An Alternative Approach to Dementia Care: Systematic Literature Review on Types of Music Interventions and Their Applicability

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Abstract

Nowadays, dementia is becoming increasingly prevalent. Few treatment approaches effectively target the management behavioral and psychological symptoms of dementia (BPSD). This systematic literature review examines the applicability of music therapy for targeting BPSD and increasing quality of life for people with dementia. First, the quality of the included studies was assessed and ranked hierarchically. Next, music therapy components which were included in the delivered interventions were extracted and reported. Lastly, it was extracted which psychological outcome variables were affected by music interventions in samples of people with dementia. These results were discussed and compared, taking into account the determined quality of the studies. Data was retrieved from Scopus, PubMed, and Web of Science. In total, 12 studies were selected, including only randomized controlled trials exploring the effects of music interventions on psychological outcome variables in a sample of dementia care patients. Results showed that the most common music intervention utilized in dementia care was active group music interventions, integrating multiple music therapy strategies such as singing, movements, or playing musical instruments at the same time. Based on these findings, music interventions can alleviate emotional, behavioral, and cognitive complaints, and improve quality of life. This systematic review suggests that music interventions are a viable approach for managing BPSD in dementia patients. The limitations of this literature review are discussed in the discussion section. Future research should examine the role of type of dementia, type of music intervention, and dementia severity and their interaction in music intervention research for dementia care patients.

Keywords: dementia, music interventions, music therapy, randomized controlled trials, systematic literature review

Introduction

In today's society, dementia is a disease which many of us are to some degree familiar with. Those of us who are fortunate enough to not have a family member who is affected, most likely do know someone in their proximate surroundings, or have at least heard about the neurocognitive disorder on the news. Dementia is an umbrella term for progressive degenerative brain syndromes which are affecting an individual's memory structure and causing cognitive, behavioral, motor, and affective disruptions (Alzheimer's Disease International (ADI), 2021). Dementia is the seventh leading global cause of morbidity and currently, 55 million people worldwide are diagnosed with dementia (ADI, 2021; World Health Organization (WHO), 2021). It is most prevalent in adults over the age of 65 and twice as common in women (ADI, 2021). More importantly however, the prevalence rate of dementia is estimated to reach 78 million worldwide by 2030 (ADI, 2021). This is relevant because dementia dramatically impacts the individual, their immediate surroundings, and society as a whole. The functional abilities of affected individuals rapidly decrease, making them dependent on external help and support (WHO, 2021). In most cases, informal caregivers take on a large portion of care for people living with dementia (WHO, 2021). The term informal caregiver refers to anyone providing care to someone in need, typically without financial reimbursement (John Hopkins Medicine, n.d.). Caring for a dementia patient is cognitively, physically, and emotionally challenging, and that is disregarding the additional financial stresses that come with providing informal care to dementia patients (WHO, 2021). These demands for informal caregivers increase over time as dementia is progressive and advances through increasingly severe stages of cognitive decline, thus making intensive long-term and in-patient care unavoidable (ADI, 2021). In short, dementia and its symptoms not only influence the affected individual, but further impact the patient's immediate surroundings as well.

On a societal level, dementia care creates both direct and indirect economic burden. Firstly, social and health care systems provide direct financial support to the affected individual and their caregivers (Wimo, Jönsson, Bond, Prince, & Winblad, 2013). Secondly, those who care for dementia patients tend to leave their primary employment, thus no longer generating taxable income and losing a significant portion of their disposable budget (Wimo et al., 2013). The global societal cost of dementia care resulting from the direct and indirect economic burden is estimated to be around 1.3 trillion $US (WHO, 2021). With the large amounts of personal and

societal resources that are being invested in dementia care, the disease creates a significant global social burden (ADI, 2021; WHO, 2021). Furthermore, the global population is continuously ageing, and as already forecast by the Alzheimer Disease International, the global burden of dementia can thus only be expected to increase in the future (ADI, 2021), especially considering that age is the strongest known risk factor for dementia (WHO, 2021). It follows that questions about dementia care provision and financing are becoming increasingly important as the current health care systems and providers may at some point reach their limits (Seitz, Purandare, & Conn, 2010).

Behavioral and psychological symptoms of dementia (BPSD) are positively associated with patient and caregiver distress, rising health care costs, and long-term hospital stays (Cerejeira, Lagarto, & Mukaetova-Ladinska, 2012). Furthermore, BPSD correlate with the functional abilities of people living with dementia and play a key role in the well-being and quality of life in both patients and their caretakers (Cerejeira et al., 2012; Crespo, Hornillos, & De Quirós, 2012; McKeith & Cummings, 2005). It follows that interventions in dementia care should target, or at least include, strategies for reducing or managing BPSD. However, most therapy approaches that are applied in daily dementia care combine pharmacotherapy with cognitive strategies (Grand, Caspar, & MacDonald, 2011). Generally, those interventions target the decline in functional and cognitive abilities seen in patients living with dementia (Grand et al., 2011), which improves cognitive functioning only among people with mild to moderate dementia and only during early stages of dementia (Kasl-Godley & Gatz, 2000; Saragih, Tonapa, Saragih, & Lee, 2022).

Currently, there is no treatment available to cure or modify the clinical presentation of dementia (WHO, 2021). Pharmacological treatment approaches, such as acetylcholinesterase inhibitors (Donepezil, Galantamine, Rivastigmine), target neurotransmitters associated with memory in hope of altering the disease's course (Birks, 2006). However, pharmacological interventions and psychotropic medication show only a limited effect on BPSD and adverse side effects such as nausea, vomiting, or diarrhea, may occur (Dyer, Harrison, Laver, Whitehead, & Crotty, 2018; Kavirajan & Schneider, 2007; Laver, Dyer, Whitehead, Clemson, & Crotty, 2016; WHO, 2021). Cognitive-behavior therapy (CBT) is a non-pharmacological alternative and is often used to build coping strategies and reduce distress (Kasl-Godley et al., 2000). Although CBT is promising for problem solving and managing problem behaviors of dementia patients by

increasing desired behaviors and reducing non-desired behaviors, this treatment approach is only applicable during early stages of dementia (Kasl-Godley et al., 2000). In later stages, cognitive abilities have declined to such extent that cognitive therapy cannot be executed anymore (Kasl-Godley et al., 2000) and thus, a different approach is needed.

