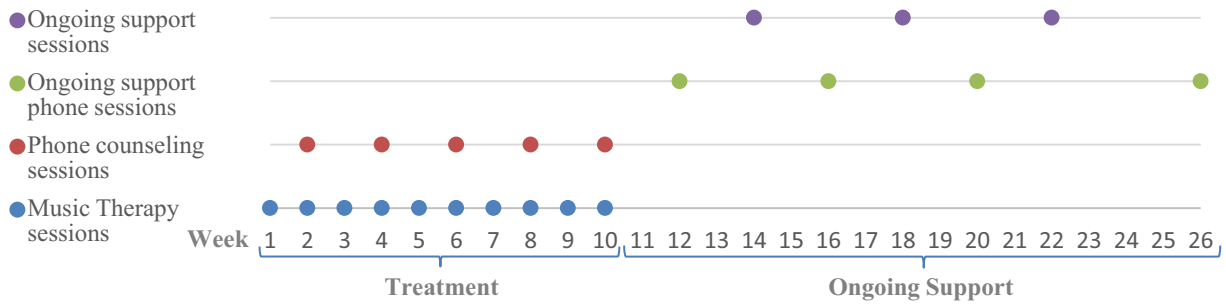

FIGURE 1
Schema of the study.

interventions and to examine whether these contributed to the daily care of the PWD. These sessions employed topics from the burden questionnaire (Zarit Burden Interview - ZBI) (11) for PCs to enable a discussion of common challenges with this population and to give legitimacy to address silenced topics, such as: "Do you feel anger/frustration when you are near your spouse?"; Do you feel that you have lost control of your life since your spouse's disease?"

Follow-up phone call

Around a month after the intervention ended, a follow-up call was held with the spouse. This call examined whether the musical strategies had been implemented and how had the therapy impacted the daily life of the PWD and their spouse even after the intervention had ended.

Researcher's journal

The journal included documentation of the treatment goals, preliminary planning of the therapy sessions, interpretation, feelings, and personal conclusions of the therapist-investigator that emerged during the intervention. Writing the journal led to an observation of the processes the therapist underwent with the clients and provided a necessary distance from the therapeutic process required as an investigator.

Data analysis

The data was analyzed according to the cross-case synthesis method (12), which is standard with this method, and includes merging and crossing a collection of cases. Cross-case synthesis enables an in-depth exploration of similarities and differences across cases, to gain research insights. Data analysis was conducted following a three-stage process: (1) An in-depth analysis was conducted of each couple's experiences during joint music therapy sessions, including preferred musical activities. (2) The case studies were compared to reveal similar or contrasting influences of the work model on the PWD, the PC, and both as a couple. (3) Identifying a repeating pattern made it possible to recognize central themes that emerged from all the case studies with the aim of drawing conclusions about the contribution of the work model.

Findings

Five main themes emerged from an analysis of the content of all the couples' sessions and phone counseling.

Joint therapy strengthened the couple's relationship

The study emphasized positive and joint musical work to facilitate moments of connection and quality time together for the couples. The joint therapy sessions contributed to strengthening the couple's relationship, created a shared experience, and a break from the caregiver-care recipient roles that had been created as a result of the dementia.

> *When Sophie and Mark sang the aria Habanera from Bizet's opera Carmen together, it was easily possible to forget that Sophie had an advanced case of vascular dementia. In the therapy sessions the spouses sang songs together, Sophie as a soprano and Mark as a tenor-baritone. The restlessness and depression Sophie was coping with on a daily basis lessened and for the first time she was fit to participate in a joint activity with Mark. Mark had a huge smile on his face when Sophie joined him in song. Although it was without vocal warmup and sheet music, these were precious moments where he could put aside the heavy role of PC. They simply went back to being a couple, partners in a meaningful activity that gave them a sense of connection and enjoyment.*

Practicing using music together helped with independent implementation

During the therapy sessions it was suggested that the couple practice using music together to help them on a daily basis. The joint practice made it possible to involve the PWD in therapy, fine-tune the intervention, and increase the PWD's degree of cooperation.

> *Jonathan's walking was very slow and stiff since he was living with advanced Alzheimer's and Parkinson's, making it difficult for him to move from one place to another. However, when his wife Yael learned to use rhythm in the therapy sessions to encourage walking, it became easier, both technically and emotionally. Together we explored what was right for Jonathan: Whether to walk to the sounds of a marching tune, to the percussive sound of a regular and steady beat, or to a rhythmic count: left-right, or one-two. The practice was accompanied by laughter and enjoyment. Yael hummed a military march and humorously used military terms like: "Yes, sir" and saluted when Jonathan asked to go home for the weekend, and said "we are returning to base" when she guided him back to the couch, and "soldier at ease" when she helped him sit down. The practice became an experience, and Jonathan, whose speech was usually repetitive and meaningless, suddenly declared: "want a hug." Jonathan's involvement in the practice made him feel loved and equal and made the use of rhythm an inseparable part of the couple's daily life.*

The support sessions provided a separate therapeutic space for the PC

Concurrent to the joint therapy sessions, the PC spouse was individually addressed in a separate session, where topics that were inappropriate or impossible to discuss together could be raised and processed, giving this spouse an empathetic ear, understanding, and support. The support sessions made it possible for the spouse to share and ask for advice on the daily challenges common with dementia, to vent emotions, and to regain strength.

Observing the spouse losing cognitive function and changing was intolerable for Tamar. Robbie was frustrated and depressed. Although music always played in their home, Tamar preferred to watch the musical activity rather than partake. The disconnection protected her. "I've lost a friend. I used to be able to consult and speak with him. Now I cannot," Tamar shared for the first time, expressing the loneliness and pain she felt in living with her husband Robbie's Alzheimer's disease. We were already in the middle of the therapeutic process and Tamar felt safe to express these feelings out loud. She did not want to burden her children or close friends with these hard feelings. Outwardly, Tamar presented a strong and optimistic facade, kept busy, and was socially active. "But inside I'm a very sad person," she expressed with honesty.

The validation, understanding, and empathy she received for her feelings during the phone sessions helped her to process and come to terms with the dramatic turning point in their lives. The therapy sessions created an opportunity for Tamar to return to the joint sessions and to experience positive and pleasant quality time with her spouse in a non-threatening manner. Also, the sense of distress Tamar described at the onset of the intervention lessened after she was given an opportunity to grieve the loss of their couplehood.

Connection between theoretical support and joint activity in therapy

The phone support sessions were held with the PC spouse separately. However, topics that emerged during the calls made it possible to fine-tune the intervention in the therapy sessions and to suggest different ways of using music. In this way, the phone sessions went from theory to applied practice.

Singing and listening to classic Israeli songs turned out to be extremely meaningful for Eliraz. "There's hope!" Motti, her husband, declared whenever she responded verbally and coherently after a musical activity. Motti was elated because Eliraz was living with dementia and spent most of the day sitting in her wheelchair, barely able to speak and understand instructions. However, when Motti tried to recreate the success on his own, he encountered great difficulty. He was frustrated that Eliraz did not respond to music on a daily basis in the same way she did during the joint therapy sessions. A joint examination revealed that without musical support, Motti had a hard time producing song and tended to recite the words without a melody. Also, he tended to ask Eliraz questions about the background of the songs, which elicited frustration and distress in Eliraz. Joint practice in the therapy sessions helped Motti learn singing techniques and how to address Eliraz in order to elicit past memories. Toward the end of the intervention, Motti succeeded in using music effectively. His singing was good, and he managed to create moments of closeness and connection, which the couple sorely lacked.

Ongoing support affected the use of music in daily life

When the therapy sessions ended, the participants continued to receive support for an additional 3 months. During this period, therapy sessions and phone support sessions were conducted with each spouse once every other fortnight, so that the same type of session occurred at a frequency of once a month. This frequency of sessions and calls made it possible for the couples to gradually wean off the support while still providing a small amount of assistance. In this way, the couples were encouraged to continue using music independently without being left to cope on their own.

Elizabeth did not believe that a day would come when she and Victor would once again stand face to face, hold hands, and sway to the sounds of Tango. Victor, who was living with advanced dementia and required long-term care, was uncommunicative most of the time. The musical activities during the therapy sessions were a shared couple activity and elicited in Victor rare coherent verbal responses, which surprised and pleased Elizabeth. The phone support that Elizabeth received helped her to use musical strategies also during the week. Together we examined the couple's challenges and how music can assist. Thus, Elizabeth learned to sing and play music in order to stimulate Victor, who spent most of the day sitting passively in the armchair. However, the musical work required effort from Elizabeth. She stated that the therapy sessions and the phone counseling boosted her motivation and encouraged her to use music more often. Without support, it was harder. In the follow-up phone session, about a month after the intervention ended, Elizabeth said: "After I speak to you, I also use singing, now I use it less."

Discussion

The current study examined whether a work model that included extensive support for a total period of 26 weeks enabled the independent implementation of music, used in daily life and over time for PWD and their PCs. The work model made it possible to address the needs of both spouses, separately and together, while maintaining the required balance. Moreover, the MT's presence enabled better implementation of the musical strategies independently and this was maintained during the intervention and the support. The research literature shows that addressing the roles of the MT for PWD and their spouses presents two widespread approaches. In the first approach, the MT focuses on treating the PWD but does not address the PC. The dependence on the therapist is high and the use of music is preserved only during the therapy sessions (13). In the second approach, the MT provides musical strategies as external counseling and not as part of a therapeutic intervention. There is no dependence on the MT, but the use of music is not maintained, and even negative effects are seen in the therapist's absence (7). The current work model integrates both approaches, where the MT provides therapy as well as support in using musical strategies.

As can be seen in Figure 2, the MT has three main roles: providing joint music therapy; supporting the PC spouse; and providing musical strategies for daily use.

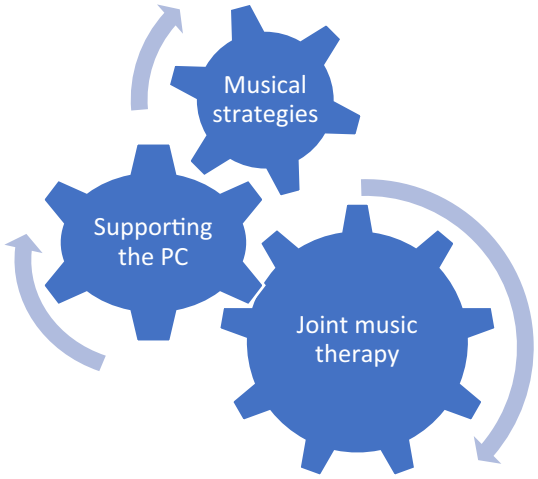

FIGURE 2
The MT's roles in the work model.

The MT's primary role is to provide therapy The therapy is given jointly while addressing the couple as one unit, contrary to focusing on the PWD and providing separate support for the PC (14). Strengthening the couple's relationship when dementia is involved is a significant part of improving the couple's quality of life. The PC spouses feel a sense of loss for their partner, since they can no longer share their thoughts, feelings, and experiences with them as a couple. The important sense of "us" and togetherness is damaged due to the disease (15).

The MT's second role is to provide separate counseling and support for the PC. The phone counseling provided a platform for discussing topics that could not have been raised in the joint sessions, for giving tools to cope with the daily challenges, and for fine-tuning the therapeutic intervention. This model is consistent with other studies that see the importance and significance of addressing the PC spouse, in order to enable them to continue to provide optimal care (8, 16).

The MT's third role is to enable the spouses to continue using music beyond the therapy session. In the current work model, musical strategies were given internally, as part of the joint therapy, which addressed the needs of both spouses. Musical strategies were also provided separately to the PC in a way that made it possible to fine-tune the therapeutic intervention and to practice during the session together with the MT. Unlike studies that include musical strategies conducted by the PC with limited guidance and support from the MT (17), in the current model the MT supports the couple in joint music therapy sessions and during a follow-up period. This format makes it possible to implement the musical strategies and provide ongoing support while gradually reducing the frequency of the sessions. The number of therapy sessions in the work model enabled an ongoing process to develop and sufficient time to practice and implement independent use of musical strategies. Only afterwards, it was possible to space out the therapy sessions and lessen the dependence on the MT.

Conclusion

The study findings indicated that the MT's extensive support helped to implement the use of music in the daily lives of PWD and their spouses. This extensive support requires an inclusive solution of couple's therapy, counseling for the PC, and providing musical strategies. This inclusive solution requires extensive training of MTs. Alongside the resources required to enable the ongoing presence of a MT, it is a model that: (1) Provides a therapeutic space for the couples. (2) Enables good implementation of musical strategies. (3) Provides a stable foundation that makes it possible to reduce the frequency of the sessions, which saves resources, yet still provides support in using music independently. This study examined a limited number of couples and additional studies are required to further validate and develop the work model. In addition, a longer follow-up period is needed to examine the sustainability of the couple's use of musical strategies and to explore whether music has been integrated into their daily lives.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Department of Music at Bar-Ilan University (E.MUS.2018-7). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

MR, AD, and AG conceived of the study, participated in its design, and took part in drafting the manuscript. MR, the music therapist, was in charge of coordination, data collection and coding as part of her Ph.D dissertation. AD and AG supervised the work. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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A scoping review of music-based interventions for swallowing difficulties: implications for treating older adults with presbyphagia

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Objectives: Presbyphagia refers to age-related changes in the swallowing mechanism (e.g., reduced skeletal muscle strength that decreases bolus control). If left untreated, these changes can lead to dysphagia, which refers to impaired swallowing (e.g., coughing or choking when eating). Given that swallowing difficulties are common among older adults that they make up the fastest growing age group globally, the need for interventions to address presbyphagia is gaining urgency. To begin to address this need, we conducted a scoping review to analyze music therapy research aimed at enhancing swallowing function. The objective was to identify key intervention characteristics and propose clinical implications for treating presbyphagia using music therapy.

Methods: This review followed the methodological frameworks outlined by Arksey and O'Malley and Levac et al. and used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis for Scoping Reviews for analysis and reporting. Four electronic databases (i.e., ProQuest, PubMed, RISS, Web of Science) were searched for quantitative and qualitative studies in English or Korean that used music-based interventions to address swallowing function in older adults. Content analysis was conducted to identify and compare the main features of music interventions for swallowing difficulties among older adults.

Results: Ten articles were identified and analyzed. It was found that three core components–respiration, vocalization, and singing–were employed to enhance swallowing function in populations with neurological impairments, dementia, or head and neck cancer. Notably, actions closely linked to swallowing function, such as laryngeal elevation and oral movements, were utilized therapeutically to speak or sing. Based on these characteristics, clinical implications are proposed to address presbyphagia.

Conclusion: Singing entails a systematic and focused incorporation of stepwise activities that can be used to address swallowing disorders. In this context, critical clinical implications that music therapists should consider when treating individuals with presbyphagia include warmup breathing, vocalizing targeting laryngeal control, and singing targeting oral motor control. This review can contribute to the expansion of music therapy with older adults and the advancement of music therapy techniques.

KEYWORDS

swallowing, music intervention, singing, scoping review, older adults, presbyphagia

1. Introduction

The global population of individuals aged 65 years or older currently stands at 720 million, with projections indicating a doubling of this figure within the next three decades (1). Among older adults, a prominent characteristic is the gradual decline in multiple physical functions, rendering them more vulnerable to conditions such as sarcopenia, dysphagia, osteoporosis, and frailty (2, 3). Given the rise in life expectancy and the multifaceted nature of aging, encompassing biological, psychological, and social changes, it is imperative we gain a deeper comprehension of how to effectively treat common age-related difficulties and disorders. One such difficulty is presbyphagia.

Aging leads to various changes in swallowing physiology, and these changes are collectively referred to as presbyphagia (4). While presbyphagia refers to normal age-related changes in the swallowing mechanism, these changes may be manageable if treated before they cause difficulties or serious dysfunction in swallowing. Difficulty swallowing is referred to by the umbrella term dysphagia and can be caused by neurological impairment, structural abnormalities, or muscle or brain disorders. Dysphagia has been found to affect over 20% of individuals over the age of 50 years in community settings and nearly 60% of individuals over the age of 80 years in nursing home settings (5).

Swallowing difficulties encompass both physiological and functional aspects, impacting not only psychological and social wellbeing but also overall health and communication (6, 7). As such, difficulties in swallowing can impact an individual's quality of life. Notably, depression emerges as a significant symptom in this context, drawing attention in several studies (8, 9). These studies underscore a substantial link between swallowing difficulties and depression, especially among older adults. This emphasizes the significance of integrating psychological interventions with therapeutic approaches to effectively manage swallowing difficulties.

Swallowing is a neuroanatomical process composed of three stages: oral, oropharyngeal, and esophageal (10, 11). Specific structures such as muscles, nerves, the tongue, salivary glands, epiglottis, vocal cords, larynx, and hyoid bone are involved in each stage (11). Difficulties can arise from either mechanical obstruction or impaired motor function along the pathway through which food and liquid travel. Swallowing difficulties arising from neurological or structural causes necessitate rehabilitation interventions focused on precise motor timing and repetitive tasks to enhance function (12, 13). Interventions addressing swallowing difficulties aim to enhance laryngeal elevation and strengthen the associated muscles, ultimately improving swallowing function in dysphagic patients (14, 15).

The age-related changes defining of presbyphagia, such as diminished tongue pressure from muscle loss and extended upper esophageal sphincter opening times, increase an individual's risk for dysphagia, including increased risk of aspiration (16). Unfortunately, conventional swallowing treatment modalities such as supraglottic swallow and Medelsohn maneuver, may be inappropriate or less effective with older populations (17). For instance, older adults commonly experience heightened fatigue and comorbidities that prohibit them from adhering the treatment. Therefore, when addressing swallowing changes and difficulties in older adults, it is crucial to consider the specific needs and limitations of this population, including the use of proper sensory activation and easily manageable swallowing motor tasks.

As an alternative to conventional treatment modalities, music-based interventions can target the oral and vocal structures involved in the process of swallowing and can be designed to meet the unique needs of older patients. In particular, singing can directly induce functional changes (18, 19). The basis for applying singing to improve swallowing function stems from respiration, phonation, and articulation sharing common neuroanatomical processes. Specifically, singing activates an auditory-motor feedback loop in the brain, which is further strengthened by the common neural network shared between singing and speaking (20). The processes of swallowing and vocalization are intricate coordination systems that necessitate precise integration of musculature in the upper airway, encompassing the oral, pharyngeal, laryngeal, and respiratory regions (21). Because singing requires coordination of respiration, vocalization, and articulation (22–24), it can address the needs of patients with dysphagia by integrating musical elements such as melody and rhythm. Thus, perceiving vocal melodies and integrating vocal and auditory information in speech production during singing involve neural engagement in auditory, linguistic, and emotional processing (25). The use of singing as a therapeutic method has been proven effective in the rehabilitation of diverse medical conditions, including stroke, aphasia, and mood disorders (26).

Singing has emerged as a promising rehabilitative approach in the realm of swallowing treatment, as evidenced by studies in neurorehabilitation (27, 28). While these singing-based music therapy approaches for dysphagia hold promise, the majority of the literature focuses on speech function (29, 30). It has been discovered that laryngeal elevation-based techniques applied in singing demonstrate favorable outcomes for patients with neurological impairment. The utilization of singing as a rehabilitative approach for improving swallowing function can be rationalized based on the evidence that the mechanisms involved in singing, including breathing, vocalization, and articulation (31), also play a crucial role in the process of swallowing.

Considering the need to expand the applications of music-based interventions, it is important to understand the theoretical and clinical characteristics of music-based intervention tasks. To address this need, we conducted a scoping review of music-based interventions focused on improving swallowing function. Scoping reviews use structured guidelines to synthesize information (32). This scoping review sought to gain insight from the research exploring the role of music-based interventions in swallowing rehabilitation and determine if there was consensus regarding the therapeutic components used to improve particular functional outcomes. Based on the analysis of the research, we suggest clinical implications for music therapists working with individuals with presbyphagia.

2. Methods

Levac et al. (33) refined the stepwise process originally outlined by Arksey and O'Malley (34) for scoping literature reviews, and we followed Levac et al.'s five stages, with the literature search and selection process being conducted iteratively. Additionally the research process, if there were areas that needed further supplementation based on data collection and review, continuous

modifications were made to the process. In this study, we used the population, concept, context (PCC) framework to enhance the validity of the research presented in the JBI reviewer's manual and other guidelines (35, 36). The framework's detailed standards for classifying and analyzing information are the following;

2.1. identifying the research question(s)

The scope of the research on this topic is extensive, so questions regarding the research should use precise descriptions and specific inclusion criteria (33, 37). In other words, research questions must be defined clearly with criteria, as they provide a roadmap for subsequent stages, including research subjects, interventions, and outcomes. Therefore, this study constructed research questions considering the PCC framework. The PCC framework was used to establish the following:

- Population: Adults who experienced swallowing difficulties or swallowing disorders.
- Concept: The use of music-based interventions to treat swallowing difficulties/disorders among adults.
- Context: Publications describing music-based interventions for swallowing issues as a primary concern, written in either Korean or English.

Based on the PCC framework described above, the research questions for this study were as follows:

- What types of music-based intervention studies have been conducted to date that have addressed swallowing function in adults?
- What are the components of music-based interventions to improve swallowing function among adults?
- Given the components of music-based interventions for improving swallowing function, what are the clinical implications for treating individuals with presbyphagia?

2.2. Searching the literature

A two-step search method was employed using electronic databases to conduct a literature search for published research. This method involved an initial search followed by reference and related literature searching. The procedures for selecting the database and keywords for the initial search were as follows.

2.2.1. Selection of databases

Given the need for expertise and objectivity in music therapy interventions, we only reviewed published work from academic research databases. Conducting a literature review within the scope of the present topic requires collecting a substantial number of research findings. It takes time to comprehensively gather research results through keyword searches, especially for topics in which non-standardized terms are used interchangeably, such as in music therapy. In addition, the authors communicated with experienced researchers in the field of literature reviews and systematic literature analysis to ensure databases that offered advanced search capabilities and were commonly used for literature reviews were selected. Consequently, ProQuest, PubMed, Research Information Sharing Service, and Web of Science databases were used with no date restriction.

2.2.2. Selection of search terms

The literature regarding music-based interventions for improving swallowing function was identified and analyzed. Music-based interventions use music to achieve therapeutic goals and may be implemented by music therapists or other professionals (38). Keywords commonly used in the field were supplemented with subject terms that aligned with the objectives of the study. To ensure a comprehensive search was conducted, the researchers modified the search terms and the sequence of database usage, repeating the search on different days to compare results. MeSH terms related to diagnoses (e.g., "swallowing disorder") and musical techniques (e.g., "music," "singing," "vocal") were combined with "intervention" and "therapy." In addition, intervention-related terms such as "treatment," "rehabilitation," "training," and "intervention" were employed, either individually or within specific categories in English and Korean. Research that was published in Korean was translated into English. The validity of the translation was verified through mutual discussion among the researchers. Table 1 shows the databases and search strategies used.

2.3. Stage 3: identifying studies

Inclusion criteria were the following: (a) implementation of a music-based intervention targeting swallowing function, (b) publication in English or Korean, and (c) reporting of measurable functional changes of swallowing or laryngeal diadochokinesis as a secondary assessment indicator of swallowing function. Exclusion criteria were (a) participants under 20 years of age, (b) duplicate intervention with the same participants, and (c) music listening intervention only. To remove duplicates and irrelevant articles, two researchers (SKi and SKa) screened article abstracts based on the previously described search strategy. Then the two other researchers (SJK and MY) revalidated the identified articles.

The assessment of study eligibility during the initial full-text screening involved two researchers (SJK and MY). Subsequently, to ensure the inclusion of studies aligned with the review's objectives, the researchers conducted multiple rounds of full-text reviews. Instances of disagreement were resolved through consensus achieved during meetings and discussions. Final selection of articles was based on consensus.

2.4. Charting the data

The data retrieval and organization were done using EndNote X9 software from Clarivate Analytics (PA, USA). Then, to code the data, our framework was established in advance. Our framework includes general study information and details about the research questions. The charting table was completed independently by one researcher (MY) and peer reviewed by two researchers (SJK and SKi). A data extraction template was created to organize information from the identified articles. To ensure

TABLE 1 Databases and search strategies using keywords.

Database	Search strategies and keywords
ProQuest (PsysARTICLES)	("dysphagia" OR "swallowing" OR "deglutition" OR "swallowing disorder*") AND ("music" OR "singing" OR "vocal task" OR "therapeutic singing") AND ("intervention" OR "treatment" OR "rehabilitation" OR "training")
ProQuest (PsyscINFO)	("dysphagia" OR "swallowing" OR "deglutition" OR "swallowing disorder*") AND ("music" OR "singing" OR "vocal task" OR "therapeutic singing") AND ("intervention" OR "treatment" OR "rehabilitation" OR "training")
PubMed	("dysphagia" OR "swallowing" OR "deglutition" OR "swallowing disorder*") AND ("music" OR "singing" OR "vocal task" OR "therapeutic singing") AND ("intervention" OR "treatment" OR "rehabilitation" OR "training")
Web of Science	(((TS = (dysphagia) OR TS = (swallowing) OR TS = (swallowing disorder*) OR TS = (deglutition))) AND ((TS = (music) OR TS = (singing) OR TS = (vocal task) OR TS = (therapeutic singing)) AND (TS = (intervention) OR TS = (treatment) OR TS = (rehabilitation) OR TS = (training))))
RISS	Each word in Korean: (((dysphagia) OR (swallow) OR (swallowing disorder)) AND ((music) OR (singing) (vocal task)) AND ((intervention) OR (treatment) OR (rehabilitation) OR (training)))

TABLE 2 Charting framework's detailed criteria.

Category	Sub-category	Details
General characteristics	Author information	Name, affiliation, academic field
	Publication-related information	Publication year/country, study design
	Participant information	Diagnosis, diagnosis of swallowing disorder, group assignment, number of participants, gender ratio of the intervention group/control group
Music-based intervention	Instructor	Music therapist or not
	Session information	Session time (min), intensity (per week), duration (weeks), total sessions, type (individual/group), accompaniment (live or recorded)
	Intervention details	Intervention steps and activities, music selection, therapeutic rationale, studies referenced in the protocol
Therapeutic goal	Measurement and outcomes	Assessment tools, outcome area, study outcomes

comprehensive data coverage, the researchers conducted the literature collection and selection processes twice, altering the order of the databases and sequence of the search terms.