Music therapy may be a viable non-pharmacological treatment approach for alleviating behavioral and psychological symptoms in people living with dementia in later stages of the disease. Music is widely accessible, can be customized to a patients' abilities and needs, and is cost-effective in comparison to other treatment approaches (Baird & Samson, 2015; Vink, Bruinsma, & Scholten, 2003). Furthermore, music therapy avoids adverse effects of psychotropic medications and show potential to reduce BPSD in people living with dementia (Ballard, Waite, & Birks, 2006; Paul & Ramsey, 2000; Vink et al., 2003). Health benefits of music interventions are numerous: they have been shown to increase quality of life (Blackburn & Bradshaw, 2014; Kishita, Backhouse, & Mioshi, 2020; Park, 2015) and to improve mood and decrease depression and anxiety in patients with dementia (Biasutti & Mangiacotti, 2021; Cooke, Moyle, Shum, Harrison, & Murfield, 2010a,b; Guétin et al., 2009; Hars, Hermann, Gold, Rizzoli, & Trombetti, 2014; Park, 2015). Music therapy may further promote healthy ageing (Park, 2015) and brain plasticity across the lifespan (Wan & Schlaug, 2010). Most importantly, music therapy is preverbal and thus can be applied to populations that have issues addressing their problems verbally, such as patients with dementia (Gold, Solli, Krüger, & Lie, 2009). Therefore, this systematic review explores the effects of music interventions on BPSD in patients with dementia.

In this review, music therapy refers to the "...systematic process of intervention wherein the therapist helps the client promote health, using music experiences and the relationship that develops through them as dynamic forces of change" (Brusica, 1998, p.20). Music therapy may utilize various methods, including music listening, singing, rhythmic movement, and playing instruments (Paul et al., 2000). Furthermore, music interventions may either be active or receptive. Active music interventions adopt an interactive approach in which participants are encouraged to take part in the musical experience and in the process of music making, for example through singing or playing instruments (Tsoi, Chan, Ng, Lee, Kwok, & Wong, 2018). In comparison, receptive music interventions are less interactive and refer to interventions in which "... the client listens to music and responds to the experience silently, verbally, or in another modality." (Brusica, 1998, p. 113). Systematic literature reviews show that both approaches can

improve psychological and behavioral symptoms of dementia (Vink, Bruinsma, & Scholten, 2003). However, conclusions about the different types of music therapy and their efficacy differ: Vink et al. (2003) found that active music interventions are superior in improving psychological and behavioral symptoms in patients with dementia, whereas Tsoi et al. (2018) found receptive interventions to be more effective. Going more in detail, Tsoi et al. (2018) supplemented the literature review with a meta-analysis and found receptive music interventions significantly reduced anxiety, agitation, behavioral problems, and apathy. Vink et al. (2003), although finding mostly active music interventions to significantly reduce BPSD in patients with dementia, concluded that these findings are weak due to significant risk of biases and methodological limitations of the included studies. Small sample sizes, poor reporting of results and randomization, poor statistical analyses, short intervention periods, and no follow-up assessments are common methodological issues in music therapy research (Grau-Sanchez et al., 2022). The evidence regarding the efficacy of music therapy interventions in the context of dementia care are thus unclear. This review aims to update the review conducted by Tsoi et al. (2018), taking into account the quality of the included trials, and comparing which psychological complaints of dementia patients can be addressed with music interventions.

In short, music therapy may be a viable approach to improve mental health variables in dementia care. However, as mentioned above, existing research that compared the efficacy of different types of music therapy interventions on mental health variables is contradictory. In a feature article, Paul et al. (2000) summarized which factors seem to have an influence on the beneficial therapeutic effects of music. They provide a detailed overview of studies, showing that musical parameters such as rhythm, volume, and pace have a differential effect on participants' physiological responses such as blood pressure, heart rate, muscle tension, and respiratory rate. On the other hand, Mofredji, Alya, Tassaioust, Bahloul, and Mrabet (2016) point out the important role of the relationship between the therapist and the patient in music therapy and argue that it may be a more relevant mechanism of change than the applied music or music therapy methods. Then again, Robb et al. (2018) argue for the importance of basing music interventions on theory, thus driving the intentional use of music and ensuring that the developed interventions are informed by solid research. It becomes evident that simply applying any type and any amount of music intervention does not automatically ensure improved health.

It seems that music interventions must be tailored to the client's specific problem and to the overall goal. This, however, makes standardized treatments and statistical comparisons difficult. O'Callaghan (2003) argues that clinical research cannot capture the interpersonal dimension of music therapy and the complexity of the applied music. Alternatively, Robb et al. (2018) argues that cross-study comparisons in music research are indeed possible. The authors conclude that the problem with cross-study comparisons lies with the lack of proper and detailed descriptions of the performed interventions, not with the fact that music interventions are tailored. In 2010, Robb, Burns, and Carpenter developed the Reporting Guidelines for Music-based Interventions to allow cross-study comparisons and generalization. These guidelines include the seven following criteria: 1) intervention theory, 2) intervention content, 3) intervention delivery schedule, 4) interventionist, 5) treatment fidelity, 6) setting, and 7) unit of delivery. A detailed description of the relevant elements for each category are reported in Table 1 (Appendix A). Although multiple literature reviews have examined and discussed the efficacy and application of music therapy in the context of dementia care, none have taken the application and content of the applied interventions into account, which is relevant for assessing the quality of the included studies and examining whether cross-study comparison is reasonable in the first place.

Based on the previously discussed literature regarding the comparison of music interventions in dementia care, this literature review first investigated the quality of the included music interventions with respect to risk of biases and the quality of reporting according to the Reporting Guidelines for Music-based Interventions as developed by Robb et al. (2010). The second research question, which components are used in music interventions for dementia care, moves on to describe the applied interventions more in-depth according to the Reporting Guidelines for Music-based Interventions. Previous literature reviews grouped the included music interventions according to their approach (active vs. receptive; Tsoi et al., 2018; Vink et al., 2003), which was adopted in this literature review as well. A second distinction was made with regards to the social context: the included music interventions were categorized as taking place in a group setting, or in an individual setting. The last part of the results section is concerned with answering the following third research question: Which psychological outcome variables of dementia patients were affected by music interventions? I reviewed which psychological outcome variables improved over the course of a music intervention. Outcome

variables will be classified as either targeting behavioral, cognitive, or emotional variables. Considering that dementia research has increasingly utilized quality of life as an outcome measure to identify unmet needs of patients (Miranda-Castillo, Woods, Galboda, Oomman, Olojugba, & Orrell, 2010), and that quality of life is a multidimensional construct which cannot be labelled as either behavioral, cognitive, or emotional, quality of life will be a separate category. In order to ensure that only the most reliable evidence is included, only randomized controlled trials were included.

Methods

Search strategy

This systematic literature review followed the Preferred Reporting Items for Systematic Reviews and Menta-Analyses guidelines (PRISMA; Liberati et al., 2009) to answer the given research questions. To identify suitable studies, the databases of Scopus, PubMed, and Web of Science were searched on July 9th, 2022. The following search string was used: “music intervention” OR “music therapy” AND “mental health” OR “quality of life” AND “dementia” AND “randomized controlled trial” NOT “protocol” NOT “review”. Language was limited to English. The last keywords (“protocol” and “review”) were added as an excluding Boolean operator after an initial search showed too many results. This further ensured that found papers were randomized controlled trials.

Inclusion and Exclusion Criteria

Articles eligible for inclusion were randomized controlled trials (RCT). Both parallel and cross-over RCTs as well as cluster RCTs were included as randomization in the allocation process was still given and group outcomes can be compared. To answer the given research questions, the studied population had to have a formal diagnosis of dementia according to the DSM-V, ICD10, or other accepted diagnostic criteria. No differences were made between type or severity of dementia. Four different participant pools were included: 1) studies examining mild/moderate/severe dementia, 2) studies examining Alzheimer’s disease, 3) studies including both sub-groups, or 4) studies making no distinction between different types of dementia. The RCTs had to have music therapy or a music intervention as the primary intervention. All types of care settings (nursing home, day clinics, outpatient care) were included for further review. Music interventions could either be compared to care-as-usual, waitlist control, or any other type of reference treatment. Relating to the third research question, outcome measures had to be related

to mental health, quality of life, or well-being. More specifically, psychological and behavioral symptoms of dementia were included as they are considered to be core symptoms accompanying dementia patients (apathy, anxiety, depression, aggression, agitation, sleep disruption, irritability and psychosis; Li, Hu, Tan, Yu, & Tan, 2014; McKeith et al., 2005). Considering that quality of life (QoL) has gained increasing interest in dementia research, QoL was accepted as a viable psychological outcome measure as well (Whitehouse & Rabins, 1992). All measurement tools reported by the authors were accepted. All data was extracted by one researcher independently.

Trials with a non-randomized study design were excluded from further analysis. Articles were further excluded if the studied population did not have a formal diagnosis of dementia (e.g. mild cognitive impairments). Mixed interventions as the primary intervention, containing music therapy only in parts, were excluded as well. Finally, articles which did not compare the means between the intervention and control groups were excluded from further analysis in order to ensure that the found effects can be attributed to the intervention.

Data Collection

All search results were imported in Rayyan, a free online tool for managing systematic literature reviews, and screened for eligibility in three iterative cycles based on the aforementioned study eligibility criteria (Ouzzani, Hammady, Fedorowicz, & Elmagarmid, 2016). First, titles were screened for relevance and inclusion of topic-relevant variables, then the abstracts of the included studies, and finally the full texts. If in doubt, articles were included for further assessment. The final article pool contained 12 studies. For each of the studies included in the final review, the following characteristics were extracted: name(s) of the author(s), publication year, country, recruitment site, study design (parallel, cluster, cross-over), sample size, gender distribution, mean age, the type of music intervention, the control condition, total number of sessions, outcome variables and their significance. These information are reported alphabetically in Table 2 (Appendix C). It was assessed whether participants were eligible for inclusion (having a formal dementia diagnosis), whether the balancing of participant characteristics through random group allocation was successful, and whether a follow-up assessment and power analysis was included. Follow-up measurements are relevant to detect whether the effects of the intervention were persistent for an extended period of time. Power analyses are relevant to determine the sample size that is needed to detect a significant result. In the final step, Table 2 (Appendix C) was extended by the results of the quality assessment,

displaying the rank of each of the included studies, ranging from one (highest quality) to eight (lowest quality).

Synthesis of Results

Quality of Included Studies

For each study separately, it was judged whether there was a low, high, or unclear risk of bias according to the Cochrane Collaboration's tool for assessing risk of bias in RCTs (Higgins et al., 2011): i.e. random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, and selective reporting. Additional quality assessment parameters were statistical power analyses and follow-up measurements. Furthermore, the reporting quality of the included interventions were assessed based on the Reporting Guidelines for Music-Based Interventions (Robb et al., 2010). For each intervention separately, it was discerned whether information on the following reporting criteria were provided: 1) intervention theory, 2) intervention content, 3) intervention delivery schedule, 4) interventionist, 5) treatment fidelity, 6) setting, and 7) unit of delivery. Together, these parameters were used to determine the quality of each study, rank the included studies accordingly, and serve as a relevant factor in the evaluation of the effectiveness of an intervention. Ranks were determined based on the total amount of adequately reported reporting criteria and aggregated risk of bias.

Components of Music Interventions in Dementia Care

All interventions were classified and grouped according to their approach (active vs. receptive) and social context (group vs. individual). In the next step, reported intervention characteristics and treatment components were extracted and reported according to the Reporting Guidelines for Music-based Interventions (Robb et al., 2010). First, information on intervention theory were extracted. This included a rationale for the selected music and how the music was expected to influence target outcomes. Second, information on intervention content were extracted. In detail, the following content-related information were extracted: the person who selected the music, the administered music, how the music was delivered, which materials were used, and what intervention strategies were implemented (i.e. singing, listening, rhythmic movement, playing instruments). Third, the intervention delivery schedule was extracted, including the number of sessions, session duration, and session frequency. Additionally, information about the interventionist and their qualifications were extracted and reported, as well

as any strategies to ensure treatment fidelity. Furthermore, information on the location and setting of where the intervention was delivered were described. Last, the unit of delivery was extracted, including information on how the intervention was delivered (i.e. individual or group).

Psychological Outcome Measurements

For answering the second research question, the included studies were scanned for their psychological outcomes and how they were measured. It was then extracted which outcome measures changed significantly from pre- to post-test measurements. All psychological outcome measures were labelled with one of the following outcome dimensions: 1) behavioral, 2) emotional and social, and 3) cognitive. QoL is a multidimensional concept exploring various concepts such as physical health, emotional well-being, socio-economic status, and life satisfaction (Ettema, Dröes, de Lange, Ooms, Mellenbergh, & Ribbe, 2005). For this reason and because four studies included QoL as an outcome measure, it was decided not to label QoL in one of the three categories but create a separate section.

Results

Results of Search

The search parameters led to a total of 32 articles on Scopus, 573 articles on PubMed, and 1278 articles on Web of Science. In the first step, titles of the search results were screened for duplicates and for eligibility based on the inclusion and exclusion criteria. This initial screening led to a total of 80 articles. In the next steps, those studies were again screened for eligibility based on their abstract. 56 articles were excluded from further analysis based on the inclusion and exclusion criteria, leaving 24 articles to be assessed based on the full text. Five studies did not include music therapy or music intervention as a primary intervention, five studies did not compare the means between groups, one study did not randomly allocate participants to groups, and one study did not describe the music intervention in detail, thus being excluded and leaving 12 articles to be assessed. All of them met the inclusion criteria for the population, study type, intervention, and outcome measures. The steps of the literature search and assessment are depicted in more detail in Figure 1 (Appendix A). Details of the studies are presented in Table 2 (Appendix C).