To finalize the literature search, we used a modified data extraction form developed by JBI researchers (39). Two authors independently reviewed and cross-checked each selected literature and coded the data using Microsoft Excel 2022. The extracted data involved author name(s), publication year, country where the research was conducted, research methodology, participant population, intervention activities and their specific elements, reported outcomes, effects of the intervention, and details about the musical tasks used. We also categorized the intervention content described in each study by specific activity and analyzed the results to compare commonalities and differences across the studies. In addition, data collected about the music therapy interventions included intervention provider, intervention contents, intensity of sessions, presence of protocol groundwork, composition of musical tasks, and therapeutic rationale. Similar activities were grouped under the same category and classified accordingly.

The collected data was categorized and analyzed following the charting table's detailed criteria (see Table 2).

2.5. Collating, summarizing, and reporting the results

This stage of the scoping review was informed by the methodological framework outlined by Levac et al. (33). A comprehensive descriptive synthesis of the data presented in the charting table was conducted by three researchers (SJK, MY, SKi), while qualitative content analysis techniques were applied by two reviewers (SJK, MY) to formulate clinical strategies for addressing presbyphagia. The results from the synthesis and qualitative analysis were subsequently used to contextualize the results, specifically in relation to our research questions, and to inform the clinical implications surrounding the integration of music therapy sessions for individuals with presbyphagia. These insights also point to future research directions.

3. Results

The search process identified 105 studies from the target databases. After duplicates were removed, 72 citations underwent title and abstract screenings. Following this 62 studies were excluded because they did not meet the inclusion criteria. Consequently, 10 studies were analyzed for this scoping review (see Figure 1).

3.1. What types of music-based intervention studies have been conducted to date that have addressed swallowing function in adults?

What types of music-based intervention studies have been conducted to date that have addressed swallowing function in adults?

3.1.1. Study characteristics

Of the 10 studies included for analysis, two were published in 2010 (27, 40), five between 2012 and 2018 (28, 41–44), two in 2021 (45, 46), and one in 2022 (47). In terms of research design, there were three case studies (28, 41, 46), two randomized controlled studies (42, 45), four one-group pre/post studies (27, 40, 43, 44), and one ABA-mixed method case series study (47). The studies were conducted in Korea (6), USA (2), Japan (1), and Russia (1) (Table 3).

To reiterate, a diagnosis of a swallowing disorder was not required for inclusion in this review. Presbyphagia symptoms can occur without meeting the criteria for dysphagia. It was hoped that by identifying and analyzing music-based interventions focused more generally on swallowing difficulties in adults that insight into the treatment of presbyphagia could be obtained. Among the 10 studies, four applied singing interventions to improve swallowing disorders due to neurological impairments. One study included older adult participants without swallowing disorders (42) and another included older adult participants at-risk for dysphagia. Singing interventions were also applied to swallowing disorders due to head and neck cancer (HNC) (45). Two studies included mixed diagnoses with participants diagnosed with either cancer and brain damage (46) or stroke and dementia (40). It is important to note that the location of a tumor can impair swallowing as can radiation from cancer treatments. Brain damage from stroke or dementia can also interfere with one's ability to swallow.

The number of participants who completed the intervention in each study varied from 1 to 29. In one of the three case studies, a single participant was involved (41), while the other two case studies each had three participants (27, 46). The ages of the participants in all 10 studies exceeded 50 years; three studies included participants aged 60 and above (43, 44, 46), and two studies had an average participant age of over 80 years (41, 42). Of the 10 studies reviewed, six studies employed individual intervention (27, 28, 41, 44–46), whereas four studies utilized group intervention (40, 42–44). In terms of conducing sessions, seven studies involved music therapists (27, 28, 41–43, 46, 47), while three did not report facilitators (40, 41, 44).

Regarding outcome measurements, vocal components, articulation, and swallowing functions were measured. Vocal aspects included measures like maximum phonation time (MPT) and vocal quality (jitter, shimmer, Noise-harmonics to ratio, NHR), while articulation involved tasks such as alternating motion rate (AMR) and sequential motion rate (SMR). For swallowing, direct measures like video fluoroscopic swallowing study (VFSS), video fluoroscopic dysphagia scale (VDS), Dynamic Imaging Grade of Swallowing Toxicity (DIGEST), modified water swallowing test, and mean swallowing pressure were utilized. Indirect methods encompassed assessments within the Frenchay dysarthria assessment related to swallowing functions, laryngeal diadochokinesis (L-DDK) test related to laryngeal-muscle movement, and electromyography (EMG), among others. Only three studies used the Swallowing Quality of Life (SWAL-QoL) questionnaire (28, 43, 46).

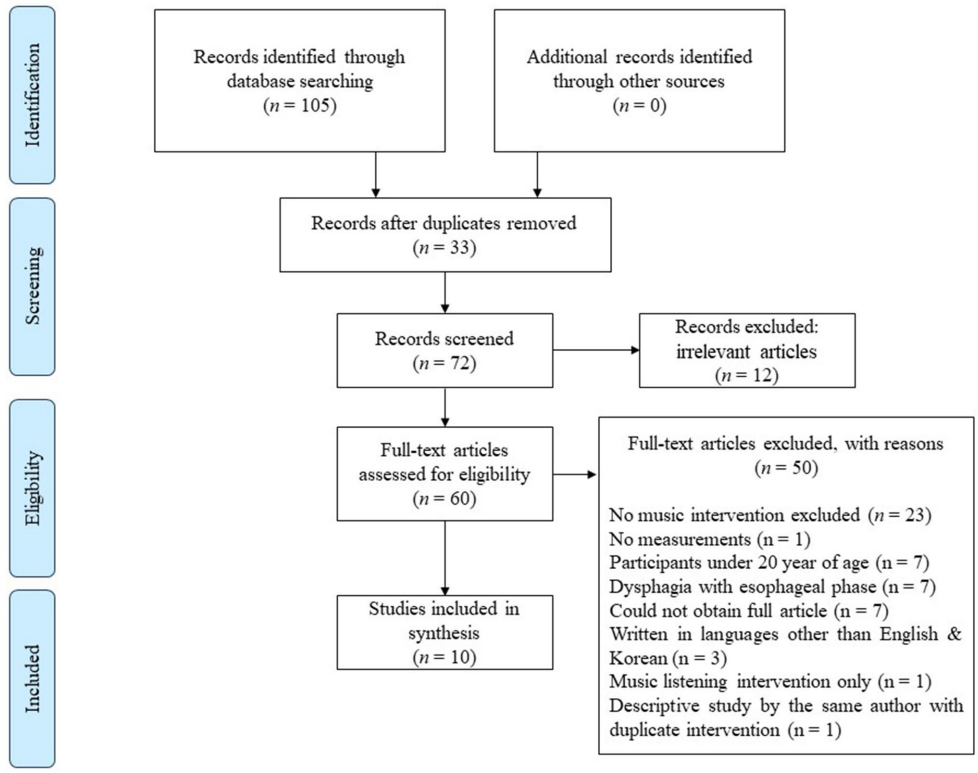

FIGURE 1
Workflow of the scoping review.

TABLE 3 Study characteristics ($N = 10$).

Author (year), Country	Study design	Patient description		Instructor, mode, frequency, duration	Intervention (steps, program)	Measurement	Main outcome
		Diagnosis (*N*)	N, sex (M:F), age (mean or range)				
Jomori and Hoshiyama (2010) (40) Japan	One-group pre/post study pilot	CVA (6), brain injury (1), dementia (1), disuse syndrome (2)	10 (4:6) 77.6 ± 5.6	NR; Gr 40 min/ once (pilot)	6 steps (1) Introduction of the song; (2) Rhythmic movement activity with instruments; (3) Singing; (4) Rhythmic activity, beating a drum to song; (5) Instrumental performance for cool down; (6) Ending song by the therapist	(1) The number of swallowing movements (per hour) by EMG	(1) Sig. differences in swallowing rate between before and during music therapy for all participants. (2) Sig. high correlation coefficient between the increase in the frequency of swallowing during music therapy and the swallowing rate before music therapy.
Kim (2010) (27) Korea	One-group pre/post study	Stroke	8 (8:0) 58.7, (47, 49) 51–70	MT; In 15 min/ 3 times a week, 4 weeks	6 steps (1) Warm up vocalization (2 min); (2) Singing (3 min); (3) Two-step breathing using diaphragmic control (2 min); (4) Three-step breathing for 10 repetitions (2 min) (5) Laryngeal elevation through vocalization (3 min); (6) Singing for closing (3 min)	(1) Frenchay Dysarthria Assessment: reflex, respiration, laryngeal categories	(1) Sig. differences for pitch in the laryngeal section between the initial and mid-evaluation. (2) Sig. differences for dribble or drool in the reflex section, respiration at rest in the respiration section, laryngeal pitch, and speech in the laryngeal section between the initial and final evaluation.
Yun and Lee (2012) (44) Korea	One-group pre/post study	Dysphagia risk	29 (0:29) 66.48 ± 4.93	NR; Gr 60 min/ once a week, 8 weeks	3 steps *Based on Jomori, and Hosihiyama (40); Kim (27) (1) Breathing (2 min); (2) Vocalization (3 min) (3) Singing (50 min)	(1) Functional dysphagia scale (2) Modified water swallowing test (3) Food test (4) Nutrition state: TSF, MAMC	(1) Sig. differences in items related to preparatory disorders, aspiration risk, and pharyngeal disorders as well as in the total score on the functional dysphagia scale. (2) Sig. imprv. of pre- and post-intervention scores in the water swallowing test and food swallowing test.
Segall (2017) (42) USA	RCT	Elderly	A: 10 (NR) 85.5 ± 4.47 B: 10 (NR) 85.5 ± 4.47	MT; Gr 45 min/ twice a week, A: 4 weeks B: 8 weeks	5 steps (1) Posture instruction and alignment (5 min) (2) Diaphragmatic breathing (10 min); (3) Vocal warmups (10 min); (4) Singing preferred songs (15 min); (5) Closure (5 min)	(1) MSP (2) Voice data: intensity, MPT	(1) Sig. imprv. in each group's assessment items. (2) Difficult to determine group differences given different intervention periods.

(Continued)

TABLE 3 (Continued)

Author (year), Country	Study design	Patient description		Instructor, mode, frequency, duration	Intervention (steps, program)	Measurement	Main outcome
		Diagnosis (*N*)	N, sex (M:F), age (mean or range)				
Stegemöller et al. (2017) (43) USA	One-group pre/post study	IPD	HD: 6 (NR) 65 ± 11 LD: 6 (NR) 69 ± 7 LD: 6 (NR) 69 ± 7	MT; Gr NR/ HD: twice a week, 8 weeks LD: once a week, 8 weeks	2 steps (1) 4 series of vocal exercises (2) Group singing	(1) UPDRS (2) EMG (3) SWAL-QOL	(1) Sig. imprv. in EMG outcome measures. (2) Sig. imprv. in UPDRS total and UPDRS motor scores. 3) No sig. Differences in SWAL-QOL.
Jo et al. (2018) (41) Korea	Case study	Brain injured	1 (1:0) 82	NR; In 30 min/ 5 times a week, 4 weeks	2 steps (1) Humming, vocalization, singing with lyrics (15 min); (2) Wind instrument playing (15 min)	(1) MMSE-K (2) BASOFF (3) Spirometer (4) Modified dysphagia risk assessment scale	(1) Imprv. of cognitive functions. (2) Imprv. of oral motor function during meals. (3) Imprv. of respiratory function. (4) Imprv. (reduction) in dysphagia risk score.
Yeo and Kim (2018) (28) Korea	Case study	Tongue cancer (1), SCI (1), PD (1)	3 (2:1) 62.3 (50–78)	MT; In 30 min/ 2–3 times a week, about 4 weeks	4 steps (1) Respiratory muscle relaxation and warmup (2) Vocalization and therapeutic singing (3) Vocal training for laryngeal elevation (4) Breathing for conclusion	(1) Voice data: intensity, jitter, L-DDK, MPT, NHR, pitch (2) SWAL-QoL	(1) Imprv. of L-DDK, MPT, SWAL-QoL in all patients. (2) Imprv. of patients' voice quality.
Jo et al. (2021) (45) Korea	RCT	HNC	Con:13 (10:3) 59.15 ± 4.22 Inter:15 (9:6) 50.87 ± 3.68	MT; In 20 min/ 3 times a week, 4 weeks	4 steps (1) Physical preparation with breathing for relaxation (2 min); (2) Vocal warmup (3 min) (3) Singing for laryngeal elevation (10 min) (4) Modified singing (5 min)	(1) DIGEST (2) VDS (3) Voice data: intensity, jitter, L-DDK, MPT, NHR, pitch, shimmer	(1) Sig. imprv. of L-DDK in the intervention group compared to that of the control group. (2) Sig. imprv. of VDS, DIGEST in IG, and items in the pharyngeal phase score of VDS. (3) Sig. imprv. of the pharyngeal CG in VDS, DIGEST score.
Yeo et al. (2021) (46) Korea	Case study	PD, HNC	4 (1:3) 65.8	MT; In 30 min/ twice a week, 12 weeks	5 steps (1) Respiratory muscle relaxation; (2) Vocal folds relaxation by vocalization; (3) Laryngeal elevation by vocalization of two vowels; (4) Modified singing for respiratory control; (5) Articulation based on musical phrases or accents	(1) VDS (2) VFSS (3) Voice data: AMR, L-DDK, MPT, SMR (4) SWAL-QoL	(1) Imprv. of L-DDK, SWAL-QoL in all patients. (2) Imprv. of VDS in all patients associated with different swallowing tasks for each patient group. (3) Decrease of MPT in PD, HNC, increase in PD.

(Continued)

TABLE 3 (Continued)

Author (year), Country	Study design	Patient description		Instructor, mode, frequency, duration	Intervention (steps, program)	Measurement	Main outcome
		Diagnosis (*N*)	N, sex (M:F), age (mean or range)				
Apreleva Kolomeytseva et al. (2022) (47) Russia	ABA-mixed method case series study	ALS	8 (2:6) 58.1	MT; In About 60 min/ twice a week, 6 weeks	15 steps (1) Opening and assessment (5 min); (2) Body alignment (3 min); (3) Diaphragmatic breathing (4 min); (4) Controlled breathing and lip seal (3 min); (5) Music assisted relaxation for voice (8 min); (6) "Ping pong" soft palate (1 min); (7) Phonation (5 min); (8) Consonant range cantillation (2 min); (9) Velopharyngeal port (3 min); (10) Impulse diaphragmatic breathing (2 min); (11) sustained vowels production (5 min); (12) Laryngeal elevation through vocalization (5 min); (13) Vocal cord relaxation (2 min); (14) Preferred song performance (5 min); (15) Closure and assessment (5 min)	(1) MIP, MEP, FVC (2) PEF; (3) VFSS (4) CNS-BFS swallowing, speech sub score (5) Voice data: MPT, AMR, SMR, jitter, shimmer, NHR, VSA (6) F0, speaking rate, speech pause ratio/ pause frequency during oral reading (7) F0, speaking rate, speech–pause ratio/ pause frequency during spontaneous speech	Imprv. of bulbar and respiratory functions as follows: (1) MIP, MEP (2) PEF (3) Hypernasality level, time-to-laryngeal vestibule closure, maximum pharyngeal constriction area, peak position of the hyoid bone, total pharyngeal residue C24 area (4) CNS-BFS swallowing and speech subscales (5) MPT, jitter, shimmer, NHR (6) Speaking rate, speech–pause ratio, pause frequency

ABA, applied behavior analysis; ALS, amyotrophic lateral sclerosis; AMR, alternating motion rate; BASOFF, Behavioral Assessment Scale of Oral Functions in Feeding; Con, control group; CNS-BFS, Center for Neurologic Study - Bulbar Function Scale; CVA, cerebral vascular disease; C24 area, area of cervical vertebrae C2 to C4; DIGEST, dynamic imaging grade of swallowing toxicity; EMG, Electromyography; F, female; FVC, forced vital capacity; F0, frequency; Gr, group intervention; HD, high dosage group; HNC, head and neck cancer; Imprv., improvement; In, individual intervention; Inter, intervention group; IPD, idiopathic Parkinson's disease; L-DDK, laryngeal diadochokinesis; LD, low dosage group; M, male; MAMC, mid arm muscle circumference; MEP, maximal expiratory pressure; MIP, maximal inspiratory pressure; MMSE-K, mini mental state examination-k; MPT, maximum phonation time; MSP, mean swallowing pressure; MT, music therapist; N, no; NHR, mean noise to harmonics ratio; NR, not reported; PD, Parkinson's disease; PEF, peak expiratory flow; RCT, randomized control trial; SMR, sequential motion rate; SCI, spinal cord injury; Sig., significant; SWAL-QOL, Swallowing Quality of Life questionnaire; TSF, triceps skin fold thickness; UPDRS, unified Parkinson's disease rating scale; VDS, video fluoroscopic dysphagia scale; VFSS, video fluoroscopic swallowing study; VSA, vowel space area.

3.2. What are the components of music-based interventions to improve swallowing function among adults?

3.2.1. Music intervention component analysis

Within the scope of the scrutinized literature, the therapeutic applications were grounded in singing, commonly employed for speech rehabilitation. As an extended and modified use of the speech production system, singing can be a key element of swallowing interventions in music therapy (48, 49). Upon examining the interventions used in each study, they generally applied musical components to focus on swallowing functions in the process of singing, encompassing the respiratory, vocalization, and articulatory stages. To identify the core components of music-based interventions targeting swallowing function, we reviewed not only the intervention contents but also all relevant description details within the studies as well as key reference materials.

The constituent activities within the structured music interventions were subjected to analysis (see Table 4). Examining the studies based on the executed activities, it became apparent that the predominant tasks were 'upper body movement – stretching arms, neck, and shoulders to relax the muscles (28, 41–44, 46, 47), and 'vocal sound gliding using a vowel sound' (27, 28, 42–47), which was reported in 8 studies among 10 studies. Conversely, activities involving direct stimulation of the laryngeal muscles, pertinent to swallowing,

were featured in only four studies (27, 28, 45, 46). The music tasks related to laryngeal movements closely involved in the swallowing process and airway protection were identified as 'stepwise breathing' (27) and 'vocalizing (/ah/)-/oo/-/ee/ in ascending pitch order' (27, 28, 45, 46). In addition to these, activities related to vocal musculature and orofacial motor skills included humming (27, 28, 41, 45, 46) and sound gliding (27, 28, 42–47), as well as vocalizing the vowel /a/ while exhaling after inhaling sufficiently (46, 47).

Upon conducting a detailed analysis of each activity in accordance with the therapeutic goals for swallowing function, the following results were obtained. Relaxing of respiratory muscles ($n = 2$) was attempted in a form of diaphragmatic breathing and upper body stretching. Enhancing targeted articulatory system ($n = 1$), and inducing laryngeal muscle movement ($n = 1$) were attempted in a form of singing, while relaxing vocal musculature ($n = 3$) was achieved through activities such as vocal sound gliding, vocalizing vowel sounds, or humming. Activities that directly stimulate the larynx, which plays the most direct role in the swallowing process, include inducing airway protection ($n = 1$), elevating the larynx ($n = 1$), regulating orofacial musculature ($n = 1$), and stimulating orofacial motor skills ($n = 1$).

3.2.2. Vocalization and singing for swallowing

Vocalization activities were undertaken in nine of the studies with diverse objectives and methods. The objectives of these vocalization activities encompassed soft palate elevation, vocal cord relaxation, and laryngeal elevation. In terms of methods, five studies (27, 28, 45–47) employed vocalization in the form of glissando or humming to facilitate vocal cord relaxation. These vocalization activities were subdivided into preparatory and execution stages. The preparatory stage of vocal activities typically involves comfortably and lengthily producing the vocalizing vowel /a/ or humming, while the execution stage corresponds to actively controlling vocal structures' movements to produce sounds with varying pitch while singing.

Regarding intervention activities, several methods were utilized. These included brief glissando utterances by the participant, subsequently reflected upon by the therapist (27, 28, 45, 46), as well as modeling (42). Additionally, three studies incorporated aspects of adjusting pitch or tempo given by music therapist (27, 28, 45). Beyond the vocal preparation phase, the primary objectives extended to sustaining laryngeal elevation, enhancing voice intensity, and strengthening motor function in the oral muscles. Furthermore, the introduction of vocal training through diverse methods, including vocal instruction, glissando, and messa di voce (a vocal method that involves maintaining a consistent pitch while gradually increasing the volume of the voice), highlighted the goals and techniques that were utilized.

All studies incorporated a singing phase as part of their intervention. Preferred song singing was performed in two studies (28, 43), and in seven studies singing was carried out while modifying respiration or lyrics (27, 41, 42, 44–47). Only one study (40) included preferred song singing without specific therapeutic goals and described this as a rhythmic activity.

3.2.3. Use of lyrics to focus on targeted oral motor movement

Among the studies involving singing with lyrics, five used singing to improve physical functions such as breathing and articulation (28, 41, 44–46). Activities using vocalization of vowels and consonants or singing with lyrics to strengthen the orofacial muscles were presented in all studies. Singing was performed by inserting consonants instead of lyrics. In a study with the primary goal of strengthening oral muscles, a detailed description of the spherical shape of vowels and rationale for the selection criteria of consonants to replace lyrics were presented. It was reported that vocalization using vowels induces various movements of the jaw and helps to strengthen the muscles of the lips, cheeks, and jaw. Also, Korean palatal sounds, such as /gah/ and /kah/, and Korean tongue consonants, such as /tah/, were used to maximize tongue movement.

The manner in which singing was conducted also exhibited variations depending on the type of intervention. In certain cases, singing activities within group interventions were intertwined with functions like articulation and breathing (43, 44), while in others, they pertained to speech function (28, 41–43, 45–47). Notably, these activities pursued goals not directly aligned with swallowing function. Additionally, interventions targeting swallowing function, both in individual and group settings, predominantly comprised breathing and vocalization exercises, as opposed to conventional singing.

3.2.4. Enhanced musical experience

Regarding the use of music, six studies meticulously outlined the therapist's accompaniment choices (27, 28, 43, 45–47) For instance, during breathing exercises, a trill accompaniment was introduced to signal breath holding during breathing activity or adjustment was made to accommodate the participant's vocal range and voice intensity during singing. The music excerpt selected for the patient's involvement was tailored according to the patient's vocalization.

In contrast, the remaining four studies (40–42, 44) did not delve into the therapist's musical involvement, as they refrained from specifying the musical excerpt employed by the therapist or the music incorporated. Instead, their focus rested on monitoring the activity's progression. The singing process appeared to be centered around general singing without specific musical modifications for a particular purpose. However, the therapist's musical proficiency emerged as a pivotal factor, as it served as an effective strategy for enhancing engagement and refining participant performance.

When considering vocalizations, the incorporation of musical components into singing activities stands out as crucial, employing an array of approaches. The therapist's musical expertise assumes a central role in shaping this process, adjusting song composition through alterations in accompaniment and the integration of musical elements. While prioritizing singing activities that accentuate articulation, the prevalent approach involved the direct rendition of familiar songs devoid of a therapeutic rationale.

3.3. Research question 3: given the components of music-based interventions for improving swallowing function, what are the clinical implications for treating individuals with presbyphagia?

3.3.1. Clinical implications of singing to treat presbyphagia

Given the results of this scoping review, we offer clinical implications for music therapy addressing age-related swallowing

TABLE 4 Analysis of intervention activities based on goals, target function, approach, studies, and population.

Intervention activity	Target therapeutic goal	Included study	Suggested activities for presbyphagia
Diaphragmatic breathing	Relaxing respiratory muscles	*N* = 3: Segall (42), Stegemöller et al. (43), Apreleva Kolomeytseva et al. (47)	Body alignment for relaxation
Upper body movement – stretching arms, neck, and shoulders to relax the muscles	Relaxing respiratory muscles	*N* = 8: Yun and Lee (44), Segall (42), Stegemöller et al. (43), Jo et al. (41), Yeo and Kim (28), Jo et al. (45), Yeo et al. (46), Apreleva Kolomeytseva et al. (47)	Head and neck movement (head posture change)
Singing a short phrase of melodies with regular breathing between phrases	Enhancing targeted articulatory system	*N* = 1: Yeo et al. (46)	Respiratory muscle movement
Singing a preferred song in a comfortable tempo and pitch range	Inducing laryngeal muscle movement	*N* = 6: Segall (42), Stegemöller et al. (43), Jo et al. (41), Jo et al. (45), Yeo and Kim (28), Yeo et al. (46)	Respiratory muscle movement
Vocal sound gliding using a vowel sound	Relaxing vocal musculature	*N* = 8: Kim (27), Yun and Lee (44), Segall (42), Stegemöller et al. (43), Yeo and Kim (28), Jo et al. (45), Yeo et al. (46), Apreleva Kolomeytseva et al. (47)	Vocal warmup
Vocalizing the vowel /a/ while exhaling after inhaling sufficiently	Relaxing vocal musculature	*N* = 2: Yeo et al. (46), Apreleva Kolomeytseva et al. (47)	Vocal warmup
Humming	Relaxing vocal musculature	*N* = 5: Kim (27), Jo et al. (41), Jo et al. (45), Yeo and Kim (28), Yeo et al. (46)	Vocal warmup
Stepwise breathing	Inducing airway protection	*N* = 1: Kim (27)	Laryngeal muscle movement
Vocalizing (/ah/)-/oo/-/ee/ in ascending pitch order	Elevating larynx	*N* = 4: Kim (27), Yeo and Kim (28), Jo et al. (45), Yeo et al. (46)	Laryngeal elevation
Vocalizing using a consonant sound	Regulating orofacial musculature	*N* = 3: Jo et al. (41), Stegemöller et al. (43), Apreleva Kolomeytseva et al. (47)	Oral motor exercise
Singing a modified song repetition of target orofacial movement	Stimulating orofacial motor	*N* = 4: Jo et al. (41), Jo et al. (45), Yeo et al. (46), Apreleva Kolomeytseva et al. (47)	Oral motor exercise

difficulties in older adults. Singing has clinical viability because it is not sensitive to the patient's level of cognitive functioning. Considering the attributes of the aging demographic, the co-occurrence of cognitive deterioration is anticipated, thereby amplifying the clinical strength of singing as an intervention that holds significant accessibility for this specific cohort.

In addition, music therapy interventions for presbyphagia should place significant emphasis on respiration, vocalization, and singing. These facets involve extensive engagement and straightforward implementation for a broad segment of the older adult population. To effectively address presbyphagia, these music therapy elements should align with physical activity and target muscle strengthening pertinent to swallowing. Patients should be able to execute these tasks independently to maintain a consistent level of intervention intensity and experience the psychological benefits of music-related activity (49, 50).

In interventions incorporating singing, respiratory exercises conducted at the initial stage were predominantly employed alongside relaxing music to elevate activity levels or stretch associated muscles. However, when designing interventions that target swallowing function, particularly tailored for older adults, controlled respiratory exercises are essential, encompassing stronger dynamics and brief breath pauses for practicing the complete closure of the epiglottis, a structure related to swallowing. Hence, there is a need to cautiously incorporate sufficient repetition of regulated respiratory maneuvers.

Vocalization is a vital function closely tied to swallowing, with crucial laryngeal muscle control. Vocal folds, false vocal folds, and aryepiglottic folds contract in tandem with hyoid and laryngeal elevation, protecting the airway (51). Furthermore, oral control and lingual control are integral to vocalization and swallowing. Both non-speech vocalization and speech demand mouth opening and an upright head position for effective sound projection. Speech adds the

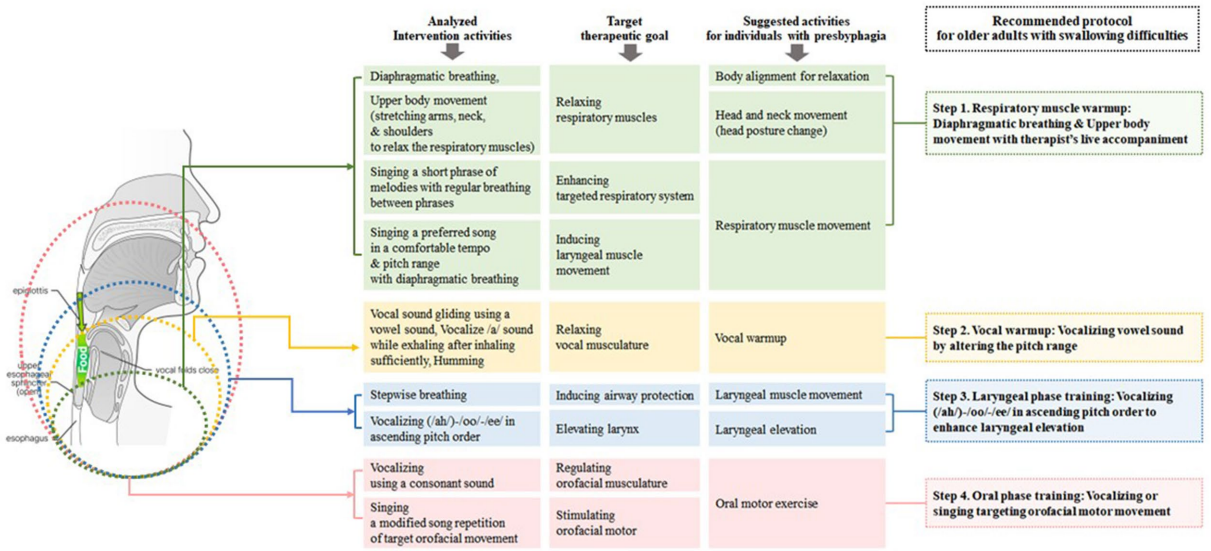

FIGURE 2
Proposed clinical implications based on research analysis.

complexity of coordinating lip, jaw, and tongue movements; shaping oral-pharyngeal cavities for vowel resonances; and forming obstructions for consonants, requiring synchronization with voice onset and offset (52).

Considering the relationship between vocalization and swallowing (53), it becomes apparent from the current research analysis that activities such as humming, vowel sound production, gliding vowel sounds, and vocalizing at different pitches have tended to center around the oral phase. In light of the age-related decline in muscle function among older individuals, movements necessitating resistance, such as laryngeal elevation, should be more proactively integrated. To this end, a diverse array of singing such as vocalizing or singing melodies with various pitch intervals can be effectively employed. Furthermore, avenues for facilitating more vigorous movements of structures like the tongue and jaw need to be explored in vocalization. In singing, careful consideration must be given to the choice of lyrics for vocalization exercises, specifically utilizing lyrics containing certain pronunciations and incorporating direct tongue protrusion and yawning. The overall clinical implications are summarized in Figure 2.

4. Discussion

The purpose of this article was to analyze relevant research to present the theoretical frameworks and intervention protocols using music-based interventions for swallowing difficulties in adults within rehabilitation settings. Considering the growing need to address swallowing difficulties among older adults, it is necessary to expand the scope of music therapy interventions by looking at the clinical applications of previous research findings. As such, this review synthesized the music therapy applications for swallowing interventions and analyzed components of musical tasks tailored to facilitate swallowing function. Not surprisingly, the majority of studies examined in this review included singing tasks encompassing various target subtasks, such as orofacial muscle exercises and vocalizations, which could be implemented by older adult populations.

Compared to a previous scoping review of singing-centered interventions in pulmonary rehabilitation, the current analysis showed that singing interventions for functional improvement were structured to include respiration, vocalization, and singing. Studies exploring singing in respiratory rehabilitation tend to prioritize community-based group singing, so there was less specific information regarding the therapeutic aspects of singing tasks for functional improvement (54). It implies that understanding therapeutic considerations in composing music therapy tasks for target behaviors is essential. This aligns with our findings, showing a consistent intervention structure. However, our review found specific vocal and singing tasks associated with swallowing function, suggesting a deliberate inclusion of aspects related to swallowing function.

Among the examined studies, seven (27, 28, 41, 42, 45–47) evaluated the relationship between oral and language functions in swallowing capabilities. Singing tasks are inherently tied to respiratory control, articulation, and phonation, all of which prominently impact structures involved in swallowing function. Changes observed in these parameters underscore the potential of a singing-based enhancement protocol to exert a comprehensive influence on individuals with presbyphagia. Studies that assessed alterations in laryngeal AMR and L-DDK before and after interventions consistently found proof that musical interventions possess the capacity to concurrently enhance both swallowing and speech functions (28, 45, 46). Furthermore, activities promoting movements of the jawbone or tongue, pivotal for precise articulation, share commonalities with the mechanisms inherent in singing, wherein the lyrical content is structured. Consequently, if forthcoming endeavors integrate singing activities focused on enhancing articulatory engagement, a mutual advancement in both the participants' swallowing and speech functions could be reasonably anticipated.

In music therapy sessions, selecting and modifying lyrics tailored to each patient are significant tasks for music therapists. Generally, this involves considering mechanisms such as auditory-motor interactions (55). For swallowing function, there are differences in the treatment direction due to the high involvement of more complicated timing and the movement of oral and pharyngeal regions. In the interventions included in this scoping review, vocal activities like humming and gliding, which were predominantly employed, went beyond mere warmup exercises and served as direct goal-oriented activities manifested by lengthy duration and the inclusion of multiple tasks during the vocalization phase of the intervention [i.e., (43, 46)]. Thus, for older adults with decreased muscular strength, a more proactive and efficient implementation of music applications should be developed to induce functional improvement.

4.1. Strengths and limitations

Scoping reviews inherently have limitations in thoroughly exploring the information extracted from their findings, as their primary focus is to outline the extent of published works on a given topic. Consequently, this particular review refrained from systematically evaluating the quality of the included studies. In terms of understanding the research topic, all authors are qualified music therapists and researchers with clinical experience in music therapy interventions targeting swallowing function. Notably, this review is the first of its kind to examine music interventions aimed at improving swallowing function; however, due to the limited availability of relevant research, there are limitations in extrapolating the specifics of these interventions. Since not all included studies were conducted by music therapists, there may be variations in the composition and level of expertise in interventions. Given the lack of prior research on music therapy interventions for presbyphagia, this analysis included different music-based interventions designed to enhance swallowing function across various groups of participants. From this approach, clinical implications were derived.

5. Conclusion

This scoping review holds the potential to enhance the efficacy of music therapists in addressing age-related swallowing disorders prevalent among the aging population. This research provides valuable insights for music therapists to respond more effectively to the challenges posed by age-related swallowing difficulties. Given that singing, a frequently employed musical activity within music therapy, shares structural elements with the phonation process, its utility in augmenting speech function is well understood. While singing to treat swallowing difficulties appears to parallel its application for speech enhancement, its direct extension to improving swallowing function is limited.

In the context of ameliorating age-related swallowing difficulties, it is essential to structure music therapy interventions that encompass precise muscular control and heightened execution intensity of anatomical structures intrinsically linked to swallowing function. It is anticipated that music therapy in clinical settings will witness a growth in treatment tailored to the indispensable mechanism of swallowing, consequently contributing to an enhanced quality of life for the older adult population.

Author contributions

SJK: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. MY: Conceptualization, Formal analysis, Validation, Writing – original draft, Writing – review & editing. SKi: Data curation, Formal analysis, Visualization, Writing – review & editing. SKa: Data curation, Validation, Visualization.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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A narrative review of music therapy for neuropsychiatric symptoms in Alzheimer's disease and rationale for protocolized music teletherapy

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Introduction: Alzheimer's Disease (AD) constitutes a major societal problem with devastating neuropsychiatric involvement in over 90% of those diagnosed. The large spectrum of AD neuropsychiatric symptoms leads to polypharmacological prescribing that, in turn, poses a major risk for increased side effects. Non-pharmacological interventions such as music therapy (MT) are therefore recommended as first-line treatments. The amalgamation of an aging population, long lifespan, and shortage of qualified music therapists limits access to MT services for AD.

Objective: The purpose of this paper is to provide a rationale for a protocolized music teletherapy (MTT) intervention to increase accessibility for MT as a psychosocial intervention for neuropsychiatric symptoms in people with AD by conducting a narrative review of the existing MT and AD literature.

Methods: We conducted a narrative review of MT and MTT publications indexed in PubMed and Google Scholar wherein authors used the Neuropsychiatric Inventory. We examined the impact of MT on neuropsychiatric symptoms of AD and identified MTT as a way to increase access to clinical services.

Results: MT can have positive impacts on neuropsychiatric symptoms in AD. However, we identified an ensuing need for protocolized MT interventions, access to services, and increased awareness. MTT is an option that can address these needs.

Discussion: Although MT can have positive effects on neuropsychiatric symptoms and can be beneficial and safe for individuals with AD, the current approach to MT practice is enormously heterogeneous with studies demonstrating variable therapist qualifications, uses of music, therapy approaches, and clinical populations. Congruently, the existing literature indicates that MT has not been standardized with protocolized interventions, making it difficult for clinicians and researchers to objectively assess the evidence, and thus, prescribe MT interventions. The lack of MT standardization, coupled with a low number of music therapists relative to people with AD, result in a lack of awareness that hinders access to MT as a psychosocial treatment for neuropsychiatric symptoms in people with AD. We therefore propose that protocolized MTT interventions are needed to increase access to better address neuropsychiatric symptoms associated with AD.

KEYWORDS

Alzheimer's, dementia, geriatrics, music therapy, narrative review, telehealth, neuropsychiatric symptoms

Introduction

The Alzheimer's Disease (AD) population in the United States is currently at 6.5 million and is predicted to reach over 12.5 million by 2050 (1). As such, AD constitutes a major societal problem warranting treatment, funding, and research. AD is accompanied by neuropsychiatric symptoms in over 85% of those diagnosed (2–5). These symptoms can be disruptive, impair care, and result in unsafe conditions for people with AD (6). Neuropsychiatric changes including irritability, agitation, anxiety, and depression are common in patients in the earlier stages of AD (2). In later AD stages, symptoms can include aggression, anger, restlessness, delusions, hallucinations, sleep disturbances, and sundowning. Additionally, environmental factors including but not limited to noise, heat, and social interactions, can activate and augment these symptoms (7, 8). These neuropsychiatric changes decrease quality of life and increase caregiver burden, often leading to institutionalization (9, 10). The ability to successfully address these neuropsychiatric symptoms has the potential to prolong independent living at home, delay institutionalization and may reduce caregiver burden, and reduce expenses.

Pharmacological approaches to neuropsychiatric symptoms of AD

The Food and Drug Administration (FDA) had not approved pharmacological interventions for treatment of AD neuropsychiatric symptoms until the recent approval of brexipiprazole (Rexulti) (11). The vast majority of pharmacological treatments for AD neuropsychiatric symptoms are prescribed off-label. Most commonly, physicians prescribe atypical antipsychotic medications to address psychosis in AD, but these have black-box warnings, potentially making them unsafe (12, 13). Although brexipiprazole was approved for the treatment of agitation associated with AD, it carries a black-box warning for increased mortality in elderly individuals with dementia-related psychosis as well as increased risk of suicidal thoughts and behaviors in young adults (11). Additionally, off-label prescribed medications often have side effects that may be difficult to tolerate in elderly populations with comorbidities such as cerebrovascular conditions and Parkinson's disease. Common psychotropic medications including olanzapine, quetiapine, risperidone are typically discontinued within 3 months because of lack of tolerability or associated cerebrovascular events and extrapyramidal symptoms (14). Moreover, because of the large spectrum of neuropsychiatric symptoms in AD, treatments to address depression, agitation, psychosis, or sleep disturbances often lead to polypharmacological prescribing and pose an increased risk for side effects. Thus, non-pharmacological treatments, including music-based interventions, can constitute first-line psychosocial treatments that may maintain neuropsychiatric regulation without the risk of side effects (2, 15).

Music to address AD neuropsychiatric symptoms

Researchers have provided a neurological rationale for music as a psychosocial intervention for AD. For example, Ferreri et al. conducted a double masked within-subject design in healthy participants engaged in music listening and showed a positive association between dopamine and the music experience. The participants received a dopamine precursor (levodopa), a dopamine antagonist (risperidone), or a placebo (lactose) (16). The authors found that the dopamine precursor levodopa enhanced the hedonic and motivational experience associated with music, whereas the dopamine antagonist diminished the effect. In a separate study, Wang et al. evaluated fMRI resting-state data from the Alzheimer's Disease Neuroimaging Initiative (ADNI) to study functional connectivity within and between auditory and rewards systems in older adults with mild cognitive impairment (MCI), AD, and age-matched healthy controls (17). Wang et al. found preserved within- and between-network connectivity in the auditory and reward systems in MCI individuals compared to AD, suggesting that functional connectivity is impaired as AD pathology progresses.

Scholars conducting preliminary studies in music and AD have indicated that music ability and memory are housed in an "island of preservation" in people with dementia (18). Memory for familiar music can be somewhat maintained in AD (19–23). The ability to respond, recall, or produce music by singing, playing instruments, or composing is often preserved even in the severe stages of AD (24, 25). When 7 Tesla functional brain magnetic resonance imaging (fMRI) and positron emission tomography (PET) compared AD regions of interest to the brain's response to music excerpts, regions such as the anterior cingulate cortex and ventral pre-supplementary motor area which encoded musical memory corresponded to areas, showed substantially minimal cortical atrophy and minimal disruption of glucose-metabolism (26). The unique relationship between music and preserved memory suggests music-based interventions, including music therapy (MT), may constitute an approach to address neuropsychiatric symptoms in AD.

Introduction to music therapy

MT is a specific music-based intervention wherein qualified music therapists (MT-BCs[1]) use music to address clinical objectives within the context of a therapeutic relationship. MT is based on the

1 We use MT-BC to represent qualified practitioners, as we are geographically located in the United States, and this is the official qualification for music therapists (www.cbmt.org). We recognize that other countries have different terminologies for professional qualification.

interactions between the service user,[2] a compassionate and empathetic MT-BC, and the music. Capitalizing on the associations between music, neuroscience, and the interpersonal relationship between the service user and therapist, MT can be an engaging psychosocial treatment for people with AD. In the United States, MT-BCs undergo academic training and accrue 1,200 supervised clinical training hours prior to the board-certification exam. Resulting from their "rigorous" (27) academic and clinical training, MT-BCs are uniquely qualified to design and implement effective psychosocial interventions for people with AD to address their diverse needs. MT-BCs are educated in and guided by psychotherapeutic frameworks that are developmentally and clinically appropriate given the service user, objectives, and context. MT-BCs are knowledgeable and skilled in a plethora of music genres and styles, various instruments and voice, and the psychology of music (28, 29). With this unique knowledge and skill set, MT-BCs implement research-based interventions to maximize therapeutic outcomes.

After receiving a referral from a healthcare professional, the MT-BC conducts a formal assessment as part of the treatment process to design and tailor interventions that best use the person's strengths and motivations to address their needs. MT interventions are based on the service user's assessment, music preferences, experiences, and motivations for therapy and therefore minimize the potential for music-induced harm (30). Tailored MT interventions can vary depending on factors related to the service user's preferences and experiences, the MT-BC, and music all within the unique contextual parameters of the setting and related clinical objectives. As such, MT interventions typically vary across different service user populations, clinical objectives, as well as the education, clinical experiences, and approaches of the MT-BC.

Regarding the music within MT, there are often misperceptions that certain music genres are beneficial as well as that there are music genres more likely to result in detrimental impacts on people's health (31–36). However, each individual's preferred music is the most effective and therapeutic regardless of the genre or message within the music (37, 38). Resultant of its malleability and the MT-BC's musical skill sets, live music can be more effective and therapeutic than recorded music (39, 40). Therefore, MT-BCs are academically and clinically trained to be knowledgeable in a wide variety of music genres and are competent musicians on instruments including voice, piano, guitar, and percussion. The use of preferred live music during interactive MT can also result in a stronger therapeutic relationship, alliance, and therapeutic outcome (30, 41).

MT is distinct from receptive music listening and music medicine[3] as MT-BCs address non-musical clinical objectives that have been collaboratively formulated by the service user, MT-BC, and the multidisciplinary treatment team. MT-BCs integrate service user's preferred music and present it in a developmentally appropriate manner. Moreover, MT-BCs use live music with optimized levels of repetition to enhance engagement and clinical success and are able to manipulate a variety of musical elements including melody, harmony, tempo, dynamics, timbre, and structure. Common MT interventions for people with AD may include singing, playing instruments, composition, reminiscing, and receptive music listening. MT-BCs are trained to use nonverbal behavior with older adults and those with AD to enhance clinical outcomes (42, 43). The gestalt of these music and common therapy factors based on traditional talk-based interventions can result in augmented service user engagement, motivation, and positive treatment outcomes (38, 42, 44, 45).

Further supporting MT for AD, music is processed in bilateral cerebral hemispheres and is considered to be different from noise. Stegemöller et al. (2018) proposed that professionally trained musicians such as MT-BCs have less noise in their speech and singing (46). As a result, Stegemöller et al. (2018) suggested that MT can augment neuroplasticity because the brain is more efficient at processing a clear auditory signal (46). Additionally, the Neuroplasticity Model of Music Therapy (NMMT) describes how MT can augment neuroplasticity via utilizing the service user's preferred music (46, 47). The NMMT and Hebbian principle note that pairing novel information and behaviors with rhythm can synchronize neural activation and augment the likelihood of neuroplasticity, particularly seen when MT-BCs are able to successfully manipulate various elements of live music by activating various brain regions (46). As such, music and MT may be an effective way to engage people with AD and thus offer potential therapeutic effects for the neuropsychiatric symptoms associated with AD.

To date, the existing MT literature for AD is positive but limited in its scope related to neuropsychiatric symptoms. Moreover, there is a paucity of literature regarding music teletherapy (MTT) research outcomes. This gap in the literature is consequential because MTT may be able to increase access to MT as a psychosocial intervention to address neuropsychiatric symptoms in AD. Therefore, the purpose of this paper is to provide a rationale for a protocolized music teletherapy (MTT) intervention to address neuropsychiatric symptoms in AD by conducting a narrative review of the existing MT and AD literature.

Method

Narrative review

To provide a rationale for a protocolized MTT intervention to increase accessibility for MT as a psychosocial intervention for neuropsychiatric symptoms in people with AD, we conducted a focused search via PubMed and Google Scholar. Inclusion criteria consisted of refereed AD articles published in English using the neuropsychiatric inventory (NPI) (48) as a dependent variable. The NPI is a frequently used quantitative measurement for neuropsychiatric symptoms available in over 40 different languages and has been used in 350 clinical trials. The NPI examines many of the neuropsychiatric changes that develop in AD including delusions, hallucinations, agitation/aggression, depression, anxiety, elation/euphoria, apathy/indifference, disinhibition, irritability, aberrant motor behavior, sleep and night time behavior disorders, appetite and eating disorders (48–50). Tailoring our review to the NPI allowed us to compare the studies in a more standardized

2 We recognize that people with AD can be referred to as patients, clients, or service users depending upon a number of contextual factors including but not limited to setting, country, level of care, and relationship to care provider.

3 Typically occurring in adult medical settings, music medicine can be defined as listening to recorded music that is chosen by a medical professional without specialized music training, assessments, or a therapeutic process (Dileo, 1999; Silverman et al., 2016; Yinger & Gooding, 2014).

manner. We included AD but excluded other forms of dementia. We recognize these criteria as delimitations of the paper.

Results and rationale for music teletherapy

MT is considered beneficial and safe by people with AD and their caregivers (51). We identified eight existing clinical trials that met our inclusion criteria of MT services to treat neuropsychiatric symptoms of individuals with AD. We extracted relevant data from these studies and depicted the results in Table 1. As seen in Table 1, most researchers investigating MT found significant improvement on neuropsychiatric symptoms of AD. However, there are limitations in these studies. The researchers conducting these trials did not use a single standardized MT protocol and the approaches towards how MT was conducted varied widely.

TABLE 1 MT clinical trials for treatment of neuropsychiatric symptoms in AD.

Author(s)	Design	Sample	Independent variable	Music therapy	Dependent measure(s)	Results
Brotons and Marti, 2003 (52)	Within subjects.	$N = 14$ couples (Patient and spouse who is a caregiver). Probable diagnoses of AD, Stages 4–5 GDS.	Individuals with AD participated in 10 MT sessions, individuals with AD and caregivers participated in 7 sessions together, and caregivers alone in 4 sessions.	MT for individuals with AD involved in music listening, singing, instrument playing, and movement/dance. MT sessions of individuals and caregivers included instrumental ensembles and singing. Caregivers alone engaged in singing, music listening, music relaxation, musical games, and song writing. Two professional music therapists, including one board-certified music therapist (MT-BC).	NPI and other measures taken at baseline, 2 days before the end of MT, and 2-months post.	Three time points indicated a lower NPI score ($X2 = 17.72$, $p = 0.001$).
Gallego et al. (2021) (53)	Quasi-experimental. 6 nursing homes were masked and randomized to 1 of 3 conditions.	$N = 90$. Active music involved groups of 6, 7, 8, and 9 residents. Receptive music involved groups of 6, 7, and 8 people. Control had groups of 8, 9, 11, and 12 residents.	45-min. group tx twice a week for three months (12 sessions total). Active music vs. receptive music vs. control group who watched nature videos without any music.	Tx consisted of active music intervention, receptive music intervention, or usual care. Active music and receptive music contained the same songs except the opening and goodbye songs. Active music included rhythmic exercises, dance exercises, music games. Receptive music listening involved listening to a playlist from a computer with a facilitator naming the song title, performer's name, and providing residents the opportunity to reminisce. Music facilitators, with master's level-qualification in creative arts therapy and specialization in MT.	NPI and other measures taken at baseline and post.	NPI decreased in the active music ($p = 0.001$), did not change in receptive music, and increased in control group ($p = 0.001$).

(Continued)

TABLE 1 (Continued)

Author(s)	Design	Sample	Independent variable	Music therapy	Dependent measure(s)	Results
Gómez Gallego and Gómez García 2017 (54)	Within subjects.	*N* = 42. 25 mild and 17 moderate AD.	MT group tx twice a week for 45-min. across 6 weeks.	Welcome song, rhythmic accompaniment with clapping and instruments, movement to music, musical games, and goodbye song. Included two professionals trained in music therapy.	NPI and other measures taken at baseline, 6th session (3 weeks), and final session.	Decrease in NPI total scores for both mild and moderate AD.
Giovagnoli et al. (2018) (55)	Randomized controlled trial.	*N* = 45. 23 exp. and 22 control.	MT group twice a week for 40 min. across 24 weeks.	Active music therapy by a music therapist. Non-verbal approach and improvisational	NPI and other measures taken at baseline, 12, and 24 weeks.	Decrease in NPI at week 12 for experimental group, $p = 0.039$. Between group differences in NPI was $p = 0.253$. Less patients in AMT showed worsening of NPI score at 24 weeks compared to control group, $p = 0.048$.
Li et al. (2015) (56)	Quasi-experimental trial design. Separated into MT or control groups according to acceptance of adjunct MT or not.	*N* = 41. 20 in MT and 21 in control.	Individualized music listening at home for 30 min. Daily in the morning and before sleep at night across 6 months.	Receptive, listening-based MT. Consisted of excerpts of Mozart's Sonata for Two Pianos in D major (KV 448) in the morning for 30 min. and Pachelbel's Canon in D major for violins at night. Did not mention a music therapist involved in the study.	NPI and other measures taken at baseline and 6 months (as tx ended).	No significant difference between the two groups; MT had less behavioral and psychological symptoms than control group after cognitive status was adjusted.
Lyu et al. 2018 (57)	Randomized controlled trial.	*N* = 288 completed. 96 mild, 100 moderate, and 95 severe AD. 97 in group singing, 96 in lyric reading, and 95 in control group.	Singing group, lyric reading of favorite or familiar song without music, or control. 2x per day for 30 to 40-min. per session, for 3 months.	Singing or listening to favorite & familiar songs. Did not mention a music therapist involved in the study.	NPI and other measures taken at baseline, 3 months (as tx ended), and 6-months post tx.	Singing group had greatest reductions in NPI, significant difference. While moderate had even better NPI scores, those with severe in group singing had the greatest improvement across time, both at the end of the tx and 6-months post tx.

(Continued)

TABLE 1 (Continued)

Author(s)	Design	Sample	Independent variable	Music therapy	Dependent measure(s)	Results
Raglio et al. 2008 (58)	Non-standardized randomization criteria. Participants listed in alphabetical order and those who were listed as odd numbers = experimental group. Even = control group.	$N = 59$. 30 exp. and 29 control.	30 30-min. group MT sessions across 16 weeks vs. educational support or entertainment activities.	Use of rhythmic and melodic instruments to promote communication. Briefly mentions a music therapist involved in the study but does not define any qualifications or training designations.	NPI and other measures taken at baseline, 8, 16 (end of tx), and 20 weeks (4 weeks post tx).	NPI scores decreased in experimental group but not control group (interaction x group: $F_{3, 165} = 5.06$, $p = 0.002$. Differences between the 2 groups occurred at 8th ($p = 0.003$), 16th ($p < 0.0001$), and 20th weeks $p = 0.0007$).
Satoh et al. (2015) (59)	Recruited 10 to experimental group. Then recruited 10 more who were willing to participate but could not be due to inclusion or exclusion criteria.	$N = 20$. 10 exp. and 10 control. Mild to moderate AD.	1 h, MT group session once a week for 6 months vs. control.	Singing training utilizing voice training (YUBA Method), reviewing songs from previous week, singing familiar songs with normal voicing, and singing familiar songs from youth or recent years as part of a life review. Karaoke was used for all but the voice training. Also required to practice 20 min. at home with a karaoke system 3 x per week at home. Authors were a professional singer and pianist who led the MT sessions.	NPI and other tests along with fMRI baseline and posttest.	Decrease in NPI score, $p = 0.042$ for music therapy group.