In the following sections, I will present the results of the literature review and answer the three research questions derived for this review: 1) what is the quality of included studies with regards to the estimated risk of bias and adequate intervention reporting? 2) which components

are used in music interventions for dementia care?, and 3) which psychological outcome variables of dementia patients were affected by music interventions?

Study Characteristics

All studies displayed in Table 2 (Appendix C) studied the effect of at least one music intervention on behavioral and psychological complaints of people living with dementia. Sample sizes varied between 20 and 120. All studies only included participants with a formal dementia diagnosis. The mean sample ages of all included studies lied between 76-87 years. The majority of included samples on average showed moderate cognitive impairments[1-7,10-12] (n = 10) with the exception of Raglio et al. (2015), having a sample with predominantly severe cognitive impairments, and Särkämö et al. (2014), having a sample with predominantly mild cognitive impairments. Eight out of the included 12 studies had more female participants than male participants[2-4,6,8-10,12], whereas two studies showed more male participants[1,11], one study included only male participants[7], and one study did not report the distribution of gender[5]. Six studies excluded participants who had a hearing impairment[1,2,5,7,10,12] and six studies excluded participants who could not physically participate in the intervention[1,2,7,9-11]. One study excluded participants who have received music therapy in the last year[8]. Most participants stayed in a long-term care facility[1-7,9,10,11,12] (n = 11), but participants were also recruited from assisted living institutions (n = 2)[3,4], day-care centers[8,9] (n = 2), and Veterans homes[7] (n = 1). Overall, four studies were conducted in Europe[5,8,9,12], four in Asia[2,7,10,11], two in North America[1,7], and two in Oceania[3,4].

Quality Assessment of Included Studies

In total, eight parallel RCTs[1,2,10,11], three cross-over RCTs[3,4,6], and one cluster RCT[5] were identified. The risk of bias inherent to the included RTCs was estimated using the Cochrane collaboration tool (Higgins et al., 2011). Eight of the included studies described in detail the method that was used to generate the group allocation at random[1,2,7-12]. Four studies did not report their methods for random sequence allocation adequately[3-6]. For seven studies, the random allocation process was concealed[1-5,8,9], whereas it was not clearly stated for five studies[6,7,10-12]. Two studies reported blinding the participants and the personnel[2,7], in five studies the participants and personnel was not blinded[3-5,10,12], and for five studies it was not reported whether participants and personnel were blinded[1,6,8,9,11]. Seven studies blinded the assessment of outcome measures[3-5,7-9,11], three did not implement blind assessors[1,10,12], and for the remaining

two studies it was not explicitly stated[2,6]. Out of the 12 included trials, three showed a high risk of bias with regards to the outcome data and selective reporting[3-5], whereas there was no indication of bias for the remaining nine trials[1,2,6-12]. Table 3 (Appendix D) displays the results of the risk of bias assessment in detail. Finally, three RCTs included a follow-up measurement[2,8,9], nine did not include further post-intervention assessments[1,3-5,6,7,10-12]. Four studies carried out statistical power analyses[2-4,10], whereas eight studies did not carry out a power analysis[1,5-9,11,12]. Overall, Chu et al. (2014), Liu et al. (2021), Raglio et al. (2015), and Särkämö et al. (2014) show the lowest risk of bias, followed by: Cho et al. (2012), Sung et al. (2012), Tang et al. (2018), Cooke et al. (2010a, 2010b) and Weise et al. (2020) respectively. The highest risk of bias was detected for Gómez-Gallego et al. (2021) and Kwak et al. (2020).

Moving on to the reporting quality, the Reporting Guidelines for Music Interventions (Robb et al., 2010) include 12 reporting criteria in total. A detailed overview for each includes study on which reporting criteria were adequately described can be found in Table 4 (Appendix E). Out of all the included trials, Cho (2018) and Chu et al. (2014) provided the most comprehensive reporting with reporting on a total of 10 out of the 12 reporting criteria. Särkämö et al. (2012) is next with reporting on nine out of the 12 reporting criteria, followed by: Tang et al. (2018), Weise et al. (2020), Gómez-Gallego et al. (2021), Cooke et al. (2010a, 2010b), Liu et al. (2021), Raglio et al., and Sung et al. (2012) respectively. With reporting on two out of 12 reporting criteria, Kwak et al. (2020) has the least comprehensive intervention reporting.

When adding the estimated risk of bias and the reporting completeness together, the following ranking emerges: Chu et al. (2014) shows the lowest risk of bias and most comprehensive intervention reporting. Next are: Särkämö et al. (2012), Cho (2018), Tang et al. (2018), Liu et al. (2021), Raglio et al. (2015), Weise et al. (2020), Cooke et al. (2010a, 2010b), Gómez-Gallego et al. (2021), and Sung et al. (2012). Kwak et al. (2020) has the lowest overall quality, showing the highest risk of bias and least complete reporting.

Which components are used in music interventions for dementia care?

In the following section, the included randomized controlled trials on music interventions for people with dementia were classified according to 1) approach (active vs. receptive), and 2) setting (individual vs. group). Within each classification, the trials were presented alphabetically for each intervention separately, the seven different components as developed by Robb et al. (2010) were described in detail. Namely, this includes the following elements: 1) intervention

theory, 2) content, 3) delivery schedule, 4) interventionist, 5) treatment fidelity, 6) setting, and 7) unit of delivery. To gain some insight into the effects of the intervention, results of the intervention were shortly presented.

Active Music Interventions

In total, 10 studies which explored the effects of an active music intervention on various measures in people living with dementia were included in this review[1-5,7-11]. Various different activities were employed, namely singing[1-5,8,9,11] (*n* = 8), rhythmic movements[2-5,7-9,10] (*n* = 8), playing instruments[2-4,7,8,10,11] (*n* = 7), and listening[2-4,11] (*n* = 4). Six studies were led by a certified music therapist[1,2,5,8,9,11], three by a musician[3,4,7], and in one trial a trained research assistant led the intervention[10]. Sample sizes of the intervention condition ranged from 10-52, with the median laying at 29, illustrating the average sample size.