AD, Alzheimer's disease, exp., experimental, min., minutes, tx, treatment, GDS, Geriatric Depression Scale.

Lack of standardized music therapy protocols

Although MT can be beneficial as well as safe for people with AD and their caregivers, current MT practice is heterogeneous with variable therapist qualifications and therapeutic approaches (51, 60–62). For example, although there are 99 MT training programs in Europe, the European MT confederation reports that standardization of training standards have not yet been completed (63). MT interventions can also vary between recorded music versus live music. Additionally, there can be differences in active interventions including instrument playing, composition, music making, singing, listening, and reminiscing. The totality of the vast number of musical elements to consider, MT intervention types, and sociocultural aspects of music further compound the heterogeneity of MT. Moreover, MT researchers have not consistently protocolized intervention approaches, making it difficult to objectively assess the state of the literature.

The protocolization of MT may help to standardize it as a nonpharmacological AD treatment option, improve dissemination, and incorporate it into standard of care for AD. To develop effective protocols that will lead to referrals and increase access to care, it will be crucial to develop systematic and reproducible measures to identify mechanisms of change including but not limited to dosage, duration, procedures, and MT intervention components that predict clinically significant improvement in AD neuropsychiatric outcomes. To date, researchers have not empirically identified therapeutic process factors that contribute to MT outcomes in AD. Thus, it is imperative to identify critical MT process elements to enable future treatment refinement and to train MT-BCs to reproduce high-quality MT, both of which ultimately may improve patient outcomes. In addition, researchers will need to report these mechanisms and components in a transparent manner such that standardized reproducible protocols are developed and accepted as standard of care. As such, we recommend using reporting guidelines for music-based interventions (64) and clearly articulating the qualifications, approach,

and experiences of the practitioner providing MT. Protocolized music teletherapy (MTT) intervention has the potential to overcome some of the barriers associated with MT and increase accessibility such that MT becomes a realistic and viable psychosocial intervention option for neuropsychiatric symptoms in people with AD.

Music therapy access

There are approximately 10,000 MT-BCs in the United States. However, as MT is a medium-specific profession and MT-BCs serve a variety of clinical populations, not all MT-BCs work in AD settings. Within the United States, the AD population is currently at 6.5 million and predicted to reach over 12.5 million by 2050 (65, 66). Given these statistics, it is unlikely that there will be enough MT-BCs to meet the psychosocial needs of people with AD.

In addition to a limited number of MT-BCs and a growing population of people with AD, 50% of people with AD stop driving within 3 years of disease onset (67). Thus, challenges in transportation logistics in AD can further limit MT access. The amalgamation of these factors severely restricts the ability of MT-BCs to provide in-person MT.

We therefore recommend MTT as an option to increase access to services by eliminating the need for patients to drive to sessions. With MT-BCs providing care remotely, it would also eliminate time allocated to driving. The reduction in driving may lead to the ability to provide additional services. By eliminating travel times, MT-BCs may also increase their billable hours and increase their earning potential. Increased revenue may lead to fewer MT-BCs leaving the profession (68–70).

Music therapy awareness

To date, there is limited research regarding MT for neuropsychiatric symptoms related to AD. This lack of research based on standardized protocols likely impacts the awareness of MT as a potential treatment for AD. Moreover, care providers are often not aware of MT as a psychosocial intervention for AD because of poor access to MT in the outpatient setting, and therefore do not make referrals (71). Additionally, it is possible caregivers are unaware of MT as a treatment for AD and therefore are not likely to request it as a treatment option for their loved ones. Reasons that caregivers are unaware of MT as a treatment in the USA may be because the United States' Alzheimer's Association website does not offer MT as a treatment option (72).Whilst the National Institute of Aging recommends music and singing to patients with AD, the NIA does not specifically recommend MT as a treatment for neuropsychiatric symptoms in AD (73). As a result of the combination of these factors, patients and caregivers can experience difficulty in obtaining MT services.

Rationale for protocolized music tele-therapy

To date, there is no published clinical trial study investigating MTT for neuropsychiatric symptoms in AD. However, authors have noted that non-MT telehealth interventions can be delivered for people with MCI and AD and that these treatments can be as effective as in-person delivery (74–77). MT scholars reported that MT can be delivered to older adults via telehealth (78, 79). Although MTT was already in existence (80, 81), it was popularized out of necessity during the COVID-19 pandemic (82). Various MT authors have described MTT as a potential service delivery model (78, 79). Telehealth can reduce caregiver burden, reduce access barriers, and reach a wide range of patients in rural areas or locations with low numbers of music therapists (83). Furthermore, MTT augments accessibility and reduces travel time for both the therapist and service users. Music therapists are likely to continue using telehealth in the future and believe that caregiver involvement is important (78).

Given the interactive and music-related aspects of MT, there are potential complications with MTT including but not limited to compromised quality of the music, delays when interacting or when concurrently engaging in live music, reliable internet connections, and secure and accessible platforms. These complications may be exacerbated in AD populations who may have difficulty learning new skills such as accessing MTT on a phone, tablet, or computer. However, advances in technology have made it easier for individuals to use smartphones and tablets for therapeutic purposes (84, 85). We suggest providing service users with high quality instruments, technology that relies on cellular data instead of home-based wifi, and using both live and recorded music and more talk-based therapy approaches in MTT. As approximately 50% of surveyed music therapists reported that they would continue telehealth delivery after the pandemic restrictions are over (79), MTT is a viable delivery format for MT.

During the pandemic, researchers stated there was a need to determine how people with AD and their caregivers benefit from MT services delivered via telehealth and the role of the caregiver in the process (78). Currently, there is no music therapy study comparing an in-person delivery format with MMT; however, other non-MT telehealth psychosocial interventions for older adults with dementia and their caregivers can be as effective as in-person delivery (75–77). Based on these results, MTT may have potential to be as effective as in-person service delivery formats. Relatedly, Saragih et al. suggested future researchers conduct trials to determine what factors are associated with positive outcomes in telehealth interventions for people with dementia and their caregivers as there is a need to provide evidence for what might be effective with older adults with dementia as well as the mechanisms of action. Based on our review, we suggest this is also the case for MT and MTT.

Our narrative review regarding MTT to increase accessibility for MT as a psychosocial intervention for neuropsychiatric symptoms in AD implicates three main categories representing barriers to MT for AD utilization and delivery: (1) lack of standardization in MT protocols, (2) lack of access to music therapy, and (3) lack of awareness. Based on the interactions between these identified factors, we created Figure 1 to depict a rationale for MTT to address neuropsychiatric symptoms in AD.

The barriers to accessing music therapy are problematic, especially since music might be a viable non-pharmacological approach to address the neuropsychiatric symptoms for adults with AD. We therefore propose music therapists utilize MTT to increase the number of people served, particularly those with AD and their

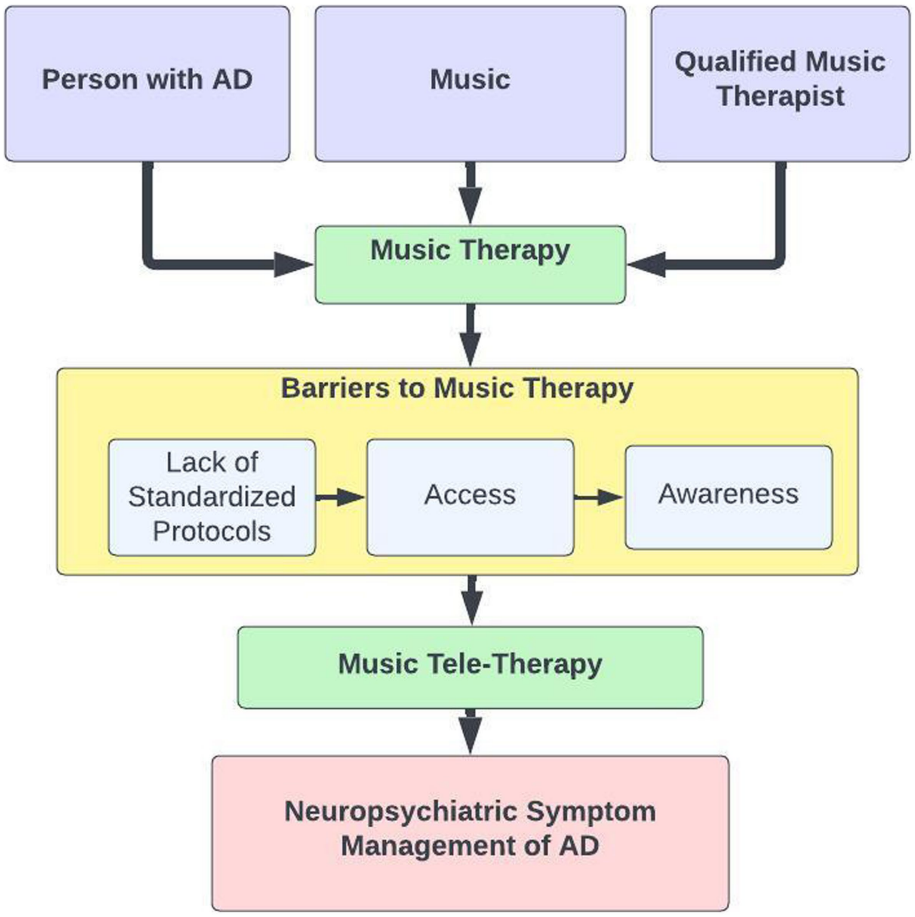

FIGURE 1
Barriers to MT for AD utilization and delivery. A flow diagram depicts the barriers to music therapy and music tele-therapy as a solution in the management of neuropsychiatric symptoms of AD.

caregivers, who often have limitations in accessing treatment. As a person-centered and flexible treatment, both MT and MTT have the potential to address the neuropsychiatric symptoms that are problematic for people with AD and their caregivers. However, MTT has the potential to improve access to care.

Limitations

There are numerous limitations of this review. First, our inclusion criteria were purposely narrow as we wanted to specifically investigate the impact of MT on neuropsychiatric symptoms as measured by the NPI in AD. There were other articles wherein authors investigated music and MT for individuals with dementia or addressed different dependent measures (86–90). Although using the NPI as inclusion criteria allowed us to compare and contrast studies with a validated quantitative outcome measure, it also limited our results to eight studies. Only including articles published in English is also a limitation and we note the privilege associated with our familiarity of the English language. A final and consequential limitation is that not all countries have established MT training programs or qualified MT practitioners.

Suggestions for future research

Based on the narrative review, there is a need for studies to improve the understanding of the underlying mechanisms of MT via imaging and biomarkers. To date, the underlying mechanisms of action within MT for AD are poorly understood and a better comprehension of these mechanisms may lead to the ability to design best practice MT interventions that may include neuromodulation or pharmaceuticals to augment MT's clinical effects. MT may have the potential to raise people's thresholds for tolerating environmental stimuli that activate unmet needs in AD (91). Therefore, future investigators could design and measure the impact of MT interventions and structured MT environments to address unmet needs by adjusting the sensory input and maximizing skills and abilities of each individual throughout the session (44). Future research using broader inclusion criteria may identify limitations and help develop a research agenda. Additionally, researchers could study process elements within MT to identify what components of MT are most clinically significant such that these processes are incorporated into standardized protocols. These may include specific features related to the music, the therapist, as well as specific music therapy interventions. Future researchers might also examine the differences

between music medicine and receptive music listening and MT provided by a MT-BC. This is a crucial item on the research agenda to protect service users from music induced harm (30). However, given the challenges that people with AD may have, we recommend MT/MTT because of the specialized academic and clinical training that MT-BCs receive. Therefore, it would be beneficial for researchers and clinicians to compare MTT to MT as well as other established treatments by measuring neuropsychiatric symptoms. Future service delivery model research is also warranted to compare MT with MTT. For example, the most user-friendly approaches to MTT application should be studied to optimize the clinical impact of music therapy. These suggestions for future research may also consist of clinical trials, effectiveness, feasibility, mechanistic, and refinement studies.

Conclusion

The purpose of this paper was to provide a rationale for a protocolized MTT intervention to increase accessibility for MT as a psychosocial intervention for neuropsychiatric symptoms in people with AD. We conducted a narrative review of MT publications using the NPI as a dependent measure indexed in PubMed and Google Scholar. Based on the narrative review of eight studies that met our inclusion criteria, MT seems to have positive impacts on neuropsychiatric symptoms in AD. However, we identified an ensuing need for protocolized MT interventions, increased access to MT, and greater awareness of MT. As a relatively inexpensive psychosocial intervention, MTT can be an accessible option with the potential to address these barriers. Although MT can have beneficial effects on neuropsychiatric symptoms in AD, we highlight a subsequent need for MT that is easily accessible and follows a standardized intervention protocol. MTT has the potential to constitute a viable solution to fulfill these needs. Future MTT research from all paradigms is necessary.

Author contributions

SW, AC-T, MS, and SY conceived the concept of the review, performed the research and wrote the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Creative aging in virtual spaces: using museum content and music therapy to explore cultural diversity

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Introduction: During the pandemic, many creative aging programs stopped being delivered in person, and practitioners turned to various virtual platforms to deliver content for older adults to maintain their cognitive, physical, and psychosocial well-being. Collaborators from a university-based music therapy program and a global music museum developed asynchronous virtual programs, one for wellness populations and another for memory care settings. Content was developed and delivered by the paper's principal investigators in collaboration with the museum's curatorial team and an upper division music therapy class composed of juniors and first-year graduate equivalency students (n = 21). The asynchronous program included museum gallery content and music therapy interventions of singing, movement, and/or instrument playing based on highlighted geographic regions. The purpose of the study was to explore older adults' experiences when participating in the program.

Methods: Fifty-six older adults from three post-acute care facilities (two skilled nursing facilities and one assisted living center) served as participants. Older adult participants were categorized as cognitively healthy (n = 27) or those diagnosed with dementia (n = 29) and attended five music sessions over 8 weeks, ranging from 30 to 60 min in length. A within-subject repeated measures design was used to investigate the impact of the creative aging program on older adults' psychosocial well-being and engagement behaviors. Psychosocial well-being for cognitively healthy older adults were measured with the Multicultural Quality of Life Index, Engagement in Meaningful Activity Survey, and the PROMIS Social Isolation Short Form-4a. Psychosocial well-being for older adults with memory loss was measured with the Quality of Life in Late-Stage Dementia tool.

Results: Cognitively healthy older adults showed an increase in psychological/emotional wellness after participating in the program, while older adults with memory loss appeared less irritable and physically uncomfortable and seemed to enjoy interacting with others more. Surprisingly, the cognitively healthy older adults also showed an increase in social isolation between the start and end of the program, which may not be related to the intervention, but to the fact that all three sites had COVID outbreaks during the study and had to pause their group activities programming and residents were required to stay in their rooms. Additionally, the music interventions fostered engagement behaviors of interest (facial expression, posture), and response (body movement, eye contact, and musical interaction with the leaders in the videos) for both groups of older adults. Instrument interventions were most engaging for cognitively healthy older adults. Singing interventions were most engaging for older adults with dementia, whereas movement interventions were less engaging for older adults with dementia.

Discussion: Findings suggest that creative aging virtual programs can be delivered in asynchronous settings to enhance older adults' well-being and foster engagement. Additionally, virtual programming may be used to augment ongoing programming or used to reach older adults when distance is a factor to enhance older adults' well-being.

KEYWORDS

creative aging, virtual programming, music therapy, museum, diversity

Introduction

Creative aging is a field of study that aims to promote evidence-based healthful aging through continued engagement with artful practices (1). When developed with research-driven methodology, creative aging programs have been shown to provide cognitive, physical, and psychosocial benefits to older adults across many settings (2, 3). These programs are sometimes led by teaching artists in visual arts, music, dance, and literacy. The teaching artists develop interactive programs that allow older adults to experience art making throughout the various forms, join in group discussions, or attend performances and gallery openings. Sometimes these programs are attached to community centers, museums, and other arts agencies and healthcare organizations.

The topic of museums as places of engagement and socialization for older adults has become increasingly prevalent in aging research (4–7), which has resulted, in part, with health care professionals using museums as social prescription interventions (8). Research findings related to socially prescribed museum attendance note improvements in psychological well-being and potential long-term outcomes of sustained social capital and enhanced physical health (9). A 2017 analysis by the National Endowment for the Arts provides evidence that museum attendance can slow decline in older adults, regardless of whether the participants create art or attend art (6). A 2021 American Alliance of Museums report, "Museums and Creative Aging: A Healthful Partnership," details how diverse museums across the United States further enhance arts opportunities for older adults by offering specific creative aging programs, including museums from Puerto Rico, Kentucky, Alaska, Florida, and Mississippi (1).

Sometimes creative aging programs are developed by therapists such as music therapists, art therapists, or dance therapists, and the focus is on using the therapists' art form to work on therapeutic goals and outcomes for patients in many settings (2, 3, 10–17). For example, music therapists may use active interventions such as instrument playing, developing a rock choir, iPad bands, or passive music interventions such as music-assisted relaxation, or song discussion groups to further enhance and support wellness in aging (10, 17), which is not dependent upon prior musical training (18, 19). One example of a program was conducted by González-Oja et al. 20, with 52 older adults residing in a nursing home. The researchers explored the effect of group music therapy interventions on older adults' psychosocial and physical well-being. The group participated in singing, body percussion, movement to music, and instrument play interventions for 16 weeks. Results showed that older adults' showed increases in their physical health and psychosocial well-being as measured by social interactions and creativity after participation in the music therapy program.

In the spring of 2020, many of these programs came to an immediate halt as the entire world experienced COVID- 19. Due to the rapid spreading of the virus, many arts-based community agencies in the United States closed their doors indefinitely. Senior living communities became a contained unit, and did not allow for many music therapists, or leaders of creative aging and lifelong learning programs to lead sessions for older adults. This necessary act at the beginning of the pandemic unfortunately negatively impacted older adults' psychosocial well-being. The art of gathering together was something that was no longer safe. The act of making music together especially through singing in the same room could lead to a spread of the virus.

Virtual programming and telehealth were service delivery methods that existed prior to COVID-19, and some practitioners provided their services that way. However, as COVID-19 continued from the spring into summer, many practitioners began to develop special virtual programming to interact with older adults (21–23). New programs and programs that were once delivered in person, were now being offered through asynchronous and synchronous settings. Recent research in virtually delivered programs demonstrates that technology may be an effective platform for increasing accessibility for audiences to these experiences (24), with one intergenerational, music-based virtual study noting "the use of simple and free computer technology (e.g., Dropbox, tablets, smartphones) could be a promising vehicle for communicating, learning, and enhancing relationships between opposite generations" (11). One example of adapting in person sessions to telehealth was conducted by McAulay, Block, Booth, and Cowley (25). Forty-one older adults residing in a facility participated in 12 virtual group music therapy sessions across 6 weeks. Patient mood, engagement, and relaxation as responses to the interventions were measured for each older adult. Results for this study was mixed. While the majority of older adults showed improvements in mood, full or partial engagement, and relaxation, some older adults displayed no changed in mood or a negative mood, limited engagement, and no relaxation. There is still a lot to learn about providing asynchronous and synchronous virtual music sessions for older adults. Results from Wilhelm and Wilhelm's survey (23) of music therapists showed that 64% of their respondents used teletherapy sessions, but only 48% would continue to do so after the pandemic. Results also showed a variety in the types of platforms used for sessions, and a variety of interventions used in session, with therapeutic singing, music listening, and music-cued reminiscing being the most common.

As humanities and health-based research in aging increases, organizations are responding, and they are especially considering the impacts of COVID-19 on older audiences. The American Alliance of Museums has called for museums to "invest in a diverse array of onsite and online programs that encourage healthy and active aging" and "foster

new kinds of research and partnerships that can advance these goals" (1). Early in the pandemic, the International Council on Active Aging (ICAA) assembled a Senior Living Task Force and advocated for the increased use of technology and the recognition of multidimensional wellness (26). With these recommendations in mind and in response to the significant social isolation many older adults experienced during COVID-19, this paper will explore one such program that was developed between a global music museum and a university music therapy program for older adults in the Southwest. The purpose of this program was to explore the effect of a virtual creative aging program on older adults' psychosocial well-being and engagement behaviors. The research questions are: (1) How does participation in a virtual creative aging program affect older adults' psychosocial well-being? (2) How does participation in a virtual creative aging program affect older adults' engagement behaviors? and (3) What are older adult's perceptions of a virtual creative aging program?

Materials and methods

Project background

A global music museum and a music therapy program at a university in the Southwest began a formal partnership in early 2020 to engage board-certified graduate music therapy students in on-site music and memory care experiences. The partnership is unique because of the focus on cultural diversity. The museum is organized by galleries, each with a different geographic focus around the world. Each gallery hosts displays of instruments, music making accessories, and audio and visual clips of performers that are unique to that culture. Geographic galleries include: Africa, Asia, Europe, Latin America, the Middle East, and USA/Canada. The music therapist involved in the project has a research area in cultural diversity and aging, and taught classes on this topic at the time the partnership began.

The onset of the pandemic and subsequent closure of the museum delayed the launch of the program and encouraged organizers to consider new ways for sharing programming with older adult audiences. The professor of music therapy at the university and the curator of education at the museum (both principal investigators in this study) developed 30–45-min Zoom sessions that partnered museum gallery content with music therapy interventions. Between May 2020 and April 2021, the synchronous program reached over 550 senior participants through 22 sessions. This demand led the museum and the university partners to further collaborate on asynchronous video content to serve a larger audience. Organized and overseen by the principal investigators, the museum's curatorial team of five subject-area experts and an upper division music therapy class composed of juniors and 1st year graduate equivalency students ($n = 21$) developed and filmed content.

Museum content and music therapy interventions

Two video collections were produced, one for active seniors (senior wellness) and another for seniors with memory loss (memory care). Each collection contains five 15-min videos with an emphasis on content from various geographic locations, including USA, Europe, Latin America, Asia, Oceania, Africa, and the Middle East. Each video combines the museum content with music therapy activities and engages seniors in cognitive, physical, and psychosocial ways that explore specific geographic regions. For example, a video focused on West Africa includes content from the Sierra Leone and Liberia exhibits and musical content from Ella Jenkins's "West African call-and-response" and the West African *kuku* drum pattern. Video content, musical selections, and music therapy focus are outlined in Tables 1, 2. The layout for each video was musical introduction, museum intervention 1, music therapy intervention 1, museum intervention 2, music therapy intervention 2, and musical outro.

During the development of the museum gallery content, curatorial speakers considered how to engage the imagined audience through a balance of shared information, question prompts, and listening examples. Curators made efforts to simplify language and slow the rate of speech to accommodate participants experiencing memory loss. Video producers also ensured that camera movements and transitions were seamless and not abrupt. Questioning techniques encouraged the audience to stop or pause videos to promote further discussion. For example, a curator may say, "As you look at the exhibit, what objects stand out to you the most?" or "What do you notice?" followed by a wide camera angle of the whole exhibit. Curators also made efforts to encourage active

TABLE 1 Gallery and music therapy focus for the memory care collection.

Gallery	Music and movement	Music therapy focus	Intervention types
Africa: Sierra Leone and Liberia	Ella Jenkins's West African call-and-response and *kuku* drum and dance patterns	Foster short-term memory (cognitive), foster upper extremity movement (physical)	Singing, instrument, movement
Oceania: Polynesia	"E Te Iwi E" from New Zealand	Upper-body and bilateral movement (physical), sustained attention (cognitive)	Instrument, movement
Latin America: Mexico	"Cielito Lindo" and "Cumbia Pa' Gozar" (Los Ángeles Azules)	Promote sustained attention (cognitive), promote gross motor movement across upper and lower extremities (physical)	Instrument, movement
USA/Canada: Chicago	12-bar blues and "Be Still" gospel hymn	Maintain sustained attention and foster short-term recall (cognitive), maintain gross motor movements across upper and lower extremities (physical), foster self-expression (psychosocial)	Singing, movement
Europe: Ireland and the UK	"All You Need Is Love" (The Beatles) and "Hall of Fame (The Script)	Divided attention in singing and moving (cognitive), retrieval of newly learned material (cognitive), upper extremity and gross motor movement (physical)	Instrument, movement

TABLE 2 Gallery and music therapy focus for the senior wellness collection.

Gallery	Music and movement	Music therapy focus	Intervention type
Middle East: Egypt, Turkey, and Israel	"Eich Efshar" (Jane Bordeaux)	Maintain memory recall (cognitive), self-expression through movement (psychosocial)	Instrument, movement
Asia: Taiwan and China	"Little Umbrella" (Chris Hung) and "Penghu Bay"	Maintain memory recall (cognitive), self-expression through movement (psychosocial)	Instrument, movement
Latin America: Caribbean	Puerto Rican *bomba* and "Three Little Birds" (Bob Marley and the Wailers)	Promote quality of life through learning new musical styles (psychosocial), promote divided attention through movement and singing (physical)	Instrument, movement
USA/Canada: Los Angeles	"My Wild Love" (The Doors) and "Superstition" (Stevie Wonder)	Foster retrieval of newly learned information (cognitive), foster and maintain gross motor skills (physical)	Instrument, movement
Europe: Ukraine	"*Shchedryk*" ("The Little Swallow") and "*Yihav Kozak za Dunaj*" ("The Cossack Rode Beyond the Danube")	Promote gross motor movement for upper and lower extremities (physical), promote self-expression through instrument playing and movement (psychosocial)	Instrument, movement

participation during moments of listening (i.e., "As we listen to this upcoming clip, take note of the intricate rhythmic patterns the ensemble creates. See if you can find a steady beat on your lap"). The goal was to generate discussion, active listening, and personal or collective alignment with the material.

Music therapy interventions used in the videos were singing, movement, and instrument playing.

Singing

Interventions were coded as singing, if the primary goal was music engagement through singing. In these interventions music therapy students introduced songs from the region highlighted in the gallery. They taught the lyrics and pitches to the song and encouraged participants to sing along. There were two singing interventions that were labeled as singing + as the music therapy students added in instrument playing or moving after teaching the lyrics and pitches of the song.

Movement

Movement interventions featured traditional movements from the region sequenced together with a song, or students developed sequential movements that told the story of the song. For example, in the Latin America video from the Memory Care Collection, students taught older adults how to dance the cumbia. Whereas students in the Senior Wellness collection used the lyrics from the "Little Umbrella" in the Asia gallery, to develop sequential movements for the older adults.

Instrument

Interventions were coded as instruments if the primary task was making an instrument or learning rhythmic patterns on an instrument or using body percussion in a sequential pattern. Instrument making interventions featured music therapy students making rhythm instruments out of everyday items found in the home and encouraged older adults to engage in making their own rhythm instrument and then using them in the rest of the video session. Instrument play interventions featured students teaching rhythmic patterns and how to play instruments from the region highlighted in the gallery. Body percussion interventions featured music therapy students teaching older adults a series of body percussion such as stomping, clapping, tapping that could be used along with songs in the video.

Participants

During the piloting phase of the project, 41 long-term care facilities from five US States (GA-3, PA-15, CO-2, WA-1, and AZ-20) received access to the program in exchange for feedback related to implementation and satisfaction. Three of these facilities, all located in the southwest, volunteered to participate in this current study (two skilled nursing facilities and one assisted living center). Life Enrichment staff shared general details about the video collections and evaluation with cognitively healthy long-term care residents and the family members/guardians of those residents with dementia. Residents were eligible to participate in the evaluation if they gave written consent (if they were deemed cognitively healthy by facility staff), or if their family member or legal guardian gave consent on their behalf over the telephone (for those with dementia) and the resident provided verbal assent before each activity session. A total of 27 cognitively healthy residents consented to participate at the beginning of the study and a total of 29 residents with dementia opted to participate, based on the consent of their family member or legal guardian and their continuing assent during the activity sessions.

Study design and measures

A within-subject repeated measures design was used to investigate the impact of the creative aging program on older adults' psychosocial well-being and engagement behaviors. A variety of measures were used at pre-program, mid-program, and post-program. Psychosocial well-being for cognitively healthy older adults was defined as quality of life, engagement in meaningful activities and social isolation. Whereas, psychosocial well-being for older adults diagnosed with dementia was defined as quality of life.

Psychosocial well-being for cognitively healthy older adults

Quality of Life

Healthy older adult participants' ($n = 27$) quality of life was examined with a standardized measure, administered via

paper-and-pencil, at three time points (pre-program, mid-program, and post-program). The quality of life of cognitively healthy residents was measured with the Multicultural Quality of Life Index, which assesses 10 dimensions of subjective quality of life such as physical well-being and spiritual fulfillment (27). Each domain is rated with a single item on a scale of 1–10, with 1 indicating 'Poor' and 10 indicating 'Excellent' present quality of life. Two domains which typically do not apply to long-term care residents (occupational functioning and community and services support) were eliminated, for a total of 8 items. All items were summed and divided by the number completed (1–8) for a total Quality of Life score, with higher scores indicating greater quality of life. Cognitively healthy residents completed the questionnaires independently, unless they had physical or visual impairments which impeded their ability to do so; in this case, the researcher or Life Enrichment (Activities) staff offered assistance by reading the questions aloud and marking down the residents' response.

Engagement in meaningful activities

Cognitively healthy residents also responded to questions about their activities, utilizing the Engagement in Meaningful Activities Survey (EMAS) (28) at three time points (pre-program, mid-program, and post-program). The EMAS is a 12-item scale which measures impressions of the meaningfulness of daily activities such as "The activities I do express my creativity" and "give me a sense of satisfaction." Items are measured on a scale of 1–4, with 1 indicating 'Rarely' and 4 indicating 'Always.' All items were summed, with higher scores indicating greater meaningfulness of activities.

Social isolation

Cognitively healthy residents also responded to questions about their social relationships, utilizing the Patient-Reported Outcomes Measurement Information System (PROMIS) Social Isolation Short Form-4a (29) at 3 time points (pre-program, mid-program, and post-program). The measure consists of 4 items about social health such as "I feel left out" or "I feel that people barely know me." The items are rated on a scale from 1 to 5, with 1 indicating 'Never' and 5 indicating 'Always.' All items were summed, with higher scores indicating greater feelings of social isolation.

Psychosocial well-being for older adults with dementia

Quality of life

The quality of life of older adult participants with dementia ($n = 29$) were examined at three time points (pre-program, mid-program, and post-program) utilizing the Quality of Life in Late-Stage Dementia (QUALID) scale (30). The QUALID consists of 11 items which ask the respondent to rate observed resident behaviors, such as crying or appearing physically uncomfortable, over the past week. Each item is rated according to the amount of time that the behavior has been displayed, such as 'rarely or never' to 'almost always.' After reverse-scoring items for consistency in amount of time, all items were summed, with higher scores indicating greater quality of life.

Resident music engagement

Engagement with the video collections for both participant groups was measured by an adapted version of the Music in Dementia Assessment Scale (MIDAS) observation tool (31). The MIDAS allows trained raters to observe and quantify participant behaviors at 4 points during each session: 15 min before the session, halfway through the video interventions (after the introduction, museum intervention 1 and music therapy intervention 1), at the conclusion of the video program (after museum intervention 2, music therapy intervention 2, and outro), and 15 min after a video. These behaviors include participant interest (posture, facial expressions, and/or animations that demonstrated interest), response (body movements, eye contact, and/or musical interactions that were related to the intervention/video segment), initiation (conversation engagement and/or reminiscing that occurred while watching the video segment), involvement (engagement and/or enthusiasm toward the intervention), and enjoyment (smiling, laughing, and/or relaxation in response to the video). For the current study, the MIDAS was adapted for ease of use and interpretation by converting to a 5-point Likert scale from a Visual Analog Scale, with 1 being little to none and 5 being very high. In addition, the adapted MIDAS was applied to the resident group as a whole, rather than each individual resident. The study researchers (3rd author and an additional collaborator) served as data collectors, and were trained by the first two authors to promote consistency across ratings. At the end of each activity session, residents from both groups were also asked the following open-ended questions about their impressions: "What did you enjoy in today's session?" and "What do you wish there were more of?"

Procedure

Life Enrichment (Activities) staff from the three communities led five music-focused activities sessions for residents, centered around the video collections, over an eight-week period. Each session ranged from 30 to 60 min. Two communities opted to run separate sessions for cognitively healthy residents (using the Senior Wellness Collection) and those with dementia (using the Memory Care Collection), while one community combined these resident groups into a single, weekly session using videos from both collections. Life Enrichment staff were supplied with electronic access to all materials: the Senior Wellness and Memory Care video collections, viewing guides to assist with effective facilitation of group sessions, and individual video activity guides with suggestions for how to expand upon the learning and engagement intended in the video collection. Project developers and researchers also hosted a one-hour introductory meeting to discuss strategies for implementation and answer any questions.

Data analysis

Psychosocial well-being measures

Participation at each data collection time point (pre-test, midpoint, post-test) varied due to resident discharge from the facility, health changes that prevented attendance at the session (such as a COVID-19 infection) or death. To account for missing data, the last

data point collected from each resident (midpoint or post-test; N = range of 16–19, depending on the measure) was compared to pre-test scores using repeated measures t-tests to statistically analyze change in resident outcomes during the study period.

Musical engagement measures

Descriptive statistics was used to analyze which engagement behaviors were demonstrated by older adults as they participated in the virtual programming. A Mann Whitney U test was used to analyze how cognitively healthy older adults and older adults with dementia were engaged with content. The five engagement behaviors were: interest, response, initiation, involvement, and enjoyment. Descriptive statistics was also used to analyze which intervention (singing, movement, playing instruments) elicited more engagement behaviors. The data, group MIDAS scores from 4 test points (15 min before, halfway through the video interventions, at the conclusion of the video program, and 15 min after a video) were consolidated by totaling and averaging the data to provide total and average scores for each engagement behavior. Similarly, engagement behaviors scores were totaled and averaged per intervention for comparison.

Perception of creative aging program

The collective responses to the MIDAS questions ("What did you enjoy in today's session?" and "What do you wish there were more of?") were analyzed using a word frequency text analyzer and then converted into a word cloud using a Microsoft add-in program to illustrate emerging themes. Common words like articles were not included, and researchers reviewed data to ensure consistency of responses before analyzing. For example, words like dance and dancing were both coded as dancing to accurately reflect participant interest in the visualization.

Results

Psychosocial well-being for cognitively healthy older adults

Cognitively healthy residents attended an average of 3 of the 5 activity sessions; 56% of these residents attended four or five sessions (N = 14/25). Psychosocial well-being for cognitively healthy older adults was measured using standardized tests for their quality of life, engagement in meaningful activities, and social isolation. Repeated measures t-tests comparing the pre-test to the last data point collected from each cognitively healthy resident (N = 19) are reported in Table 3. Correlations between session attendance and psychosocial well-being can be found in Table 4. Overall, the number of sessions attended was not significantly related to the outcomes of interest.

Residents reported overall good quality of life at the pre-test and showed little change in overall quality of life at the last time point. Yet, when quality of life domains were examined separately, residents did show a statistically significant increase in psychological/emotional wellness after the music therapy intervention ($t(17) = 2.12$, $p \leq 0.05$, $d = 0.50$).

Cognitively healthy residents did not show a statistically significant increase in meaningful engagement in activities after the music therapy intervention. However, across individual engagement items, there was a statistically significant increase in residents agreeing that their activities have the right amount of challenge ($t(18) = 2.54$, $p \leq 0.02$, $d = 0.58$). While not statistically significant, there were also mean increases in residents agreeing that their activities help express their creativity, give them pleasure, give them a feeling of control, and a sense of satisfaction.

Cognitively healthy residents reported an increase in overall social isolation after the music therapy intervention ($t(18) = 2.62$, $p \leq 0.02$, $d = 0.60$). Examining individual items showed a statistically significant increase in feeling left out between pre-test and last data point collected ($t(17) = 2.89$, $p \leq 0.01$, $d = 0.68$). There were also mean increases in residents feeling that people barely know them, feeling isolated from others, and feeling that people are around them but not with them, although not statistically significant.

Psychosocial well-being for older adults diagnosed with dementia

For older adults in memory care, residents also attended an average of 3 of the 5 activity sessions; 58% of these residents attended four or five sessions (N = 14/24). Caregiver-reported quality of life of these residents is reported in Table 5. The correlation between the number of sessions attended and caregiver-reported quality of life was not statistically significant ($r(23) = -0.26$, $p \leq 0.22$).

Similar to the cognitively healthy residents, there was no change in overall quality of life for residents in memory care. Yet, investigation of separate quality of life domains showed a statistically significant decrease in appearing physically uncomfortable ($t(22) = 3.95$, $p \leq 0.001$, $d = 0.82$) and being irritable or aggressive ($t(22) = 2.34$, $p \leq 0.03$, $d = 0.49$). In addition, there was a statistically significant increase in enjoying interacting or being with others ($t(22) = -2.30$, $p \leq 0.03$, $d = 0.48$).

Engagement behaviors

Engagement behaviors for all older adult participants were measured through observation of participants at four points during each session: (a) 15-min prior to the session, (b) halfway through the session (after the intro, museum intervention 1 and music therapy intervention), (c) at the end of session (after museum intervention 2, music therapy intervention 2, and outro), and (d) 15-min post session. Engagement behaviors were defined as interest, response, initiation, involvement, and enjoyment. A Mann–Whitney U test was conducted on weekly data of participants an apostrophe to participants' engagement behavior to determine if cognitively healthy older adults and older adults with memory loss were similarly engaged. Results revealed that cognitively health older adults demonstrated significantly more engagement behaviors following the virtual program than older adults with dementia when participating in the sessions ($z = 2.51$, $p < 0.05$). See Table 6 for total and average engagement behavior scores for all older adults.

Cognitively healthy older adults' top three engagement behaviors while participating in virtual creative aging programming were (1) interest (M = 4.65), (2) response (M = 4.19), and (3) initiation (M = 4.04). Whereas older adults diagnosed with dementia top three engagement behaviors while participating in

TABLE 3 Pre-test and last test comparison of psychosocial well-being for cognitively healthy older adults.

Domain	Variable	Pre-test Mean (SD)	Last test Mean (SD)	Statistical significance
Quality of life	Overall quality of life (summary score)	3.80 (0.59)	3.75 (0.77)	$t(18) = -0.29$, $p \leq 0.77$, $d = 0.07$
	Physical wellness	3.16 (0.90)	3.32 (1.06)	$t(18) = 0.68$, $p \leq 0.51$, $d = 0.16$
	Psychological/emotional wellness	**3.56 (0.86)**	**3.94 (0.94)**	$\mathbf{t(17) = 2.12, p \leq 0.05, d = 0.50}$
	Self-care/independent functioning	3.69 (0.95)	3.63 (1.15)	$t(15) = -0.24$, $p \leq 0.82$, $d = 0.06$
	Interpersonal functioning	4.29 (0.69)	4.12 (0.78)	$t(16) = -0.72$, $p \leq 0.48$, $d = 0.17$
	Social–emotional support	3.94 (0.83)	4.24 (0.83)	$t(16) = 1.23$, $p \leq 0.24$, $d = 0.30$
	Personal fulfillment	3.82 (0.81)	3.47 (1.07)	$t(16) = -1.46$, $p \leq 0.16$, $d = 0.35$
	Spiritual fulfillment	4.00 (1.03)	4.17 (0.86)	$t(17) = 0.62$, $p \leq 0.55$, $d = 0.14$
	General quality of life	3.78 (0.94)	3.39 (1.33)	$t(17) = -1.59$, $p \leq 0.13$, $d = 0.38$
Meaningful engagement in activities	Overall meaningful engagement in activities	42.68 (9.14)	43.74 (10.42)	$t(18) = 0.63$, $p \leq 0.54$, $d = 0.14$
	The activities I do…help me take care of myself	3.78 (1.22)	3.72 (1.32)	$t(17) = -0.18$, $p \leq 0.86$, $d = 0.04$
	…reflect the kind of person I am	3.78 (0.88)	3.72 (1.13)	$t(17) = -0.27$, $p \leq 0.79$, $d = 0.06$
	…express my creativity	3.44 (0.98)	3.61 (1.20)	$t(17) = 0.59$, $p \leq 0.56$, $d = 0.14$
	…gives me a sense of accomplishment	3.72 (1.32)	3.61 (0.92)	$t(17) = -0.32$, $p \leq 0.76$, $d = 0.07$
	…contribute to my feeling competent	3.90 (0.88)	3.58 (1.35)	$t(18) = -1.24$, $p \leq 0.23$, $d = 0.28$
	…are valued by other people	3.47 (1.02)	3.26 (1.10)	$t(18) = -0.68$, $p \leq 0.51$, $d = 0.16$
	…help other people	3.44 (1.25)	3.33 (1.19)	$t(17) = -0.33$, $p \leq 0.75$, $d = 0.07$
	…give me pleasure	4.11 (0.83)	4.39 (0.85)	$t(17) = 1.23$, $p \leq 0.24$, $d = 0.29$
	…give me a feeling of control	3.28 (1.13)	3.72 (1.18)	$t(17) = 1.19$, $p \leq 0.25$, $d = 0.28$
	…help express my personal values	3.83 (1.15)	3.44 (1.38)	$t(17) = -1.16$, $p \leq 0.26$, $d = 0.27$
	…gives me a sense of satisfaction	3.90 (0.94)	4.05 (1.03)	$t(18) = 0.77$, $p \leq 0.45$, $d = 0.18$
	…have the right amount of challenge	**3.42 (1.07)**	**3.95 (0.85)**	$\mathbf{t(18) = 2.54, p \leq 0.02, d = 0.58}$
Social isolation	**Overall feelings of social isolation**	**6.63 (2.77)**	**9.37 (4.96)**	$\mathbf{t(18) = 2.62, p \leq 0.02, d = 0.60}$
	I feel…left out	**1.67 (0.84)**	**2.72 (1.53)**	$\mathbf{t(17) = 2.89, p \leq 0.01, d = 0.68}$
	…that people barely know me	1.71 (1.05)	2.47 (1.55)	$t(16) = 2.07$, $p \leq 0.06$, $d = 0.50$
	…isolated from others	1.44 (0.78)	1.83 (1.25)	$t(17) = 1.59$, $p \leq 0.13$, $d = 0.38$
	…people are around me but not with me	2.42 (1.35)	2.16 (1.21)	$t(18) = 0.68$, $p \leq 0.51$, $d = 0.16$

Bold text indicates a statistically significant difference between pre-test and last data point collected at $p \leq 0.05$.

TABLE 4 Correlation between number of activity sessions attended and psychosocial well-being outcomes for cognitively healthy older adults ($N = 25$).

	1	2	3	4
1 Number of sessions attended	--			
2 Quality of life	0.22	--		
3 Meaningful engagement in activities	0.05	**0.72**	--	
4 Social isolation	0.16	−0.15	0.26	--

Bold text indicates a statistically significant relationship at $p \leq 0.05$.

virtual creative aging programming were (1) interest ($M = 3.79$), (2) response ($M = 3.29$), and (3) involvement ($M = 3.13$).

A descriptive analysis was conducted to determine if more engagement behaviors for older adults occurred following specific interventions. Results showed that cognitively healthy older adults displayed more engagement behaviors during instrument interventions ($M = 4.28$) compared to older adults diagnosed with dementia ($M = 3.22$). Whereas older adults with dementia demonstrated the most engagement behaviors during singing interventions. See Table 7 for more details.

TABLE 5 Pre-test and last-test comparison of psychosocial well-being for older adults with dementia.

Domain	Variable	Pre-test Mean (SD)	Last test Mean (SD)	Statistical significance
Quality of life	Overall quality of life (summary score)	27.57 (4.79)	26.83 (3.89)	$t(22) = 0.89$, $p \leq 0.38$, $d = 0.19$
	Resident smiles	4.23 (1.17)	4.48 (0.85)	$t(22) = -1.03$, $p \leq 0.31$, $d = 0.21$
	Appears sad	1.96 (1.15)	1.61 (0.94)	$t(22) = 1.40$, $p \leq 0.18$, $d = 0.29$
	Cries	1.31 (0.70)	1.22 (0.67)	$t(22) = 0.53$, $p \leq 0.60$, $d = 0.11$
	Appears unhappy or in pain (facial expression of discomfort)	1.96 (0.98)	1.78 (0.90)	$t(22) = 1.00$, $p \leq 0.34$, $d = 0.21$
	Appears physically uncomfortable	**2.26 (1.14)**	**1.48 (0.90)**	$\mathbf{t(22) = 3.95, p \leq 0.001, d = 0.82}$
	Makes statements or sounds suggesting discontent, unhappiness, or discomfort	2.00 (1.24)	1.78 (1.28)	$t(22) = 0.76$, $p \leq 0.46$, $d = 0.16$
	Appears irritable or aggressive	**1.61 (0.84)**	**1.26 (0.45)**	$\mathbf{t(22) = 2.34, p \leq 0.03, d = 0.49}$
	Enjoys eating	4.39 (1.03)	4.61 (0.66)	$t(22) = 1.00$, $p \leq 0.34$, $d = 0.30$
	Enjoy touching others or being touched	3.86 (0.83)	4.18 (0.85)	$t(21) = -1.91$, $p \leq 0.07$, $d = 0.41$
	Enjoy interacting or being with others	**4.17 (0.78)**	**4.48 (0.67)**	$\mathbf{t(22) = -2.30, p \leq 0.03, d = 0.48}$

Bold text indicates a statistically significant difference between pre-test and last data point collected at $p \leq 0.05$.

TABLE 6 Total and average engagement behaviors across all sessions.

Category	Interest	Response	Initiation	Involvement	Enjoyment
Total engagement behaviors cog. healthy O.A.	121	109	105	103	103
Average engagement behaviors cog. healthy O.A.	4.65	4.19	4.04	3.96	3.96
Total engagement behaviors O.A. w. dementia	91	79	67	75	69
Older adults diagnosed with dementia	3.79	3.29	2.79	3.13	2.88

TABLE 7 Average engagement behaviors across all interventions.

Category	Instrument play	Movement	Singing +
Cognitively healthy older adults	4.28	4.15	No interventions during this video collection
Older adults diagnosed with dementia	3.22	2.91	3.47

Perception of creative aging program

At the conclusion of each video program, participants were asked two open-ended questions as a part of the MIDAS assessment: "what did you enjoy in today's session" and "what do you wish there were more of." The word frequency text analysis demonstrates a positive perception of the program. In response to "what did you enjoy about today's session," participants used the words "music" and "liked" 17 times and "enjoyed" appeared 11 times. The words "dancing," "instruments," "learning," and "loved" each appeared 5–7 times. In response to "what do you wish would have been included in today's session," participants noted they wanted "more" 25 times and "liked" appeared 13 times. Other frequent words included "dancing" (11), "music" (7), "seeing" (6), and "hearing" (4). The full word frequency analysis is demonstrated through a word cloud in Figures 1, 2.

Discussion

The purpose of this study was to explore the effect of a virtual creative aging program on older adults' psychosocial well-being and engagement behaviors. Older adults participated in a five-session program across 8 weeks that was delivered in group settings with the Life Enrichment staff at their facility. A total of 56 older adults defined as either cognitively healthy ($n = 27$) engaged with videos from the Senior Wellness Collection (Asia, Europe, Latin America, Middle East and USA/Canada) or diagnosed with dementia ($n = 29$) engaged with videos from the Memory Care Collection (Africa, Europe, Latin America, Oceania and USA/Canada).

Cognitively healthy older adults who participated in the creative aging program showed an increase in their emotional well-being over 8 weeks. This aligns with other studies of older adult music participation and listening, which suggest an improvement in mental well-being and mood (32). In contrast, cognitively

FIGURE 1
Participant responses to "what did you enjoy about today's session."

FIGURE 2
Participant responses to "what do you wish would have been included in today's session."

healthy older adults showed no change in their meaningful engagement in activities. This is counter to some previous studies which found that participation in therapeutic programs incorporating music was associated with greater engagement in meaningful activities (33). Similarly, other studies have shown that music participation is related to a greater sense of accomplishment, feelings of competence, and purpose, similar to the concept of meaningful engagement (34).

Surprisingly, cognitively healthy older adults showed an increase in their social isolation over the 8-week period. This is in contrast to many studies which have found improved social connection associated with music participation (35, 36). One

possible explanation for the increased social isolation seen in the current study may lie in the external challenges that the participating facilities faced during the creative aging program. All three experienced COVID-19 outbreaks during the intervention (roughly around Week 4) where the creative aging program had to be paused, and older adult residents were quarantined to their rooms to prevent further spread of infection. It is possible that the isolating experience of the COVID-19 mitigation protocols influenced the older adults' responses on the questionnaires and potentially had a greater impact on the older adults' perceived social isolation than the creative aging program was able to attenuate.

Older adults with dementia who participated in the creative aging program showed a decrease in physical discomfort and irritation and an increase in enjoying being with others, as rated by their caregivers. Other studies have similarly found that music interventions can reduce agitation and aggression among those with dementia as well as improve social engagement (37–39).

Both cognitively healthy older adults and older adults diagnosed with dementia exhibited engagement behaviors while participating in the program. The engagement behaviors for all older adults were similar and different. Both cognitively healthy older adults and those diagnosed with dementia demonstrated interest (facial expression and posture responses to the interventions in the video) and response (body movement, eye contact, and musical interaction with the leaders in the videos) as their top engagement behaviors when interacting with the creative aging program. However, cognitively healthy older adults demonstrated more initiation behaviors (conversation engagement and/or reminiscing that occurred while watching the video segment) compared to older adults diagnosed with dementia who demonstrated more involvement responses (engagement and/or enthusiasm toward the intervention). This makes sense based on their cognitive ability. It was probably easier for the cognitively healthy older adults to engage in reminiscing experiences during the session compared to older adults with dementia. As one progresses through the illness, cognitive discussions can become difficult, and it may be easier to engage through participating in interventions without an elongated discussion (15).

While older adult participants responded to all interventions with engagement behaviors, instrument interventions were most engaging for cognitively healthy older adults. Singing interventions were most engaging for older adults with dementia, whereas movement interventions were less engaging for older adults with dementia. Perhaps this was due to the number of sequential patterns involved in the movements which could be considered a cognitively high task as there were no visual or written cues on the screen.

The positive perception of the program by participants aligns with the recent research that virtually delivered programs are an effective platform to increase accessibility and enhance communication (11, 24). Furthermore, the qualitative data suggested a high level of engagement with the material. Pairing lifelong learning content with music-based interventions may provide a favorable balance of new information with active interventions. For museum practitioners, this signals a continued inclusion of museum content within creative aging programs.

Limitations

There are a few limitations to this study's findings which should be acknowledged. The evaluation study conducted was observational, rather than experimental. Accordingly, there was no control group who did not receive the music intervention, which limits our ability to assert that the intervention caused the outcomes seen. However, within-subjects designs have the advantage of requiring fewer participants to demonstrate effects and reduce the impact of variability due to individual participant differences. Nevertheless, a relatively small sample of older adult residents participated in the research study and completed questionnaires, although additional residents were interested in the creative aging program and often sat in on the sessions. This could have limited our power to detect statistically significant differences between the pre-test and last point of data collected, especially given that the size of most effects were small (i.e., Cohen's d less than 0.20). Next, COVID-19-related breaks in the sessions, as previously discussed, may have attenuated the impact of the creative aging program. Furthermore, some of the survey items focused on domains which are typically impacted by aging and institutional residence (e.g., ability for independent functioning, feelings of control, feelings of competence) which could have influenced the older adults' responses and partially explain the lack of change in these domains. Another limitation is with the interventions. Many interventions in the wellness collection did not include a singing-only intervention. In future studies, it would be interesting to have the same types of interventions in each collection for comparison. Similarly, the creative aging program contains unique gallery tours, curator-posed engagement questions, and broad-based music therapy foci, which may not translate to other music-focused programming. As a result, this study's findings may be less generalizable to other music interventions.

Implications and next steps

Overall, the results of this study show promise for creative aging programs to be delivered virtually. While the original videos were 15 minutes, the feedback from participants on wanting more, and the ways that the Life Enrichment staff directors engaged with the videos (pausing, asking additional questions, etc.), suggests that video content could be longer. Perhaps the video content could be expanded to 30 minutes or more and could include references such as "pause here for reflection" in the video, and provide repetition of content or return to content provided earlier in the video, especially in the memory care collection. Another next step would be to include manipulatives that could be sent to the facilities or a list of manipulatives that staff could order for the session. For example, if someone on the video was talking about the texture of an instrument, it could enhance the experience if the leader at the facility could pass around the texture to connect the participants to the video even more.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Arizona State University Institutions Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

MB: Conceptualization, Methodology, Investigation, Formal Analysis, Writing - Original draft. KP: Conceptualization, Methodology, Funding Acquisition, Investigation, Formal Analysis, Writing - Original draft. TLM: Project administration, Investigation, Formal Analysis, Writing - Original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Creating musical life reviews with older people: a community case study

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Older people living in their homes might experience growing loneliness, detachment from their social environment, and decreased functional ability. In this *community case study*, we report on a project we initiated to enhance the functional ability of older people by creating musical life reviews (MLR) with them. We connected seven of our music therapy graduates (MT) to older people living in the neighborhood across the street from campus. MTs were first trained to work by a protocol for creating MLRs with older people, developed by the authors of this article. They then worked with older people from the neighborhood for 10 one-on-one sessions, on personally tailored MLRs. MTs kept on meeting in weekly group supervision sessions, thus learning from each other- and forming a community of their own. Participants expressed their high satisfaction with the process and reported that their MLRs became increasingly important to them. Most of them were interested in taking their MLR one step ahead, and playing it to family and/or friends, and, as part of the process, planned a personal event to do this. Further, two big community events were initiated by participants and MTs. To conclude, we show how the community project enhanced the functional ability of those participating in it. We also point at possible challenges and recommendations for further implementation of the project.