Individual Setting

Raglio et al. (2015) performed an active music intervention in an individual setting. No information was provided on how the music is expected to influence the clinical outcome variables and why this musical approach was selected. Participants were presented with instruments and were encouraged to use them. The authors reported that the interventionist further encouraged participants to use those for expressing their emotions. Which instruments were used and how the interventionist encouraged emotional expression of participants was not described. Participants participated in a total of 20 individualized sessions, each lasting 30 minutes. Sessions took place twice a week for 10 weeks. The sessions were conducted by a specially trained and licensed music therapist. No strategies for ensuring treatment fidelity were implemented. All sessions took place in a quiet, medium-sized room. In total, 40 participants were randomly allocated to the active individual music condition, 40 participants were allocated to the receptive individual music condition, and 40 participants were allocated to the care-as-usual control group. Compared to an individual music listening intervention, no significant differences were found on the pre-defined psychological outcome measurements, i.e. QoL (p = .43), behavioral disturbances (p = .41), and depression (p = .41). No effect sizes were reported.

Group Setting

Cho (2018) performed an active music intervention in a group setting. Singing was utilized “due to its capacity for social, emotional, cognitive, and physical engagement with a relatively low threshold for participation” (p. 2). The authors further argue that singing during

routine care tasks reduces aggression and confusion in dementia patients and enhanced communication. They expect the person-centered approach of individualized music intervention to enhance QoL in dementia patients. A researcher put together eight music lists based on the participants' recorded preferred songs, genres, and musicians, one list for each session. The welcome and goodbye songs remained the same throughout all sessions. Participants were provided with song sheets and encouraged to sing along to with the interventionist. Each song was repeated twice. The interventionist varied in speed, and volume to "stimulate the participants' interest and to maximize their musical experience, following a natural flow of increase and release of a musical tension" (p. 4). In total, eight sessions took place, each lasting 40 minutes. Sessions were held twice a week for four weeks. The active music intervention was led by a certified music therapist with 15 years of experience in working with people with dementia. Interaction with the participants was not protocolized. Treatment fidelity was in part ensured by delivering the same sequence of songs to the comparative music listening intervention. No information was given on where the intervention was delivered. The group size was 18 participants. Compared to the music listening intervention and the control condition where participants were watching TV, participants in the singing intervention improved significantly with regards to QoL scores ($p = .018$, $\eta p^2 = .46$) and positive affect ($p = .001$, $\eta p^2 = .25$). No significant changes were observed for negative affect ($p = .069$).

Chu et al. (2014) performed an active group music intervention based on previous research that has shown music therapy to reduce depression and anxiety scores of elderly people with dementia. They expected music therapy interventions to improve emotional and psychological well-being of elderly people with dementia by reducing stress levels and lowering the cortisol concentration in the blood. The music was selected by the music therapist based on the participants' preferences and prior musical experience. The following intervention strategies were employed: rhythmic movement, listening, singing, music-induced reminiscence, and playing along with instruments. Each session lasted 30 minutes and took place twice a week for 6 weeks, thus leading to a total of 12 sessions. Intervention sessions were developed and delivered by a licensed music therapist with nine years of experience. To assess treatment fidelity, all sessions were audiotaped and two external music therapists rated the music therapist's adherence to protocol. Cohen's κ ($\kappa = .8$) was calculated to estimate the therapist's consistency in adhering to the treatment protocol, with no deviation from protocol being found.

All music sessions took place in a recreation room of the facility with a room temperature of 25°C. In total, 52 participants were assigned to the experimental condition and 52 participants were assigned to the treatment-as-usual control group. Compared to the control group, the music intervention group showed a significant improvement in depression scores both mid-intervention ($p = .040$) and post-intervention ($p < .001$), although these effects dissipated at follow-up ($p = .386$). Effect sizes were not reported. Chu et al. (2014) further found improvements in cognitive functioning mid-intervention ($p = .026$), post-intervention ($p < .001$), and at follow-up ($p = .044$). The intervention did not lead to improvements in stress level ($p = .448$).

Cooke et al. (2010a, 2010b) performed an active group music intervention. No rationale for the chosen music or how the intervention is expected to affect clinical outcomes were provided. The intervention included singing and active music listening as the main music intervention strategies. The interventionist further encouraged rhythmic movement and the use of instruments. The music was based on the participants' preferences and the interventionists' repertoire. Each session lasted 40 minutes. Sessions were held three times a week for eight weeks, leading to a total of 24 sessions. Sessions were held by two musicians, no information on their qualifications were reported. To ensure treatment fidelity, a standardized treatment protocol was developed and the interventionists were trained in delivering the intervention. One practice session was held in a different facility. No information was provided on where the intervention was delivered. In total, 24 participants were allocated to the intervention group, and 23 participants were allocated to the control reading intervention. After a five-week wash out period, participants crossed over to receive the other intervention as well. No significant differences were found between the music intervention group and the reading control group with respect to QoL, agitation and behavioral disturbances, depression, or anxiety (no p-values and effect sizes reported).

Gómez-Gallego, Gómez-Gallego, Gallego-Mellado, and García-García (2021) performed an active group music intervention for people with dementia. No rationale or theory was provided that specified how the authors expected the music intervention to influence the clinical outcomes. The selected music was based on the results of a survey exploring the preferences of the included participants. The following music therapy strategies were included: active music listening, clapping, rhythmic movement, and a music quiz to stimulate social interaction and autobiographical memory. Each session lasted 45 minutes. Due to a contradiction in the methods

section of this paper, it is unclear whether the study was comprised of 12 sessions in total, being held for 24 sessions in total. The sessions were led by two of the authors of the paper who each had a master's degree in creative arts therapy with a specialization in music therapy. No strategies that were implemented to ensure treatment fidelity were reported. The sessions took place in a soundproof and spacious room. In total, four nursing homes as a cluster were assigned to the active group music intervention with groups of six, seven, eight, and nine residents participating in the intervention. Compared to the receptive music intervention and the control intervention where participants watched nature videos, the participants in the active group music intervention significantly improved in their functional status ($p < .001$, $\eta^2=0.18$), global cognition ($p < .001$, $\eta^2=0.62$), and reduced agitation ($p < .001$, $\eta^2=0.61$). The intervention did not lead to significant differences across groups on motor functioning ($p = .110$) and depression ($p = .148$).

Liu et al. (2021) performed an active group music intervention based on the premise that playing personally relevant music stimulates the retrieval of positive autobiographical memories and the emotion that is associated with that memory. The authors did not define how they expected the music to influence clinical outcome variables. Music was based on the participants' reported preferences. The music therapy strategy under investigation was playing instruments. Each session lasted 60 minutes, and participants engaged in one session per week for 12 weeks, adding up to a total of 12 sessions. Sessions were led by a trained music facilitator. No further information on his training were provided. No strategies to ensure treatment fidelity were described. No information was given of where the intervention was held. In total, 25 participants were allocated to the active group music intervention, and 25 participants were allocated to the rest-and-reading control condition. Results showed that compared to the control condition, participants in the active group music intervention condition showed significant improvements in anxiety scores ($p < .001$), but no similar effect was found for depression scores ($p = .387$).