KEYWORDS

older people, musical life reviews, community, community music therapy, ripple effect

Introduction

It was almost by chance that we learned of the existence of the Revivim community center for older people living in the neighborhood where our university is located. When we visited there for the first time, we were surprised to discover how vibrant the center was, offering various activities for the retired people living in the neighborhood. We were also surprised to see how close this center was to our music therapy training program, a mere 10-min walk away. The potential for music-oriented collaboration was great, and after meeting with Revivim center's[1] Activity Coordinator (AC), and members of the center, we came up with several ideas that could be implemented either at Revivim center or in our well-equipped music therapy ward. Revivim center was interested in having more music and musical activities for their members, and we were interested in connecting our music therapy students and graduates with this community of older people. In other words, both parties wanted to become good neighbors, and wanted music to lead the way in forging this relationship.

1 To keep confidentiality, the name of the center was changed.

In this article we will describe one of the projects that we conducted with Revivim center, namely, the *musical life review project*. As part of her MA thesis, the second author of this article developed a protocol for creating musical life reviews with older people (1). As part of her PhD project[2], she expanded the idea and training music therapy graduates (MTs) to use the protocol as part of a larger community-based project with Revivim center members. Both authors have had experience with community music projects and had great motivation for them to succeed. Both have a strong humanistic identity with warm feelings toward communities and strong faith in the power of music to help communities grow. Nevertheless, throughout this project we held an open approach, and enabled things to unfold in a natural way. We were ready to experience any outcome and to deal with it in the most professional way.

We were, therefore, very happy to acknowledge that the project was very successful and even after it formally ended, it had a long-lasting impact on the Revivim center community as well as the MTs that were involved in it, and on their professional community. We believe that the working model that was developed here can be implemented in similar social environments in which student communities and communities of older people want to bond using music. Before describing the project, we will give some context about the population we worked with, namely older people who live in the community, and their needs and challenges. We will also review literature referring to the technique we used in this project, namely, musical life reviews (MLRs).

Detail to understand key programmatic elements

Many older people, even those who are generally healthy and independent in their daily functioning, experience changes, loss, separation, and a decline in different functions (2). They have reported reduced energy levels, reduced physical and cognitive abilities, a decrease in their socioeconomic status, the death of spouses, relatives and friends, and gradual separation from their children (3). These difficulties often cause older people to feel that they are less in control of their lives, and it adversely affects their self-confidence and self-esteem. Some older people suffer from symptoms of stress, anxiety, and a general difficulty finding peace of mind (4). Others experience growing social isolation, sadness and despair, and depression is reported as one of the main problems for older people (5, 6). With rising life expectancies and growing rates of healthy and independent older people in the community, it is important to seek ways to preserve their quality of life and wellbeing and to develop practices that address the growing psychological, social, and mental needs of this population (7, 8).

Music has been used in many different ways to assist older people, and to meet their psychological, physical, and mental needs (4, 9–11). For instance, singing in a choir or playing in a musical ensemble can boost vitality and energy levels, and lower depressive symptoms (6). The social nature of making music in a group can naturally promote friendships and help those who feel lonely (12). For some, an ensemble can become a small community to which they feel an affinity. Other uses of music with older people are based on the connection between music and movement. Here, music is used to encourage movement and dance, which are important for the preservation and improvement of physical abilities (13). Other uses of music are based on the benefits of enjoyment that stems from people listening to music together and especially choosing the songs they like. The act of choosing music can be very significant, because it encourages participants to share their musical taste, and sometimes the personal stories and circumstances that are connected to the chosen song (9).

Another line of techniques that has been used successfully with older people includes musical life reviews and reminiscence [see Istvandity (14) for a systematic review]. Studies show that music has the power to encourage reminiscing among older people (15–18), an ability that is essential for developing life stories. El Haj et al. (16) found that memories are retrieved more quickly and more spontaneously when music (chosen by the participant) is played, compared to retrieving them in silence. They also found that the music-oriented memories were more specific, accurate, and detailed, compared to those elicited in silence, and that they more often connected to emotional responses. Other brain research-oriented studies found connections between listening to self-chosen music and heightened abilities to reminisce, and that (mostly positive) emotional responses were also involved (17, 18).

The idea that reminiscing and life-reviewing (not connected necessarily to music) could be used beneficially in therapy was noted by Butler (19), a psycho-gerontologist. He noticed that his clients frequently and spontaneously reminisced and reviewed their lives and he realized the healing potential this had. Life reviews at this point in life can enable people to make peace with their lives, to resolve unfinished business and past conflicts, and to invest their energies in relationships they feel are important to them now. It is an opportunity to summarize and organize memories from childhood, adolescence, and adulthood, and to put together a coherent and meaningful life story (20). These ideas resonate with Erikson's (21) eighth and final stage in his psychosocial model—integrity vs. despair—which is relevant to older people in the final phase of their lives. Erikson argued that forming life reviews at this stage in life can help to enhance feelings of integrity and acceptance and to avoid feelings of regret, guilt, and bitterness that typically lead to despair. By connecting and organizing sporadic memories, one creates coherence between past, present, and future, and makes sense of life as a whole (22). Indeed, more recent studies have shown that treatments that are focused on life reviewing and reminiscing have positive effects on the psychological wellbeing of older people (23–27).

Several studies have reported using music in combination with reminiscence therapy (4, 27–31). Istvandity (14), who systematically reviewed five of these studies, noted that although reminiscence can benefit older people in general, most of the studies targeted only those with dementia. Istvandity (14) also noted that these studies did not specify the exact protocol for working with music to induce reminiscence. Therefore, other practitioners who want to implement this treatment with their clients will find it difficult to replicate. Lastly, most of these studies focused on reminiscence, not on life reviews—essentially different phenomena (29). Reminiscence is a more sporadic process where

2 The research was approved by the ethics committee of the music department at <Anonymized> University (Approval no. B.MUS.2016-5).

one spontaneously recalls life memories, mostly good ones, while life reviews are more systematic, with the aim of encouraging self-integration of one's life events.

In this article we will describe how we implemented MLRs with older people living in the community. As a community case study the goal of this article is to describe this community project and to explore the possibility that it enhanced general constructs such as participants' functional ability and their general wellbeing. We will first describe the protocol and how we developed it, and we will then describe how we implemented it as part of a larger community project.

Context

MLRs for older people—A pilot to consolidate a protocol

We started using MLRs with older people in a pilot project we conducted during the years 2012–2014 in a sheltered housing center. This project was documented and researched as part of the MA thesis of the second author of this article (1)[3]. The MLR protocol we consolidated for older people was based in part on the musical presentation model (MP) developed by Amir (32), used mostly in a group context with various populations (33, 34)[4]. After piloting and experimentation, we came up with a short-term protocol (8–10 sessions long; see Figure 1). Although the protocol is described in four distinct stages, the actual process required much back-and-forth maneuvering:

Stage 1—"Dusting" (∼ sessions 1–2)

The MT encourages the participant to introduce their life story or parts of it, and to start recalling musical pieces from their past that might be connected to different parts of their life story. At this initial stage, participants remember only segments of the songs, sometimes a verse or two of the text and sometimes part of the tune that they try to hum. Some participants might have lived in different countries throughout their lives, and so with them, a variety of languages and musical styles is expected. The MT is required to work like a detective in finding leads for retrieving a recording of every requested song, even if it is rare or difficult to locate. Listening to such a retrieved song can come as a delightful surprise for participants after many years of not having the opportunity to hear it.

Stage 2—"Rippling" (∼ sessions 3–5)

Listening to the first few songs that were found often elicits feelings of nostalgia, memories, sights, and stories that are connected to the participant's life story, and this is all documented by the MT and used to assemble more information for the MLR. Typically, one song triggers the recall of other songs and episodes. Therefore, stage 2 is actually intertwined in a back-and-forth manner with stage 1. The dynamics of these two stages remind us of ripples: One circle of memories evokes the next ripple of memories, and the process continues for several sessions when songs and stories accumulate until the participants feel they attained saturation.

Stage 3—"Editing" (∼ sessions 6–8)

When participants are satisfied with the materials, editing begins with the aim of creating the first version of the MLR. Important decisions are made here, such as should the MLR be based on "chapters" according to stages in life, and if so—what are the participants' meaningful stages in life? What version of a song should be used, and which segment of it should be chosen? In what order should the songs be organized and grouped? Typically, a 20-min time limit is given, implying that these decisions significantly impact the form and design of the MLR. After making some tentative decisions, the MT prepares the first version of the MLR, and then plays it to the participant. The participant can then either recall more musical pieces that need to be added to the MLR (returning to stage 2 of the process) or delete or shorten songs. Listening to the first version can also trigger the retrieval of other life periods that the participant thinks need to be represented, and so, another wave of songs is revealed, and more searches are required from the MT. A second version is created, listened to for further editing, and this process repeats itself with each new version until the participant feels satisfied with the MLR. Another important decision the participant can make, typically at the end of this stage, is whether to add verbal narration between songs or life stages, providing the listener with context or telling relevant stories. When the last version is finalized, the MLR is either burned on a CD or saved as a file, to be used by the participants. A booklet can also be added with song lyrics, associated stories, etc. Typically, the participant is the one making all editing decisions and the MT is the one doing all of the technical work (usually based on software such as Shazam and Youtube to retrieve music and Audacity or Wavepad to edit the MLR). The MT also serves as an advisor in editing decisions such as how and when to fade in or out of a song, etc.

Stage 4—"Echoing" (∼ sessions 8–10)

Although this is an optional stage, most of our participants were indeed interested in pursuing it. Typically, as stage 3 progresses, participants express their desire to share their MLR with others (e.g., family members or friends). This can be done in different ways, and the MT needs to be very attentive to the exacts needs

3 Methodological precautions that were taken in this study included a constant examination of various perspectives of the findings (e.g., with an additional expert, with the advisors of the study, as well as a member check with the participants in the study). These perspectives enabled the researcher to prevent self-perceived biases and to fine-tune the protocol.

4 The general idea in the MP model is that each group participant edits a collage of musical pieces that when presented to the other group members can tell a story about him/herself. There is a 10 to 15-minute time limit, and this means that musical pieces need to be very carefully chosen, and that audio editing is required (i.e., cutting out specific parts of musical selections and pasting them in the most favorable place in the collage). In the pilot project, we made adjustments to suit the needs and abilities of older people such as working on a one-on-one basis thus enabling technical support and a specialized pace for each participant.

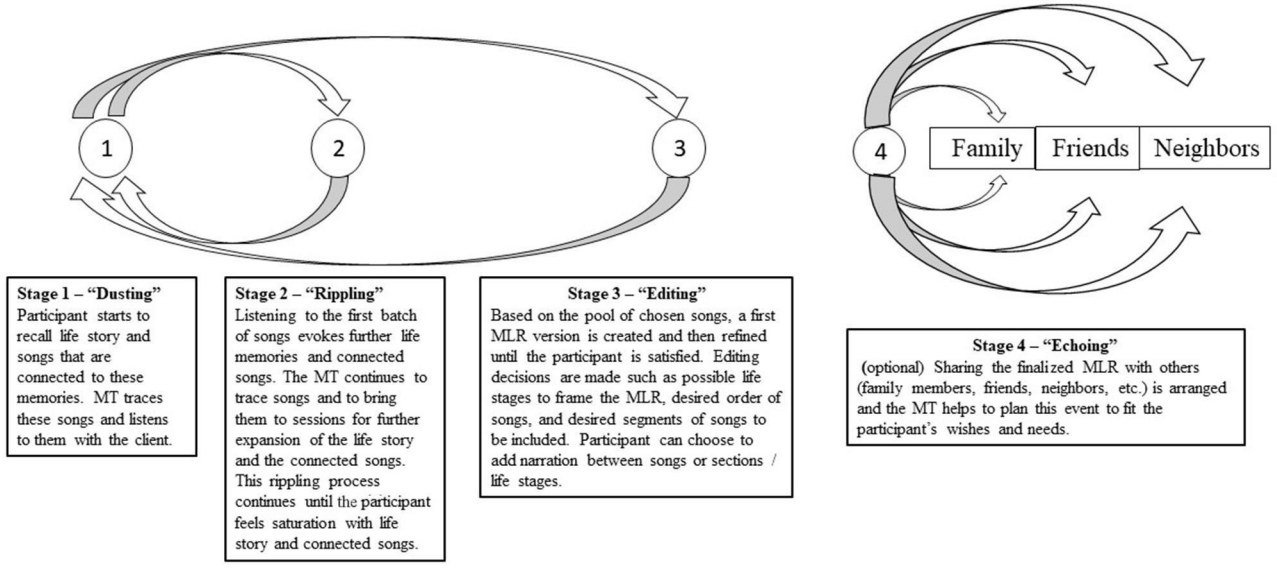

FIGURE 1
Four-stage protocol for creating MLRs with older people.

that the client is expressing and to be creative at thinking of ways to pursue the plan. Together they decide who the audience should be (e.g., close family? friends? neighbors?); What type of event they want and how big/small they want it to be (e.g., brunch at home? Birthday celebration at one of the children's homes?); Should the MLR be distributed to the audience members and if so—in what format (CD? link to YouTube? Addition of a small booklet?).

The responses of the pilot participants were very positive and showed how deeply connected the participants were toward their MLR: "The more I hear it [the MLR] the more I love it…I don't want to change anything anymore…that's me." For some it was a way to make peace with past stages of their lives: "our sessions caused me to raise good memories from my childhood… I could say that as an 7–8 year old—I was happy…."

MLRs for older people—Expanding to the community

About a year after the pilot project ended, we made the connection with Revivim center and their Activity Coordinator (AC), described earlier in this article, and agreed to embark on a larger scale MLR project involving at least ten older people. Figure 2 shows that the leap between the pilot study and the community based MLR project was not only a matter of growing in numbers (from 3 participants in the pilot to 11 participants in the project). It was also a matter of adding a new group of MTs to the process, training and supervising them, and forging the bond between the MT academic community and the Revivim center community. We will describe this process stage by stage[5].

Recruitment

Seven MT graduates were recruited for the project. They were given an explanation about the idea of MLRs with older people and that they would be working with Revivim center members. They would undergo a brief training period with the second author of this article, after which they would be working at the homes of older people on a one-on-one basis for about 10 sessions, to create personal MLRs. They would receive a modest scholarship for each such project based on a donation the university had for music community projects[6].

Training

Training consisted of two 4-h sessions. In the first session the idea of the MLR was explained, along with information about the importance of music and life reviews for older people. MTs were asked to prepare a pilot MLR with an older family member (e.g., parent, uncle or aunt, grandparent, etc.). The next session was dedicated to listening and analyzing these MLRs, and especially the process that the MTs went through to produce it. The MTs later reported that this pilot MLR was very important for their training, for gaining confidence before they started working with "real" clients[7].

5 Methodological precautions that were taken in this study included triangulation in which information was gathered from multiple sources (e.g., documentation of the supervision sessions with the MTs, interviews with the MTs), as well as the constant examination of additional perspectives on the findings (e.g., the advisor of the study, the Revivim center AC).

6 Some MTs chose to take upon themselves more than one MLR, and their scholarship was calculated accordingly. This explains how seven MT worked with 11 older people.

7 At this point in the article, we have transitioned from using the word "participant" to "client" because of the nature of the more personal and one-on-one work between the MT and the older individual during this phase of the project.

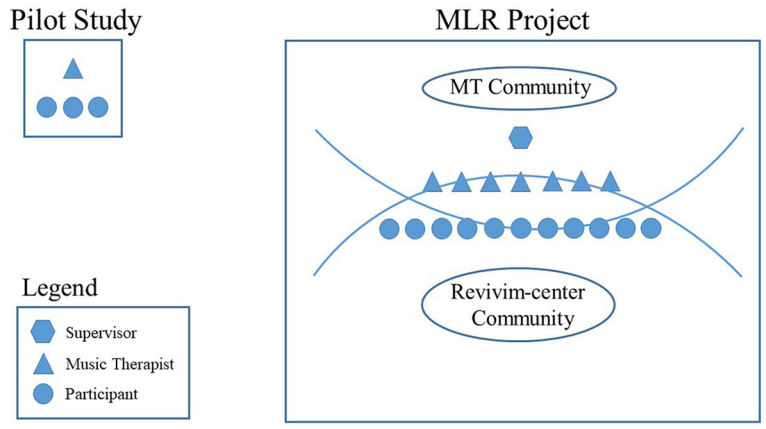

FIGURE 2
Illustration of the pilot study vs. the MLR project.

Work

With the assistance of the Revivim center's AC, MTs (all Israeli) were then assigned to older people from the Revivim center who expressed their interest in creating a personal MLR. Participants were culturally diverse: they were either born in Israel or in different countries and immigrated to Israel earlier in their lives. Though MTs were familiar with various musical styles and genres, through the work on MLRs, they fine-tuned to the exact musical styles and genres that their participants knew and loved. MTs worked at the homes of these people on a weekly basis for about 10 sessions, until the MLR was finalized. Throughout these sessions, MTs continued to meet for group supervision with the second author of this article on a weekly basis. During supervision, they raised questions, challenges, thoughts, and ideas that emerged when working with their clients. Supervision was important in the development of the MTs abilities to work with the older people, and to cope with various challenges. From one session to another, the bond between the MTs got stronger as they supported each other, shared their feelings, and gave valuable advice to each other. The clients, on the other hand, were not yet aware of each other's progress. They would start bonding only later in the process. Toward the end of this stage, clients finalized their MLRs, some of them requesting to "echo" their MLRs to family members, friends, or neighbors, and the MTs were there to facilitate this. One participant invited a friend over to hear her MLR while another invited several of her childhood friends to brunch so she could play her MLR. Other participants shared their MLR with a few family members or with an apartment full of children and grandchildren. As this stage of the project came to an end, the MTs had their last supervision meeting in which they celebrated their good work and the friendships that developed between them.

Community bonding

Despite the fact that the MLRs were complete, and that supervision was over, there appeared to be an urge to do something more, something bigger. The Revivim center's AC contacted the authors of this article and said that participants had expressed their desire to further share their MLRs with the entire Revivim center community, and that they wanted the MTs to be a part of this event. We were happy to hear this, and so we joined forces to plan such an event. We decided on a 2-h event at Revivim center, which all members would be invited to (approx. 100 people participated). On stage, eight of the participants presented one of the songs from their MLR, sharing with the audience why they chose that particular song and what it was connected to in their life stories. MTs also took the stage when called to do so, adding their part of the story. They also prepared a few songs that they performed live. People in the audience were very much moved by the songs and the stories (some applauding enthusiastically, some in tears). These songs and stories enabled people in the audience to get to know their peers on a completely new and deeper level: "This project made me curious about my friends in the club and we got to know each other better through listening to each other's musical life stories." The MTs, too, felt that they were part of a big and important transformation: "I suddenly understood how much meaning these sessions had for me… I find it difficult to end this process." They felt the warm connections with their clients expanding to the larger Revivim center community: "I will continue to listen to my client's songs for the rest of my life, and his stories will be with me forever… He let me have a taste of his world, a visit to his personal hall of glory, and so—an entire world has been revealed to me. I am so grateful for this…."

A few months later, there was apparently still an urge to share the experience with others. Together with the Revivim center's AC we thought of another idea to promote the bond between the communities. We had a one-day MT academic conference coming up, and we suggested using this platform to present the MLR project. The idea was for all of the project's participants, older people who finalized their MLRs, alongside MTs that worked with them on the project, to go on stage and talk about the project and their experiences and insights they gleaned from it. This joint presentation, in front of about 70 MTs, was very successful. For the older people it was a great privilege (for some their first time

ever) to present on an academic stage, and it gave them great pride and satisfaction. The MTs involved in the project also felt fulfilled to have an academic opportunity to share their experiences with their colleagues. The MTs in the audience were highly involved, applauding enthusiastically, some of them practically in tears. As the event progressed it was clear that the communities were bonding. To end the event, a song from one of the MLRs was chosen, and all of the event's participants sang it together in unison. This event formed a steady bond between the communities, and other musical projects were initiated in the following years.

The impact of the MLR project

The MLRs had an enormous impact on the older people. Many of them expressed their appreciation of the project on different occasions, mostly at the end of the community gatherings described above. One participant said: "I'm 84 years old now and I have done many things in my life, but this project was the most important thing I've ever done!" Another participant noted how "…experiencing the creation of the musical life story was moving and cathartic." For many participants it was a way to strengthen their connections with their children. For example, one participant said: "my daughters told me 'after listening to your musical life review, we got to know new things about you,'" and another participant noted that "I feel that I have left something valuable to my children, grandchildren, and great grandchildren." Some felt that the MLR connected between them and their spouses: "when playing my musical life story to my husband, he burst into tears," and others mentioned insights they had regarding their deceased parents: "during this process I got the opportunity to mourn my father whom I lost when I was a child" or "...through this project we rediscovered our parents' music and understood the importance of our roots and this strengthened the intergenerational ties in the family." Finally, participants mentioned how moved they were by the warm connections they made with the MTs. For some of them, the MTs were around the same age as their children or grandchildren, and this led to a warm and affectionate relationship. For many participants, being on an academic stage was in itself an accomplishment.

The MTs also felt that the project contributed to their development. As the sessions came to an end, they shared their feelings with their MT peers during supervision or wrote down their reflections. One of the MTs shared that she became acquainted with new musical styles: "I must say that I see myself listening to the MLR we created time after time… and her musical selections are simply amazing." Some MTs got to see how impressive their clients' lives were, and they perceived them as role models: "I thanked my client for the opportunity to meet such a wonderful, powerful, positive, and creative woman. I learned a lot from her, and I especially appreciate the love she had for her family and for her late husband. You don't usually see such love and affection after 50 years of marriage. I took this as an inspiration for my own life. And when it was time to say good-bye to her—I was in tears." Indeed, toward the final sessions, MTs expressed how sad they were that the process had come to an end: "I am very sad that these are my last two visits to her… and I think it is sad for her as well." One of the MTs found a way around the difficulty of ending the process and came to an agreement with her client that they would continue to meet on occasion. Indeed, as we saw earlier in the account of the community events that took place after the MLRs were already finalized, that MTs and their clients had more opportunities to meet.

Discussion

Threads of community music therapy

Although work on the MLRs was done on a one-on-one basis, the overall MLR project took on a form typical of community music therapy (35–40). For one, participants were recruited from the community (i.e., the Revivim center community) and after their MLRs were finalized, went back to share their experiences with their community. MTs, too, were recruited from an existing community of young MTs who studied together, and throughout the project they strengthened their bonds through supervision, and then expanded the scope of their community by sharing their experiences with other MTs. Second, the impact of the MLR had "rippling" and "bonding" effects, typical of community music therapy work (39, 40). The effect of the MLR project was first local (e.g., for the individuals participating in the project) but it then "rippled" to others (e.g., participants' families, friends, and the Revivim center community at large, MT colleagues, and the professional-academic community). On an inter-community level, the MLR project "bonded" between the Revivim center community and the music therapy academic community, a bond that did not previously exist. Third, the MLR project was resource oriented (38), giving a voice to the music and to the participants' life stories. Moreover, participants had control over the materials and acted as editors of their MLR, enabling them to structure their perception of their life story and give it meaning. Finally, the MLR project was propelled by ideas of social activism and social change, which are typical of community music therapy (38). During the creation of MLRs, participants underwent different changes in their perception of themselves and of their lives, and the MTs served as agents of this change. Evidently, participants were interested in echoing these ideas of change onward to friends, family members, and other audiences. The idea that older people could and should celebrate their life stories, and that they could use musical materials to do so, affected the audiences, and the MTs and participants together served as agents for this shift in social perception. Older people in the audience who had not yet taken part in the MLR project could start fantasizing about their own MLR, and MTs who were not involved in the project but did have a connection to older clients could start imagining the possibility of seeing them in such a resourceful light.

Practical implications and lessons to be learned for future applications

The fact that a growing number of older people live in the community and yet experience increasing feelings of loneliness, calls for a careful examination of the social resources available in the community, and for the pursuit of new ways to locate and

utilize such resources. The project described in this article takes existing social resources and uses a musical framework to extract a fuller potential from them. Although Revivim center and the university campus are practically in the same neighborhood, the social connections between the two were far from utilized. The MLR project challenged both sides, the older people from Revivim center, and the MTs from the music therapy program, to interact. It gave both sides a reason to meet on a regular basis, and it clearly depicted the desired result (an MLR). Both process and product became meaningful for both the participants and the MTs. This is what drove the enthusiastic progress throughout the project, and the subsequent ripples and echoes.

Although we did not directly measure feelings of loneliness, self-confidence, or wellbeing, we could definitely see how the project improved participants' functional ability in several different ways. First, the project provided myriad opportunities for participants to learn, grow and make decisions and thus to strengthen their autonomy, dignity, integrity, freedom, and independence. Second, it encouraged the creation of new relationships (with the MTs) and the maintenance of existing relationships (with children, partners, neighbors). Lastly, it enabled the participants to contribute to society by creating the MLRs and leaving it as a legacy to generations to come. Further research can examine whether this heightened functional ability had a positive effect on well-being, self-confidence, loneliness and other psychologically measurable constructs.

Several conditions must be met to succeed in such a project. For one, there must be a clear interest for each of the communities. Such projects tend to fall apart if they are one-sided. Second, there needs to be a devoted contact person representing each of the communities who is highly enthusiastic about the joint project. Third, much creativity and flexibility are needed in shaping the project to suit the interests of both communities. Music is multifaceted, and it can be used in many ways to achieve different goals. In our context too, musical activity can be shaped and molded to suit the exact needs of the communities. In fact, during our journey with Revivim center we tried other musical formats, such as a sing-along activity led by MTs and a drumming group for the older people and their grandchildren. Each of these formats was developed and tested, and each achieved different goals. In all cases, however, a healthy bond formed between the older people an the MT community, and loneliness was pushed aside. Fourth, persistence is required, and forgiveness for trials that fail. Finally, a funding source should be available, preferably one from each of the communities, thus promising a genuine sense of partnership.

Others that seek to create community-based musical-driven bonds between older people and academic communities will need to see whether conditions are ripe to embark on such a plan. They will probably come up with a set of ideas that are suited for their specific organizational structure and use musical activities in ways tailored specifically to their goals. Whether their project is based on MLRs or on any other musical activity—the meta-purpose is to form a good and warm relationship between the communities of older people and the university students or graduates, and to activate the social resources that are already there but have not yet reached their full potential.

Acknowledgment of conceptual or methodological constraints

One constraint of this article is that reports from participants and MTs came during and toward the end of the project, and no follow-up was conducted. Possibly, after a year or two, different perspectives on the project would emerge, including potential criticism, or additional ideas and insights that could further improve the project.

Another constraint is that the project was evaluated by the authors of this article, and although methodological precautions were taken, there are natural biases toward seeing the positive effects and overlooking possible problems. An evaluation conducted by impartial person could have benefited the process and provided further recommendations and insights for others who want to implement a similar community-based project. Further, it is recommended that in future study of this project, various outcomes and impact measures are defined such as improving wellbeing and social confidence, and lowering feelings of loneliness.

To conclude, we believe that the community project reported in this article had powerful impacts on older people as well as on the MTs that took part in it. The MLRs gave form and shape to the community potentials that were there, waiting to be realized. This project should be seen as just a first step in an evolving process, in which music in general, and MLRs in particular, are used to empower older people's functional ability, community life, and connection to other communities. Once such processes gain momentum and there are enough people are involved in such projects, it will be the time to evaluate the effectivity of the projects using evidence-based practices. We invite readers of this article who find the project to be relevant and practical in their environments, to go ahead and to promote such community music-based projects.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The research was approved by the ethics committee of the music department at Bar-Ilan University (Approval no. B.MUS.2016-5). All participants signed informed consent forms before participating in the project.

Author contributions

AG and NL: Conceptualization, Investigation, Methodology, Writing - review & editing. NL: Project administration. AG: Supervision, Writing - original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Effects of a music therapy and music listening intervention for nursing home residents with dementia: a randomized controlled trial

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Introduction: The aim of the present study was to evaluate the effects of an individual music therapy intervention and an individual music listening intervention on neuropsychiatric symptoms and quality of life in people with dementia living in a nursing home and on professional caregiver's burden to be able to make statements about their specific value of application in clinical practice.

Methods: A multicenter single blind randomized controlled trial with three groups was performed: an individual music therapy intervention (IMTI) group ($n = 49$), an individual music listening intervention (IMLI) group ($n = 56$) and a control group ($n = 53$) receiving usual care. The interventions were given during three weeks, three times a week on non-consecutive days during 30–45 minutes for in total nine sessions. The endpoint of the study is the difference from baseline to interim (1,5 week), post-intervention (3 weeks) and follow-up (6 weeks) in reported scores of problem behaviour (NPI-NH) and quality of life (Qualidem) in people with dementia and occupational disruptiveness (NPI-NH) in care professionals.

Results: In total 158 people with dementia were randomized to one of the two intervention groups or the control group. Multilevel analyses demonstrated that hyperactive behaviour assessed by the NPI-NH was significantly more reduced for the IMLI group at follow up and that restless behaviour assessed by the Qualidem was significantly more reduced for the IMTI group at post and follow-up measurement compared to the control group. No significant effects between groups were found in other NPI-NH clusters or Qualidem subscales.

Conclusion: In conclusion, because we found no convincing evidence that the IMTI or IMLI is more effective than the other both interventions should be considered in clinical practice. For the future, we advise further research into the sustainability of the effects with alternative designs, like a single case experimental design.

KEYWORDS

dementia, music therapy, music listening, problem behaviour, quality of life, neuropsychiatric symptoms, psychosocial intervention, nursing home

Introduction

Worldwide there are about 50 million people living with dementia and this number will triple in 2050 (1). Dementia is an umbrella term for a number of neurocognitive diseases characterized by progressive cognitive declines as well as behavioural alterations (2, 3). More than 80% of people with dementia develop neuropsychiatric symptoms (NPS) symptoms in the course of their disease, such as depression, apathy, agitation, delusions and anxiety (4–7). NPS appears to be the main factor affecting quality of life (QoL) of both people with dementia and their caregivers (6, 8). Furthermore, NPS are implicated in a cycle of negative events including placement in residential care, even risk of death in individuals with Alzheimer's disease and high societal costs (9). The clinical presentation of NPS is determined by various disease specific, individual, psychosocial and contextual factors that require highly individualized psychosocial interventions supporting people's existing capabilities (10–12). Such psychosocial interventions need to be safe and accessible and serve as a first step when problem behaviour occurs in people with dementia (13). Psychosocial interventions can greatly reduce the necessity of psychotropic drug therapies (14, 15).

Music (therapy) interventions are promising psychosocial interventions. The non-verbal nature of music provides a low-threshold approach, which can be offered up to people with dementia who have difficulty expressing themselves verbally. In the clinical setting, music is often used as an indirect intervention to improve the atmosphere and pleasure, often specified as reminiscence. But it can also be used as a personal directed psychosocial intervention specifically focusing on reducing NPS. During these interventions, abilities are addressed that are preserved in persons with dementia, such as music making, singing and moving on music (16). This is different from other therapeutic interventions, such as cognitive behaviour therapy and solution-based therapy, which rely on verbal and cognitive abilities to a higher degree (17). When music is therapeutically applied guided by a music therapist, it is called music therapy. A music therapist is specifically trained in psychotherapy through music and attunes continuously to the person and the behavioural and psychological symptoms (18). In its application, music therapy is divided into receptive music therapy and active music therapy (19). During receptive music therapy, a person with dementia is listening to music based on his/her personal preferences under the guidance of a music therapist. Meanwhile, during active music therapy a person with dementia is actively invited to play an instrument, singing, or creating a song. Active music therapy has been suggested to be more effective in decreasing problem behaviours than other types of music interventions (20). For both active and receptive music (therapy) interventions the use of individual preference of music is extremely important because pleasant and unpleasant music elicit different emotional responses (21) and the impact is influenced by the type of music used (22). Personalized music is defined as music that is integrated into one's life and is based on personal preference (23). Listening to personalized music is widely available, easy to implement but considered no real therapy when it is not guided by a (music) therapist.

Abbreviations: IMLI, Individual music listening intervention; IMTI, Individual music therapy intervention.

Several systematic reviews have shown that music (therapy) interventions with personal music preference are effective in reducing NPS such as depression, anxiety and agitation and increase quality of life (QoL). A Cochrane review (16) confirmed the positive effects of music therapy in dementia care on reducing depressive symptoms and improving overall behavioural problems. Recent systematic reviews (24, 25) suggest music therapy improves memory and verbal fluency, reduces anxiety and apathy, and has short-lasting effects on the quality of life of people with dementia. However, these reviews revealed no significant effects of music therapy on agitation and aggression. No long-term music therapy effects were reported as well (16, 24, 25).

There are many reviews available investigating the effects on music (therapy) on various dementia related symptoms and showing the therapeutic potential of music in dementia care. Nevertheless, intervention studies or high-quality trials that show effects on the broader range of NPS are scarce and charged with methodological restrictions (16, 24, 26–28). The design and implementation of this kind of research is faced with many practical and theoretical difficulties (26, 29, 30). Conclusions are limited by the small number of fully powered robust clinical trials. Small sample sizes were one of the main limitations of included studies in the reviews with low recruitment rates, often the cause of underpowered studies. And there are also studies that question the specific effects of music (therapy) on people with dementia (26). Furthermore, it is important to compare the effects of individual music therapy with an individual music listening intervention to be able to make statements about their specific value of application in clinical practice.

For this study, we developed in collaboration with experienced music therapists in dementia care an individual music therapeutic intervention (IMTI) guided by a professional music-therapist and an individual music listening intervention (IMLI) guided by a nurse. These developed interventions are specially aimed at reducing problem behaviour in nursing home residents with dementia. With the knowledge that randomized controlled trials (RCT) are still the gold standard of evaluating the effects of health interventions (31), we performed a multicenter single blind RCT to compare the developed interventions (IMTI and IMLI) with a control group receiving usual care. The aim of the present study was to evaluate the effects of IMTI and IMLI on neuropsychiatric symptoms and quality of life in people with dementia and on professional caregiver's burden. Also, practical experiences of music therapists, nurses and informal caregivers with the developed IMTI and IMLI have been systematically evaluated in a process evaluation published elsewhere (32).

Methods

Design

This study concerned a multicenter single blind RCT with four measurements: baseline (T0), after one and a half weeks (interim measurement, T1), after 3 weeks (post intervention, T2), and after 6 weeks (follow-up, T3). This RCT included two music treatment interventions (IMTI and IMLI) and a control group. The control group received usual care including usual non-pharmacological interventions like physical exercise, reminiscence therapy or validation, but without any music component. Eligible participants were randomly allocated to receive the IMTI ($n = 49$), IMLI ($n = 56$) or

usual care ($n = 53$). This RCT was reported following CONSORT guidelines for non-pharmacological treatment (33). Study visits occurred between July, 2017 and September, 2020. Alongside this RCT, we performed a process evaluation with qualitative research in which the experiences of music therapists, professional and informal caregivers with both interventions have been researched. The results of this process evaluation are published elsewhere (32).

Procedure

For both intervention groups, a standardized treatment schedule was developed in which the supervised intervention was given next to usual care during 3 weeks, three times a week on non-consecutive days during 30–45 min in accordance with practicability in residential care. A logbook was kept by music therapists (for IMTI) and professional caregivers (for IMLI) in which intervention adherence was noted. The control group received usual care. The interventions were offered at varying times of the day in close coordination with the involved care team of the participant. The time of the assigned intervention was tailored to personal client objectives (e.g., activation or relaxation) and individual daily client schedules taking into account possible overload and agreements with family or other obligations.

All outcome measures were assessed by an independent trained research assistant who was blinded to the intervention. This independent research assistant visited the involved professional caregivers of the participants in the nursing home for the NPI-NH and Qualidem assessments. For each participating person with dementia, the questionnaires were systematically administered across all four measurements to the professional caregiver closely involved in the care for the respective participant.

Participants

Participants were recruited from four nursing home organizations (spread over 12 locations) with expertise in dementia in the south of the Netherlands. Participants were eligible for inclusion when diagnosed with any type of dementia on admission by a professional (physician or psychologist) according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, regardless the etiology (minimal Global Deterioration Scale score 2) (3, 34). Furthermore, participants were only included with one or more NPS observed by the attending physician or psychologist. Further inclusion criteria were a written informed consent by a responsible family member in accordance with local ethical committee regulations and a life expectancy for at least 2 months. Exclusion criteria were any somatic or not-dementia related cause of behavioural problems, delirium, deafness and change of any medication during the last 2 weeks before inclusion. In addition, treatment with psychotropic drugs was not a contradiction for inclusion, provided that it had not changed in the last 2 weeks before inclusion. For the recruitment, local clinical research coordinators and involved staff from the four participating nursing home organizations approached potential residents either face-to-face and/or by talking with the informal caregiver about the study. Eligible participants and their professional and informal caregivers were provided with detailed information of the study described in the information letter and explained orally by the principal investigator. Subjects could withdraw from the study at any time without any effect on their usual care.

Sample size

We calculated the number of residents needed to detect a medium effect size with 90% power with a randomized complete-block design (with three groups and four measurements) at minimal 143 (35). Assuming a dropout rate of 20%, this leads to an inclusion of a total of 172 people with dementia.

Randomization and blinding

A researcher not otherwise involved in the study performed randomization. Participants were informed that they would randomly be placed in one of the three groups, including a no treatment music group, with equal chance of being assigned to any group. To maintain independence between clinical and experimental data, clinicians (music therapists, psychologists and other professional caregivers) were not involved in data collection. Research personnel were blinded to treatment assignment. Randomization codes were computer generated in blocks of six participants.

Interventions

Individual music therapy intervention (IMTI)

The IMTI was an active music therapy intervention (min. 30–max. 45 min three times a week for three weeks, for a total of nine sessions) using musical improvisation with music instruments or voice/singing and movement guided by a music therapist. Music therapists selected and applied musical elements (melody, rhythm, harmony and sound) adequately, tailored to a recipient's individual needs and goals. Every session consisted of three phases: opening-main-closing. During the opening phase of every session, experience-oriented working was the starting point to get in touch with the resident and to create a sense of security (validation). In the main phase, the music therapist worked towards the reduction of physical and emotional tension (depending on the goal) using recognized techniques and improvisation. The intervention ended with a closing phase (goodbye) in which the music therapist took care of a relaxed transfer to daily care. After the closing phase, the resident was transferred by the music therapist to the nursing staff including musical advises what can be done for the resident to relax or to activate so that daily care can be built on the experiences of the music therapist. The music therapy session took place in a quiet (therapy) room (this may be the participant's own room) where distracting stimuli were avoided. Six experienced and well-trained music therapists were available for the intervention at the different locations. Each participant received his or her music therapy session from the same music therapist. All involved music therapists had a bachelor's degree in music therapy and had at least 1 year of experience in working with people with dementia. The IMTI was developed in collaboration with experienced music therapists, dementia care professionals and client

representatives aimed at reducing or stabilizing of problem behaviour in dementia (32).

Individual music listening intervention (IMLI)

During the IMLI the personalized music was offered by an iPod, in a familiar quiet environment, supervised by a professional caregiver (during 30–45 min three times a week for 3 weeks, for a total of nine sessions). The IMLI was based on the guidelines developed for this purpose by Gerdner (23): (1) music selection according to patient's personal preference. To find out personal music preferences, the involved professional caregiver used a standardized inventory instrument of personal music preferences, namely Assessment of Personal Music Preference Questionnaire (APMPQ) (36) and the person with dementia was interviewed by a professional caregiver (if possible), supplemented with an interview with close relatives (informal caregiver, child(ren) brothers/sisters/old friends); (2) music material file (iPod) preparation for each resident; (3) factors in the environment that may cause the person to be agitated should be avoided. The intervention should preferably be offered on residents' room as a quiet and comfortable environment. The professional caregiver ensured that the person with dementia sits comfortably and explained that he/she was going to listen to music. Before putting headphones on his/her head, the professional caregiver tested the sound volume; (4) the professional caregiver monitored the intervention and regularly observed whether everything is going well and how the participant reacted to the music (in case of agitation, music listening was interrupted). When the person with dementia fell asleep and the music was not disturbing, it was considered an acceptable form of relaxation.

Outcome measures

The primary outcomes were the Neuropsychiatric Inventory Nursing Home version (NPI-NH) scale to assess the dementia-related behavioural symptoms and the Qualidem as a patient-related outcome measure of the QoL (37, 38). A trained research assistant administered both measures to involved professional caregivers of the participants.

NPI-NH is a derived version of the NPI and validated for use in nursing homes and the Dutch version has been shown to be consistent with clinical taxonomy and relatively stable across dementia stages (39, 40). The NPI-NH consists of a semi-structured interview by which the severity and frequency of disturbances in 12 symptom domains is rated. Apart from the presence of a symptom (yes or no), the frequency (F) on a 4-point scale and the severity (S) on a 3-point scale of each behaviour are rated. The total score is calculated by summing the 12 F×S scores yielding a range of 0–144. Clinically relevant determinations or changes of a symptom are defined by a score of ≥4 points (41). A 5-point scale for professional caregivers' occupational disruptiveness was developed separately, to allow an assessment of the impact of behavioural disturbances on professional caregivers. In accordance with the proposal of the European Alzheimer's Disease Consortium (EADC) the neuropsychiatric symptoms were grouped into hyperactive (agitated), affective (caused by mood-changes), psychotic, and apathic behaviour clusters (42). The validity and interrater and test-retest reliability of the NPI-NH have been well established in several languages including Dutch (37, 41). The Cronbach's alpha varied from 0.71–0.83 for NPI-NH frequency scores and from 0.73–0.81 for severity scores for T0, T1, T2 and T3 in this study.

The QUALIDEM has repeatedly been shown to be one of the most suitable QoL instruments to use for people with dementia in nursing homes (43). The original Dutch version of the QUALIDEM consists of 40 items describing observable behaviour in nine different subscales concerning relationships with staff (7) or other residents (6), positive or negative affect (9), restless behaviour (3), feeling at home (4), isolation (3), having something to do (2), positive self-image (3) and three additional questions (concerning eating and preferring to lie in bed). The four response options were never, seldom, sometimes, and often. The QUALIDEM has good reliability (38) and the Cronbach's alpha varied from 0.84 to 0.89 for T0, T1, T2 and T3 in this study.

Secondary outcomes concerned the Cantril's ladder (44) to assess well-being, the observational instrument "Kommunikationsfahigkeit bei demenzkranken Menschen" (KODEM) to assess communication behaviour and the observational instrument positive response scale (PRS) to assess well-being (45, 46). The results of the analyses of the Cantril's ladder, in which the person with dementia used a visual scale to indicate how he/she feels immediately before and after each session, are published in our process evaluation (32). The correct interpretation of the observations of the observational scales CODEM and PRS proved to be very complicated in practice. In the PRS, for example, the emotion crying is scored negatively, while during music therapy, crying can be a positive emotion for someone with dementia who has difficulty showing emotions. The goal of music therapy may be to give space to someone's grief or emotions. Because the complexity of analyzing the observational data, the data requires thorough study in order to properly interpret its validity and psychometric properties. The results will be published elsewhere.

Statistical analysis

First, descriptive statistics were computed for the key variables (NPI-NH and Qualidem) and important background variables (age, gender, Global Deterioration Scale score, dementia type, educational level) (Table 1). Differences between the experimental groups of the key variables at baseline for the background variables were checked using the *F*-test (ANOVA). The data were then reshaped to be in long-format, making each record correspond to a measurement. In the long-format data of the measurements were nested within the subjects.

Next, multilevel analyses (MLA) (47) were performed with the package lme4 (48) in R (49), to explore the effects of the interventions on the various subscales of the Qualidem and the NPI-NH total score and cluster scores (clusters: hyperactive, psychotic, affective, apathic and occupational disruptiveness). MLA deals with nested data, and in this study time points are nested within subjects. Multilevel analysis is an alternative for repeated measures (RM) ANOVA, which has several advantages. The assumptions underlying MLA are less strict than for RM-ANOVA. Contrary to RM-ANOVA MLA can analyse subjects with missing data at one or more time points which makes MLA more efficient. MLA distinguishes between fixed and random effects. In our model we specified one random effect: the intercept, which means we allow the intercepts to vary across subjects. This

TABLE 1 Baseline characteristics of people with dementia.

	IMTI (*n* = 49)	IMLI (*n* = 56)	CONTROL (*n* = 53)	THE WHOLE SAMPLE (*N* = 158)	*p*-value (2-sided)
Age, years, mean (SD)	81.7 (7.6)	81.8 (9.3)	82.3 (9.9)	81.9 (9.0)	0.93
Gender, *n* (%)					0.05
Females	30 (61.2)	43 (76.8)	29 (54.7)	102 (64.6)	
Males	19 (38.8)	13 (23.2)	24 (45.3)	56 (35.4)	
Global Deterioration Scale (GDS), *n* (%)					0.64
No cognitive decline	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Very mild cognitive decline	1 (2.1)	0 (0.0)	1 (1.9)	2 (1.3)	
Mild cognitive decline	2 (4.2)	2 (3.6)	0 (0.0)	4 (2.5)	
Moderate cognitive decline	3 (6.3)	4 (7.1)	2 (3.8)	9 (5.7)	
Moderately severe cognitive decline	14 (29.2)	20 (35.7)	12 (22.6)	46 (29.3)	
Severe cognitive decline	14 (29.2)	22 (39.3)	22 (41.5)	58 (36.9)	
Very severe cognitive decline	7 (14.6)	0 (0.0)	0 (0.0)	7 (4.5)	
Mixed/changing GDS	7 (14.6)	8 (14.3)	16 (30.2)	31 (19.7)	
Dementia type, *n* (%)					0.55
Alzheimer dementia	23 (54.8)	25 (51.0)	21 (51.2)	69 (52.3)	
Vascular dementia	6 (14.3)	10 (20.4)	3 (7.3)	19 (14.4)	
Lewy body dementia	1 (2.0)	0 (0.0)	0 (0.0)	1 (0.8)	
Frontotemporal dementia	3 (7.1)	2 (4.1)	3 (7.3)	8 (6.1)	
Korsakov dementia	2 (4.8)	1 (2.0)	2 (4.9)	5 (3.8)	
Young onset dementia	0 (0.0)	0 (0.0)	1 (2.4)	1 (0.8)	
Parkinson dementia	2 (4.8)	1 (2.0)	0 (0.0)	3 (2.3)	
Education, *n* (%)					0.19
<6 years low education	0 (0.0)	0 (0.0)	1 (5.0)	1 (1.5)	
6 years low education	1 (5.6)	2 (7.4)	3 (15.0)	6 (9.2)	
High school	1 (5.6)	7 (27.9)	3 (15)	11 (16.9)	
Intermediate vocational education	10	14	9	33 (20.9)	
Bachelor degree	5 (27.8)	4 (14.8)	2 (10.0)	11 (16.9)	
Master degree	1 (5.6)	0 (0.0)	2 (10.0)	3 (4.6)	
NPI-NH, mean (SD)					0.05
NPI-NH cluster psychotic (domain delusions + hallucinations)	2.6 (5.1)	4.0 (6.3)	2.6 (5.6)	3.1 (5.7)	0.38
NPI-NH cluster affective (domain depression + anxiety)	3.4 (4.2)	3.3 (4.9)	4.6 (5.7)	3.8 (5.0)	0.33
NPI-NH cluster apathic (domain apathy)	3.0 (4.0)	2.4 (3.5)	2.8 (4.0)	2.8 (3.8)	0.70
NPI-NH cluster hyperactive (domain irritability + disinhibition + agitation + aberrant motor behaviour)	11.7 (9.8)	18.0 (11.1)	11.3 (12.7)	13.7 (11.6)	0.00
NPI-NH total score	25.4 (19.9)	34.6 (18.6)	26.3 (22.7)	28.9 (20.8)	0.05

(Continued)

TABLE 1 (Continued)

	IMTI (n = 49)	IMLI (n = 56)	CONTROL (n = 53)	THE WHOLE SAMPLE (N = 158)	p-value (2-sided)
Occupational disruptiveness score	10.5 (8.2)	12.9 (7.0)	10.3 (8.2)	11.3 (7.8)	0.19
QUALIDEM, mean (SD)					
A: Care relationship	14.2 (5.2)	13.5 (4.8)	15 (6.33)	14.2 (5.5)	0.37
B: Positive affect	13.9 (3.5)	14.9 (3.2)	14.1 (4.0)	14.3 (3.6)	0.34
C: Negative affect	6.1 (2.2)	5.9 (2.7)	5.7 (2.5)	5.9 (2.5)	0.70
D: Restless behaviour	5.2 (2.4)	4 (3.0)	5 (3.1)	4.7 (2.9)	0.08
E: Positive self-image	7.4 (2.5)	7.7 (2.3)	7.1 (2.2)	7.4 (2.4)	0.47
F: Social relations	11.1 (3.8)	10.8 (3.8)	10.3 (4.0)	10.7 (3.9)	0.60
G: Social isolation	6.8 (2.3)	5.7 (2.4)	6.5 (2.4)	6.3 (2.3)	0.06
H: Feeling at home	10 (2.5)	10.1 (2.1)	9.5 (2.5)	9.9 (2.4)	0.50
I: Something to do	2.2 (2.1)	2.4 (2.2)	2.1 (1.7)	2.3 (2.0)	0.76

SD, standard deviation; IMTI, individual music therapy intervention; IMLI, individual music listening intervention; NPI-NH, Neuropsychiatric Inventory-Nursing Home version.

implies that we expect that subjects differ in the value of the dependent variable at T0. The intra class correlation (ICC) indicates how much variance can be attributed to the subjects (50). In the results we focus on the fixed effects which can roughly be interpreted as regression coefficients. In addition, a per protocol analysis was performed in which only people were selected who attended five sessions or more in the IMTI and IMLI.

Ethical considerations

The study protocol was approved by the Dutch Medical Ethical Committee (METC No. 17-T-30) and registered at the International Clinical Trials Registry Platform (ICTRP) (Identifier: NL8861).

Results

Baseline data

The CONSORT diagram in Figure 1 details the subject selection and allocation procedures. In total 172 people with dementia were assessed for eligibility of which 14 people with dementia were excluded. In total 158 people with dementia were randomly assigned to the IMTI group (n = 49), IMLI group (n = 56) or control group (n = 53). The dropout rate from baseline to 3 weeks post-intervention was 5.7% (9 of 158) and the dropout rate from 3 to 6 weeks follow-up was 4.4% (7 of 158). Attrition analyses of subjects that completed the study compared to participants that discontinued the study showed no significant differences in background variables ($p > 0.05$). The treatment compliance differed between the two intervention groups: in total 44 participants allocated to the IMTI group, and 27 participants allocated to the IMLI group followed 5–9 sessions (Table 2).

Multilevel analyses on NPI-NH

The results of the MLA's on the NPI-NH total and cluster scores are given in Figure 2. All groups, including the control group, showed a statistically significant reduction of the total NPI-NH score at T1, T2 and T3 (Table 3). As shown in Figure 2, the results of the MLA's on the NPI-NH clusters, especially for the outcome clusters hyperactive and occupational disruptiveness, visually indicate a reduction of both intervention groups at T2 and T3 in comparison with the control group. For the cluster hyperactive, this reduction is statistically significant for the IMLI group at T3 ($p = 0.03$) (Table 4). The ICC is 0.64 for the NPI-NH.

Multilevel analyses on Qualidem

The results of the MLA's on the Qualidem subscales are given in Figure 3. The IMTI group showed, in comparison with the IMLI and control group, visually improved scores of the subscale outcomes care relationship, positive affect, negative affect, restless behaviour and social isolation at T2 and T3. For the subscale restless behaviour, this concerns a statistically significant improvement at T2 ($p = 0.00$) and T3 ($p = 0.01$) for the IMTI group (Table 5). This effect is illustrated in Figure 4. The vertical lines represent the confidence intervals around the predictions. The ICC is 0.77 for the Qualidem.