Särkämö et al. (2014) performed an active group music intervention. The underlying theory for this intervention was that musical activities contribute to healthy ageing by promoting emotion regulation, reducing social isolation, increasing communication, and maintaining competence. They did not specify how they expect this to influence their target outcomes. The music was selected based on the participants' reported preferences. The interventionist accompanied the singing with the piano, guitar, or kantele. The intervention's main strategies

were singing and rhythmic movement. In total, 10 music sessions were held, one session per week for 10 weeks. Each session lasted 1.5 hours. Sessions were led by a trained music teacher or music therapist. No information was given on their training and qualifications. The authors did not report any strategies that were implemented to ensure treatment fidelity. No information about the setting where the intervention took place was reported. In total, 30 participants were allocated to the active group music intervention, 29 participants were allocated to a receptive group music intervention, and 30 participants were allocated to the care-as-usual control group. Compared to the control group, both the active and the receptive music intervention showed significant differences in depression scores ($p = .001$) and QoL ($p = .021$). No effect sizes were reported.

Sung, Lee, Li, and Watson (2012) developed an active group music intervention. The authors did not provide theory on how the music or the intervention is expected to influence the clinical outcome variables. Music was pre-selected based on the participants' preferences and familiar songs. The following percussion instruments were used for the music intervention: hand bell, tambourine, maracas, guiro tone block, flapper, and loop bell. The main music therapy strategy under investigation was playing musical instruments. The intervention consisted of a total of 12 sessions, each lasting 30 minutes and taking place twice a week for six weeks. Sessions were led by a trained research assistant, qualifications and trainings were not specified. No strategies to ensure treatment fidelity were described. The setting in which the music intervention took place was not described. 27 participants were assigned to the active group music intervention, and 28 participants were assigned to the care-as-usual control group. Results showed that compared to the care-as-usual control group, the intervention group did not differ significantly in agitation scores ($p = .95$). With regards to anxiety, the intervention group showed significantly lower anxiety scores than the control condition post-intervention ($p = .004$). No effect sizes were reported.

Last but not least, Tang et al. (2018) performed an active group music intervention. The authors theorize that music is beneficial to the regulation of the central nervous system in patients with dementia. Music may influence physiological reactions and endocrine functions through the stimulation of the cerebral cortex. It is assumed to be beneficial in the context of dementia care specifically because the part of the brain that is associated with music is well preserved throughout the progression of the disease. The authors expected the music to influence

the psychological outcomes by promoting music-induced reminiscence and eliciting positive emotions. Participants' musical preferences were not surveyed. It was not described who selected the used songs. The interventionist first played various sensory stimulation content, including different musical instruments, different sounds in nature, and animal sounds. Participants were then asked to distinguish between the various given sounds. Afterwards, the interventionist and the participants together sang patriotic songs, nursery rhymes, and Cantonese opera. Lastly, participants were taught to play a simple song on the xylophone. Correspondingly, the following music therapy strategies were under investigation: music listening, singing, and playing instruments. In total, 36 music therapy sessions took place, each lasting 50 minutes. Participants engaged in three music sessions per week for a period of 12 weeks. Each session was led by a trained therapist. No information about their qualifications were reported. No strategies to ensure treatment fidelity were described. The setting in which the music therapy sessions took place were not described. In total, 39 participants were randomly allocated to the intervention group, and 38 participants were allocated to the care-as-usual control group. Results could not detect significant intervention effects on dementia severity ($p > .05$) or apathy ($p > .05$) in participants of the experimental condition. No effect sizes were reported.

Receptive Music Interventions

In total, six studies explored the effects of receptive music interventions. All trials utilized music listening as the primary music therapy method[1,5,6,8,9,12], out of which two included group discussions about the listening experience[5,9]. Out of the six studies, Kawk et al. (2020) and Weise et al. (2020) created individualized playlists. The remaining studies probed the sample's music preferences and created playlists based on the survey results[1,5,6,9]. In four studies, the intervention was conducted by staff[1,6,8,12], whereas one study included a music therapist[5] and one included a musician[9]. Three studies adapted a group setting design[1,5,6] and the other half adopted an individual setting design[6,8,12].

Group Setting

Cho (2018) performed a receptive group music intervention. The author did not provide theory or a rationale for the selected approach and music. The played music was selected by a researcher based on all participants' preferred genres, artists, and songs. Music listening was the main music therapy strategy under investigation. In total, eight sessions took place, each lasting 40 minutes. Sessions were held twice a week for four weeks. The receptive group music

intervention was led by the activity staff of the nursing home. The activity staff was trained by the researcher on how to perform the receptive music intervention. Treatment fidelity was in part ensured by delivering the same sequence of songs to the comparative music listening intervention. No information was given on where the intervention was delivered. In total, 17 participants were allocated to the receptive group music intervention. Compared to the active group music intervention and the TV-control condition, the participants of the receptive group music intervention showed no significant improvements with regards to QoL (p =.187) or positive (p = .219) or negative affect (p = .105). No effect sizes were reported.

Gómez-Gallego et al. (2021) conducted a receptive group music intervention. No rationale or theory was provided that specified how the authors expected the music intervention to influence the clinical outcomes. The selected music was based on the results of a survey exploring the preferences of the included participants. For each session separately, the interventionist chose which song was played. After each song, the interventionist shared the artist's name and the song's title and encouraged participants to share their feelings and memories. The following music therapy strategies were included: active music listening, music-induced reminiscence, social interaction, and emotional expression. Each session lasted 45 minutes. Due to a contradiction in the methods section of this paper, it is unclear whether the study was comprised of 12 sessions in total, being held for 24 sessions in total. The sessions were led by two of the authors of the paper who each had a master's degree in creative arts therapy with a specialization in music therapy. No strategies that were implemented to ensure treatment fidelity were reported. The sessions took place in a soundproof and spacious room. In total, four nursing homes as a cluster were assigned to the active group music intervention with groups of six, seven, and eight residents participating in the receptive group music intervention. Compared to the active group music intervention and the TV-control condition, the participants in the receptive group music intervention showed no significant differences in any of the outcome variables, i.e. motor functions (p = .605), behavioral disorders (p = .351), depression (.102), functional stauts (p =.008), or in global cognition (p = .214). Effect sizes were not reported.

Särkämö et al. (2014) performed a receptive group music intervention. The underlying theory for this intervention was that musical activities contribute to healthy ageing by promoting emotion regulation, reducing social isolation, increasing communication, and maintaining

competence. They did not specify how they expect this to influence their target outcomes. The music was selected based on the participants' reported preferences and played on a CD-player. Participants were encouraged to share any emotions, thoughts, or memories that may have come up during a song. The main music therapy strategies that were included in the intervention were active music listening, music-induced reminiscence, emotional expression, and social interaction. In total, 10 music sessions were held, one session per week for 10 weeks. Each session lasted 1.5 hours. Sessions were led by a trained music teacher or music therapist. No information was given on their training and qualifications. The authors did not report any strategies that were implemented to ensure treatment fidelity. No information about the setting where the intervention took place was reported. In total, 30 participants were allocated to the active group music intervention, 29 participants were allocated to a receptive group music intervention, and 30 participants were allocated to the care-as-usual control group. Compared to the control group, both the active and the receptive music intervention showed significant differences in depression scores (p = .001) and QoL (p = .021). Compared to the active group music intervention, the participants in the receptive group music intervention showed a larger increase in QoL (p = .033). Effect sizes were not reported.

Individual Setting

Kwak, Anderson, and O'Connell Valuch (2020) conducted an individual receptive music intervention. The authors theorize that for patients with dementia, using individualized music that has a high personal relevance to the individual creates a positive and relaxed mood by creating a sense of familiarity, thus reducing agitation and behavioral problems. Music was selected by the families of the participants. They were asked to provide a playlist with songs that have high personal meaning to the individual. The music playlists were delivered to the participants on iPods. How and when the playlists were applied was not kept constant but was based on the participating nursing homes and their staff. Music listening was the only music therapy strategy under investigation. Interventionists were also not kept constant and varied from single staff members to a group of staff members or volunteers, all of which were trained in delivering the intervention. No strategies to ensure treatment fidelity were implemented. Considering that the application of the intervention was highly flexible and individualised, no information about the unit of delivery and the setting in which the intervention was delivered was reported. Kwak et al. (2020) did not detect improvements in agitation in either phase of the

cross-over trial (p_{Phase1} = .09, p_{Phase2} = .97). Results showed significant improvements in depression scores (p_{Phase2} = .04) and behavioral disinhibition scores (p_{Phase2} = .02) but only for one trial phase, thus failing to find an overall significant intervention effect. Results further showed a significant difference across groups in irritability, with higher irritability scores in the music intervention group (p = .02). No effect sizes were reported.

Raglio et al. (2015) derived a receptive individual music intervention. No information was provided on how the music is expected to influence the clinical outcome variables and why this musical approach was selected. The used music playlist was selected by the music therapist based on all participants' reported preferences. Music listening was the only music therapy strategy under investigation. One music session lasted 30 minutes. In total, participants attended 20 sessions. Sessions took place twice a week for ten weeks. Participants had no interaction with those delivering the music intervention. Who delivered the intervention was not described. No strategies for ensuring treatment fidelity were implemented. Participants listened to the playlist by themselves in their own rooms. In total, 40 participants were randomly allocated to the active individual music condition, 40 participants were allocated to the receptive individual music condition, and 40 participants were allocated to the care-as-usual control group. Results showed no significant differences across groups (i.e. active individual music intervention, receptive individual music intervention, and control group) for depression (p = .41), QoL (p = .43), and behavioral disturbances (p =.41). No effect sizes were reported.

Weise et al. (2020) performed a receptive individual music intervention. Their intervention was developed based on the premise that the brain regions associated with music remain relatively unaffected by dementia. Music with a high personal relevance is theorized to pose as a comprehensible and familiar stimulus in an environment which is highly confusing and distressing for people with dementia. The presence of a familiar and comprehensible stimulus is thus expected to decrease high levels of stress and anxiety, which then reduce behavioral and psychological symptoms of dementia such as agitation and anxiety. Additionally, personally relevant music is supposed to retrieve positive autobiographical memories, thus triggering a positive psychological and emotional state for the patient. Accordingly, the music therapy intervention under investigation is active music listening. Based on the reported preferences form the participants, the researchers complied three different music playlists for each participant. Participants listened to their individualized music playlist for 30 minutes every other day for four

weeks, leading to a total of 14 music listening sessions. The receptive music intervention was delivered either by the project staff or by the nursing home staff. No strategies to ensure treatment fidelity were described. No information on where the intervention was delivered were described. A total of 10 participants got allocated to the intervention condition, and 10 participants were allocated to the waitlist-control condition. The results showed no significant differences across groups with regards to social participation (p = .08, d_m = .56), sleep quality (p = .06, d_m = .40), and resistance to care (p = .18, d_m = -.31) for participants in the receptive individual music intervention. Significant differences across groups were found for agitation (p = .01, d_m = -.69) and emotional well-being (p = < .01, d_m = 1.04), with less agitation and higher emotional well-being in the music listening intervention.

Which psychological outcome variables were affected by music interventions?

In the following sections, I reviewed which psychological outcome measures were affected by music interventions. Outcomes were grouped according to four categories: 1) behavioral, 2) emotional, 3) cognitive, and 4) multidimensional, i.e. QoL. Duplicate outcome measures were counted and grouped. Subsequently, it was discussed how the outcome variables were measured and which effect was observed over the duration of the trial. Significant p-values and effect sizes (if stated) were reported.

Behavioral Variables

The most common behavioral measure was agitation (n = 5). Four of those trials used the Cohen-Mansfield Agitation Inventory (CMAI) to measure agitation (Kwak et al., 2020; Cooke et al., 2010a; Sung et al., 2012; Weise et al., 2020) and one utilized the Neuropsychiatric Inventory (NPI) agitation subscale (Gómez-Gallego et al., 2021). Weise et al. (2020) detected a significant difference in agitation across conditions (p = .01, d_m = -.69), with lower agitation scores in the receptive individual music intervention compared to the waitlist control condition. Gómez-Gallego et al. (2021) also found a significant intervention effect on agitation, but only for the active group music intervention (p < .001, η^2 = 0.61). No similar effects could be found for the receptive group music intervention (p = .351). Comparatively, other studies did not detect a significant intervention effect on agitation. In the cross-over trial conducted by Kwak et al. (2020) exploring the effects of a receptive individual music intervention, the results of the first phase showed a p-value of p = .09, and for the second phase p = .97, thus finding no significant intervention effects. Sung et al. (2012), who delivered n active group music intervention, found

no significant differences in agitation scores across conditions with $p = .95$. Cooke et al. (2010a) performed an active group music intervention and stated that no significant results were detected. The authors reported no p-values.