Multilevel per protocol analyses

Per protocol analyses,[1] in which only people were selected who attended five sessions or more in the IMTI (n = 44) and IMLI group

1 Per protocol analyses on request available via first author.

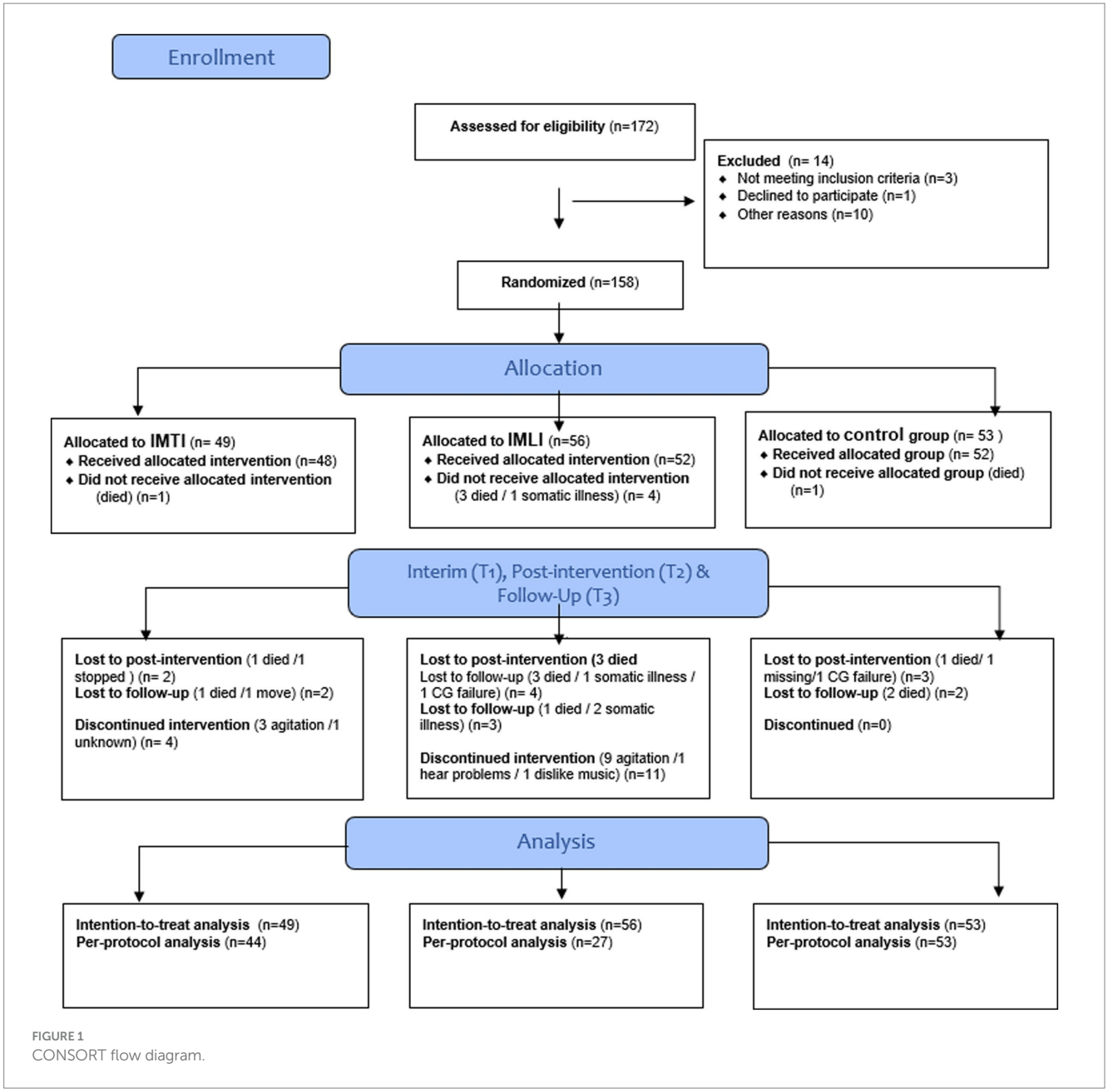

FIGURE 1
CONSORT flow diagram.

($n = 27$) showed no major differences or different significant effects compared to the intention-to-treat analysis.

Discussion

The results of this multicenter single blind RCT ($N = 158$) showed some beneficial effects of the intervention groups (IMTI and IMLI) on neuropsychiatric symptoms and quality of life in people with dementia. For the total score of NPI-NH, the IMLI group showed a statistically significant reduction for the cluster "hyperactive" at follow-up measurement (T3). Furthermore, the IMTI group showed a significant improvement of the Qualidem subscale "restless behaviour" at post measurement (T2) and this effect persisted for 3 weeks after the intervention (T3).

TABLE 2 Frequencies per condition.

	Full sample (intention to treat analysis)	Followed all 9 sessions	Followed ≥5 sessions (per protocol analysis)
Control	53	53	53
IMTI	49	34	44
IMLI	56	15	27
Total	158	102	124

Our results are partly in line with results of previous studies, in which music therapy and other music interventions for dementia have been shown to improve QoL and NPS, but effects on which specific NPS and QoL outcomes differ. The latest published Cochrane review

10.3389/fmed.2024.1304349

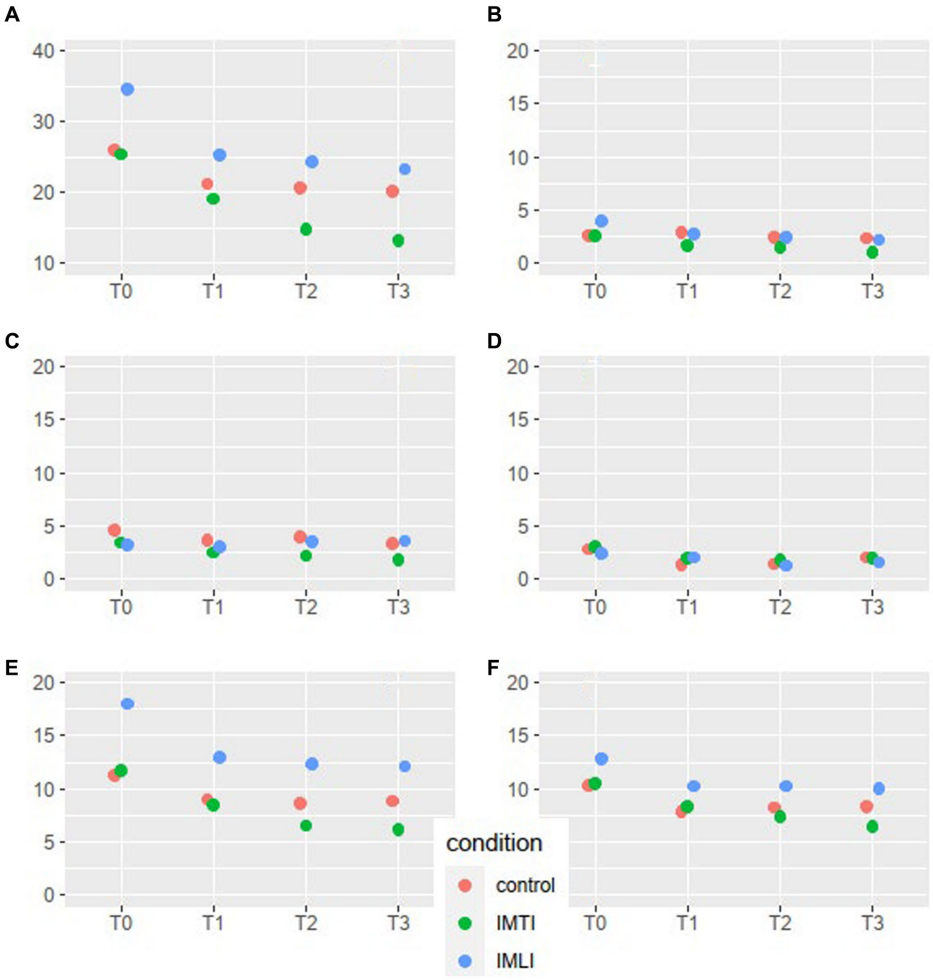

FIGURE 2
NPI-NH total score and cluster means per condition and time point for all subjects. The scales of the NPI-NH are: A = total score, B = cluster psychotic, C = cluster affective, D = cluster apathic, E = cluster hyperactive, F = occupational disruptiveness.

TABLE 3 **Multilevel analyses NPI-NH total score.**

	Estimate	SE	df	*t*	*p*	95% CI lower limit	95% CI upper limit
(Intercept)	26.294	2.77	250.3	9.50	0.000	20.91	31.68
IMTI	−0.898	3.97	250.3	−0.23	0.821	−8.63	6.84
IMLI	8.321	3.89	250.3	2.14	0.034	0.74	15.90
TimeT1	−5.034	2.31	422.6	−2.18	0.030	−9.52	−0.55
Timet2	−5.747	2.31	422.9	−2.49	0.013	−10.23	−1.26
TimeT3	−5.923	2.31	422.9	−2.57	0.011	−10.41	−1.44
IMTI:timeT1	−1.368	3.31	421.7	−0.41	0.680	−7.80	5.07
IMLI:timeT1	−4.637	3.26	422.7	−1.42	0.155	−10.96	1.69
IMTI:timeT2	−4.052	3.29	421.7	−1.23	0.219	−10.45	2.34
IMLI:timeT2	−4.674	3.23	422.4	−1.45	0.148	−10.94	1.59
IMTI:timeT3	−5.646	3.31	422.1	−1.70	0.089	−12.09	0.79
IMLI:timeT3	−5.144	3.26	422.9	−1.58	0.115	−11.47	1.19

TABLE 4 Multilevel analyse NPI-NH cluster E: hyperactive.

	Estimate	SE	df	*t*	*p*	95% CI lower limit	95% CI upper limit
(Intercept)	11.275	1.50	228.5	7.53	0.000	8.36	14.19
IMTI	0.434	2.15	228.5	0.20	0.840	−3.76	4.62
IMLI	6.725	2.11	228.5	3.19	0.002	2.62	10.83
TimeT1	−2.161	1.14	421.8	−1.89	0.059	−4.38	0.06
TimeT2	−2.636	1.14	422.2	−2.31	0.022	−4.86	−0.41
TimeT3	−2.327	1.14	422.2	−2.04	0.042	−4.55	−0.11
IMTI:timeT1	−1.035	1.64	421.1	−0.63	0.528	−4.22	2.15
IMLI:timeT1	−2.987	1.61	422.0	−1.85	0.065	−6.12	0.15
IMTI:timeT2	−2.614	1.63	421.1	−1.60	0.109	−5.78	0.55
IMLI:timeT2	−2.946	1.60	421.7	−1.84	0.066	−6.05	0.16
IMTI:timeT3	−3.050	1.64	421.4	−1.86	0.064	−6.24	0.14
IMLI:timeT3	−3.450	1.61	422.1	−2.14	0.033	−6.59	−0.31

TABLE 5 Multilevel analyse Qualidem subscale D: restless behaviour.

	Estimate	SE	df	*t*	*p*	95% CI lower limit	95% CI upper limit
(Intercept)	4.961	0.40	210.7	12.52	0.000	4.19	5.73
IMTI	0.206	0.57	210.7	0.36	0.718	−0.90	1.31
IMLI	−0.999	0.56	210.7	−1.79	0.075	−2.09	0.09
Timet1	−0.171	0.27	423.1	−0.63	0.529	−0.70	0.36
TimeT2	−0.281	0.27	423.6	−1.02	0.306	−0.81	0.25
TimeT3	0.028	0.27	423.6	0.10	0.920	−0.51	0.56
IMTI:timeT1	0.681	0.39	422.4	1.74	0.082	−0.08	1.44
IMLI:timeT1	0.646	0.39	423.3	1.68	0.094	−0.10	1.39
IMTI:timeT2	1.223	0.39	422.7	3.13	0.002	0.46	1.98
IMLI:timeT2	0.664	0.38	423.2	1.73	0.084	−0.08	1.41
IMTI:timeT3	1.040	0.39	422.9	2.64	0.008	0.28	1.80
IMLI:timeT3	0.305	0.39	423.5	0.79	0.431	−0.45	1.06

Higher positive scores refer to less restless behaviour.

(16) reported moderate-quality evidence that the music-based therapeutic interventions reduce depressive symptoms and no or low-quality evidence that the interventions may improve quality of life or decrease agitation. Previous studies on the specific treatment of depression have shown that a longer treatment duration than 3 weeks is needed, what might explain that we found no specific significant effects on the outcome NPI cluster "affective" in our study. A systematic review from Lam et al. (24) reports significant effects of both active and passive music therapy (music listening) on the outcomes anxiety, depression, quality of life and apathy. When music listening was the primary intervention they also reported significantly reduced agitation.

When focusing specifically at studies comparing active versus receptive music based interventions also varying results are found on NPS. In people with mild-to moderate dementia, Sarkämo et al. (51, 52) found that although both types of music intervention (singing and music listening) are effective for depressive symptoms, the pattern of improvement may be different between them. In moderate-severe dementia, Sakamoto et al. (53) reported that both kinds of intervention (active and receptive) have relaxing effects by parasympathetic activation, but active music intervention caused a greater reduction in behavioural problems. Raglio et al. (54, 55) reported higher effects of active music therapy than music listening on behavioural symptoms although the results did not reach statistical significance. More recently, Gómez-Gallego et al. (56) showed, when comparing active group music intervention versus group music listening in people with dementia, that active music therapy may improve behaviour (measured with NPI) of mild-to-moderate dementia residents. Instead, music listening had only a stabilizing effect on behaviour compared to the control intervention. However, a meta-analysis concluded that receptive music interventions may be more effective than active music therapy interventions in reducing anxiety, agitation, and other behavioural symptoms (57).

It is difficult to compare our results to other studies, because of limitations of the studies included in the cited reviews and

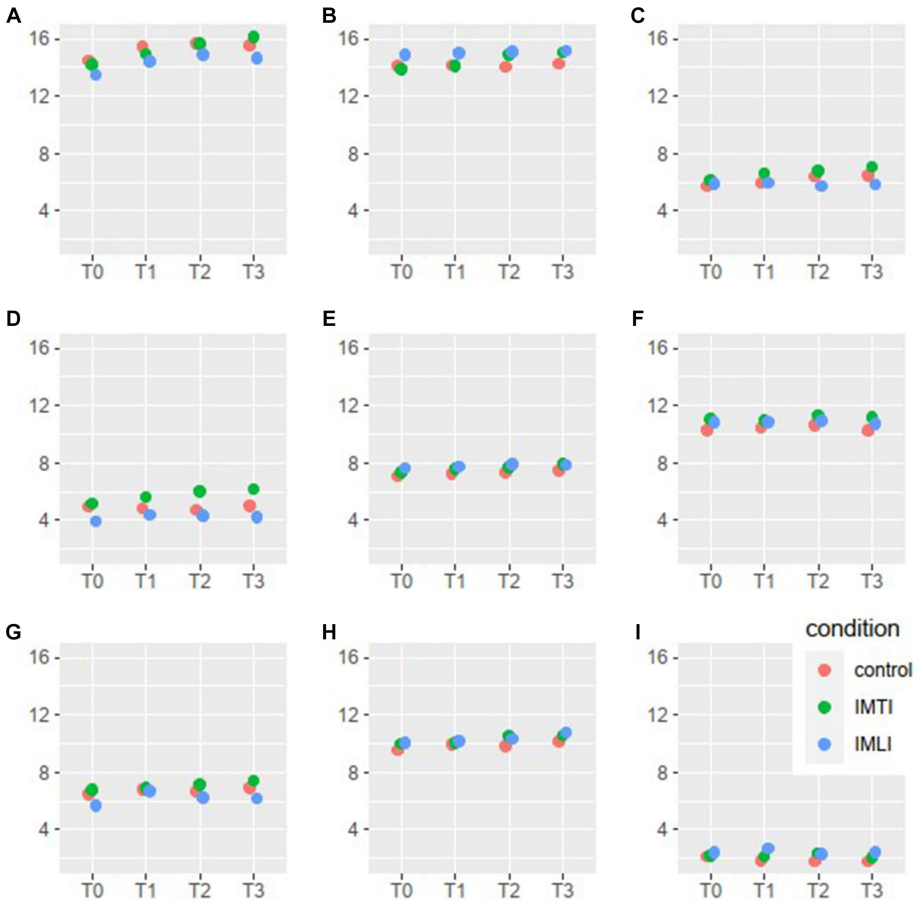

FIGURE 3
Qualidem subscales means per condition and time point. The 9 subscales of the Qualidem are A = care relationship, B = positive affect, C = negative affect, D = restless behaviour, E = positive self-image, F = social relations, G = social isolation, H = feeling at home, I = something to do.

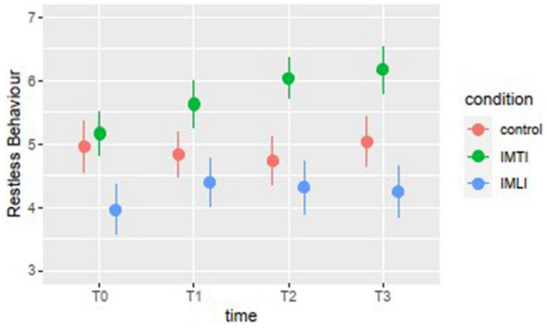

FIGURE 4
Subscale means "Restless behaviour" Qualidem.

meta-analyses because of low participant numbers, lack of standardized music therapy and high heterogeneity in outcome measures used. Furthermore, the comparison of our study results with other studies focusing on music interventions is difficult due to heterogeneous study designs, variations in duration and frequency of the studied music interventions, variations in supervisor (for example well educated music therapist or a (in)formal caregiver), variations in setting (group of individual sessions), variations in living environment of the participants (living in a nursing home or living at home) and variations in dementia stages and types. At the same time, this heterogeneity in population, outcome and intervention serves a purpose in clinical practice, in which a psychosocial intervention such as a music (therapy) intervention must be tailored to the needs of people with dementia and their caregivers.

Strengths and limitations

A main strength is that that the planned sample size was achieved with adequate power. Small sample sizes or low recruitment rates often limit the success of comparable research studies (58), approximately 50% of clinical trials fall short of reaching their recruitment targets (59). Results of a recent review from Baker et al. (58), with the aim of researching the percentage of music therapy studies of people living with dementia met their target sample size, showed that only one study from the 14 studies reviewed (music therapy delivered in people with dementia living in nursing homes) reached 89% of its target sample size. Only five studies had a RCT design and only one study had a sample size over 100 ($N = 117$). Other sample sizes concerned less than 50 participants in total. At the same

time, this power has to be seen in relation to treatment compliance, which was low for the IMLI group in our study. However, per protocol analyses, in which only people were selected who attended five sessions or more in the IMTI and IMLI group showed no different results compared to the intention-to-treat analysis. With the knowledge that recruitment in nursing homes is complex, challenging, and needs thorough planning (60), during the preparation of this RCT a lot of effort has been put by the research team into personal contacts with care organizations (from work floor to management). In each residential care organization, a local clinical research coordinator was appointed as a linking pin between clients, practitioners and policy makers, mostly a psychologist.

Another strength of our study concerned that the IMTI and IMLI were consensus-based developed together with music therapists specialized in dementia care and that the IMTI and IMLI were highly detailed described (32). In a recent study, Hakvoort and Tönjes (61) concluded that a lack of a clear description of the used intervention determines the inclusive effects of music (therapy) interventions described in systematic reviews and meta-analyses. Hakvoort and Tönjes presented three possible solutions to bridge the gap between research outcomes and practice: Create highly specific and detailed described music (therapy) interventions, develop consensus-based music therapy interventions (62) and to better define, understand, and formulate music (therapy) interventions using a shorter time frame. Regarding this last solution, most music (therapy) interventions have a duration of three to 6 months (63, 64). However, the results of these studies show that it is difficult to ascertain that change resulted solely from that music (therapy) intervention, as there were too many confounding factors (61). The IMTI and IMLI had a compact duration of 3 weeks with a high frequency of sessions (three times a week). This compact duration could also be raised as a limitation, but during the development of the interventions for this study this duration and high frequency were recommended by experienced music therapists working in elderly care. As far as we know, investigating the effects of high-frequency music therapy has not been studied before.

Nevertheless, there were several limitations. A limitation concerned that the IMLI intervention in practice was offered less often than prescribed according to protocol (9 sessions); also, the aim of the IMLI intervention protocol was to carry out the intervention by the same professional involved carer (IMLI) for each participant, but in practice this often proved to be unfeasible. To offer the IMLI according protocol was not always feasible in clinical practice because of changing duty schedules, staff movement, illness and work pressure among professional caregivers. These limitations did not apply to the IMTI, because the IMTI was offered by external independent music therapists who were not burdened with internal workload or changing duty schedules. Furthermore, the involved professional caregivers did not always keep track of which interventions and/or activities the control group received. As a result, there was not a complete overview of the care received in the control group. However, the control group did not receive any music(therapy) intervention or activity at all. In addition, it was not possible to double blind the study because the allocation of participants to the IMTI and IMLI could not be blinded from either the participant or the involved music therapists and professional caregivers. On the other hand, research assistants were blinded to treatment assignment. Completely controlling the environment and all confounding factors is often not possible in a nursing home environment and therefore it is important to be aware of these limitations and not distracted by them, because a single blind design is often the only option in this kind of research (60, 65).

Future directions for clinical practice

Alongside this RCT, we performed a process evaluation with qualitative research in which the experiences of music therapists, professional and informal caregivers with both interventions have been researched. The results of this qualitative evaluation (32) showed that it is important that music therapists are involved in composing personalized music playlists and that music therapists can coach/supervise professional and informal caregivers in offering a music listening intervention. Both carers and music therapists recommended that experiences and gained insights from music therapists during the music therapy sessions have to be integrated into the IMLI by the involved music therapists and transferred under supervision to the (in)formal caregiver. For example, which music preference is for a person with dementia in which situation the best to reduce problem behaviour and at what times a listening intervention can best be offered to a specific person/situation. The results of this RCT showed some beneficial effects of both intervention groups (IMTI and IMLI), where the IMTI appears to be slightly more effective in reducing restless behaviour (Qualidem) and the IMLI appears to be slightly more effective in decreasing hyperactive behaviour (NPI-NH). By combining both the IMTI and IMLI interventions (IMLI as an extension of the IMTI intervention), the music therapy intervention can be continued outside the music therapy sessions (for example, during difficult situations in which problem behaviour arises) by informal caregivers under supervision of a music therapist at a distance. Perhaps a cumulative effect of both interventions can then be achieved in clinical practice. Although this was not investigated in this trial.

Future directions for research

Various types of rating scales are used to measure the effects of music (therapy) interventions in people with dementia on NPS (for example NPI (different versions), CMAI, BEHAVE-AD and Global Depression Scale), and quality of life (for example QOL-AD, DQOL, Barthel Index, CBSQoL) (66). This makes it impossible to compare results between studies, and it may prevent from establishing evidence. For future research, to contribute to the accumulation of evidence for music therapy and to conduct good meta-analyses, it is important to standardize the rating scales. A standardized core outcome set (COS), consensus-derived, standardized, and parsimonious collection of outcomes to be reported at minimum in music (therapy) studies for people with dementia, can help to establish evidence in clinical research (67–70). However, there is no COS for music therapy for dementia currently; it will help if future research focuses on composing a COS.

Furthermore, for future research it's necessary to get more insight into the mechanisms of evidence-based music (therapy) interventions on reducing NPS in persons with dementia living in nursing homes. This will allow a more personalized approach in

reducing NPS and a better prediction and monitoring the effects of these interventions for future large-scale clinical studies. At this moment, specific mechanisms that may explain these effects in persons with dementia are mostly based on theoretical insights such as down or up regulating tempo of the music or tempo has effect on arousal regulation by and moving to rhythm of music which will ameliorate positive affect (71). Empirical studies examining the mechanisms of music (therapy) interventions in persons with dementia are scarce.

In addition, we would like to stress the importance of a mixed method design (quantitative and qualitative data collection) when conducting an effectiveness study of a psychosocial intervention like a music (therapy) intervention. Information gathered through qualitative methods, in addition to the quantitative data of a RCT, contributes to valuable insights for the implementation of an intervention. Qualitative research can assist in understanding the meaning and active mechanisms of an intervention to clients as well as clients' beliefs about the treatment and expectations of the outcome. Besides, qualitative research is helpful in developing appropriate outcome measures for music therapy interventions. This is in line with a review, aimed at exploring what existing qualitative studies reveal about the implementation, effects and processes of psychosocial interventions for dementia (72).

Furthermore, we see a trend in which researchers are searching for alternatives to "randomized controlled trials" (RCTs), the gold standard in research (73). The search for such alternatives is especially interesting in complex interventions, which often consist of multiple components, often focus on multiple behaviours, require expertise and skills from those offering them and that take place in a rapidly changing reality over which the researcher does not always have influence (74). These characteristics of complex interventions are very recognizable for arts therapies interventions and for interventions for vulnerable people, like people with dementia. That is why alternatives are sought and applied within clinical research, like the 'single case experimental design' (SCED). The SCED is a pragmatic design that allows effects to be measured with a small number of participants (approximately 10–15). Repeated measurements per participant before, during and after the intervention provide insight into the effectiveness of an intervention. The participant then serves as control for himself. A gradual design, in which the intervention starts at a different time for the different participants, takes more into account that the results can be attributed to the intervention rather than influences from the context. A mixed method approach and the search for alternative designs shows that complex interventions for vulnerable people in the future can be investigated not only according to the classical RCT method but also with alternative, perhaps more suitable, designs.

Finally, there is an increasing tendency wherein people with dementia are remaining at home as long as possible. In the last decade, the proportion of people with dementia living in nursing homes has begun to decline in Western European countries, consistent with policy initiatives to provide care at home where possible in the face of growing numbers of people living with dementia (75). So, there is a great need for psychosocial interventions reducing problem behaviour and improving quality of life of people living with dementia at home. The IMTI and IMLI might also have potential to reduce problem behaviour and improve QoL for home living people with dementia and their caregivers. For future research it's also worthwhile to study the effects of IMTI and IMLI for home living people with dementia.

Conclusion

Music (therapy) interventions should be considered in dementia care in case of problem behaviour. Since there is no convincing evidence to suggest that one form of music-based intervention is more effective than the other, both individual active music therapy and individual receptive music listening interventions could be considered in clinical practice. This is in line with the NICE guidelines (76) and the Dutch guideline "Problem behaviour in people with dementia" which advise to start with a non-pharmacological treatment Zuidema and Smallbrugge (13), such as music therapy (77).

For the future, we advise further research into the sustainability of the effects and the differences between IMTI and IMLI, also in connection with the question of whether you should do IMLI as standard and IMTI for a selected group and/or combine both interventions to see if there is a cumulative effect. In addition, for a complex intervention in vulnerable people we advise to experiment with alternative, perhaps more suitable designs like the SCED for music (therapy) interventions in people with dementia, so that fewer large samples are needed.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Dutch Medical Ethical Committee (METC No. 17-T-30). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

A-EP: Writing – original draft, Writing – review & editing. SZ: Writing – original draft, Writing – review & editing. PD: Writing – original draft, Writing – review & editing. PV: Formal analysis, Methodology, Writing – review & editing. AV: Writing – original draft, Writing – review & editing. JS: Writing – original draft, Writing – review & editing. SH: Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2024.1304349/full#supplementary-material

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