Gómez-Gallego et al. (2021) compared the effects of an active group music intervention on motor functioning to a receptive group music intervention and a TV-control condition using the Tinetti Scale. No significant differences across conditions were detected ($p = .110$). Kwak et al. (2020) explored how behavioral disinhibition may be affected by a receptive individual music intervention using the corresponding NPI subscale. Results showed significant improvements in behavioral disinhibition scores ($p_{Phase2} = .02$) but only for one trial phase, thus failing to find an overall significant intervention effect. Weise et al. (2020) further explored the effects of their receptive individual music intervention on sleep quality and resistance to care, but did not find significant differences between the experimental condition and the waitlist-control condition ($p_{sleep} = .038$; $p_{resistancecare} = .206$). Gómez-Gallego et al. (2021) examined the effects of an active and receptive group music intervention on functional status using the Barthel Index. Compared to the TV-control condition, only the active group music intervention showed significant improvements in functional status ($p < .001$, $\eta^2 = 0.18$).

Emotional Variables

The most assessed emotional variable was depression, with six studies exploring the effects of music intervention on depression (Chu et al., 2014; Cooke et al., 2010b, Kwak et al., 2020; Liu et al., 2021; Raglio et al., 2015; Särkämö et al., 2014). Chu et al. (2014) delivered an active group music intervention explored the effects of the music intervention on depression scores using the Cornell Scale for Depression in Dementia (CSDD). The authors found a significant difference in depression scores between the experimental and the care-as-usual-control group mid- and post-intervention ($p = .040$ and $p < .001$ respectively) with lower depression scores in the intervention group, although those effects were no longer significant at one-month follow-up ($p = .386$). Särkämö et al. (2014), using the CBS, a modified version of the CSDD, found a significant difference in depression scores for both the active and receptive group music intervention conditions compared to controls ($p = .001$). Comparatively, Raglio et al. (2015) utilized the CSDD for assessing depression and found no significant differences between the active individual and receptive individual music condition ($p = .41$). Cooke et al. (2010b) found no significant differences in depression scores across the active group music

condition and the reading-control condition using the Geriatric Depression Scale (GDS, p-values not reported). Using the same measuring instrument, Gómez-Gallego et al. (2021) also did not find significant differences in depression scores across the active group music condition, the receptive group music condition, and the TV-control condition ($p = .148$). Using the same measurement instrument, similar results were reported by Liu et al. (2021) who performed an active group music intervention ($p = .387$). Kwak et al. (2020), using the NPI depression subscale, reported significant improvements in depression scores for the participants in the individual receptive music condition ($p = .04$), but only for trial phase 2, thus failing to find an overall significant intervention effect. Cho et al. (2018) used the Positive and Negative Affect Schedule (PANAS) to assess changes in positive and negative affect across an active group music condition, receptive group music intervention, and a TV-control condition. They found no intervention effects for negative affect ($p = .158$) but did find that the active group music intervention had an effect on positive affect ($p = .001$). Weise et al. (2020) compared the emotional well-being of patients assigned to a waitlist-control condition and an receptive individual music condition using a visual analogue scale, which revealed no significant differences across groups ($p > .05$).

Three studies examined the effect of music on anxiety, with Cooke et al. (2010a) not finding significant differences between the active group music condition and the reading-control condition using the Rating Anxiety in Dementia (RAID), although here no analyses results were presented either in-text or as a table. In comparison, Sung et al. (2012), using the same measuring tool, found that the active group music condition showed significantly lower anxiety scores than those in the care-as-usual control group ($p = .004$). Liu et al. (2019), using the Hamilton Anxiety Rating Scale (HAM-A), found a significant reduction in anxiety scores in the active group music condition both mid-intervention ($p < .001$) and post-intervention ($p < .001$). Using The Apathy Evaluation Scale (AES-C), Tang et al. (2018) found no significant differences in apathy scores between the active group music condition and the care-as-usual control condition ($p > .05$). Kwak et al. (2020), who delivered an individual receptive music intervention, found significant differences in irritability scores across the experimental and control condition ($p = .02$) using the corresponding NPI subscale, with higher irritability scores in the music intervention group. Chu et al. (2014) assessed differences in stress levels between conditions using salivary cortisol levels, but found no significant difference between the active

group music condition and the care-as-usual condition at mid-intervention ($p = .971$) or post-intervention ($p = .448$).

Cognitive Variables

Two studies investigated differences in cognitive functioning between groups, all of which were using the Mini-Mental-State Examination (MMSE). Chu et al. (2014) and Gómez-Gallego et al. (2021) found intervention effects on cognitive functioning. Gómez-Gallego et al. (2021) found significant differences between conditions ($p < .001$), with higher cognitive functioning only in the active group music condition. Chu et al. (2014) did a longer-term study and found that MMSE scores were significantly higher for the active group music intervention group mid-intervention ($p = .026$), post-intervention ($p < .001$), and at follow-up ($p = .044$). Follow-up analysis revealed that if patients in the experimental group were further divided into three sub-groups based on the severity of their dementia at baseline, cognitive functioning improved significantly only for those with mild dementia ($p < .001$) and moderate dementia ($p = .005$), while it showed no significant effects for those with severe dementia ($p = .340$). Tang et al. (2018) explored the effects of an active group music intervention on dementia severity, also using the MMSE, and did not find significant differences between the experimental and the care-as-usual control condition ($p > .05$).

Quality of Life

Four studies included QoL as an outcome measure. Raglio et al. (2015) did not find significant differences in QoL between the active individual music condition, the receptive individual music intervention, and the control group ($p = .432$). The study utilized the Cornell-Brown Scale for Quality of Life in Dementia (CBS-QOL). In comparison, Särkämö et al. (2014) found significant differences across conditions ($p = .021$) using the Quality of Life in Alzheimer's disease (QOL-AD). Both the active and the receptive group music intervention groups improved in quality of life scores, with a higher increase for participants in the receptive group music condition ($p = .033$). Doing a more rigorous study, Cho et al. (2018) found that QoL scores post-intervention differed significantly across groups ($p = .018$), with a simple effect analysis showing that a significant effect was found only for the active group music condition ($p = .001$), not for the receptive group music intervention ($p = .187$) or control condition ($p = .118$). Cooke et al. (2010b) also found significant differences in QoL belonging scores between the active group music condition and the reading-control condition using the Dementia Quality of

Life scale ($p < .05$). However, further analysis showed that QoL scores significantly increased for the reading control group, not for the participants in the active group music intervention, revealing an adverse effect.

Discussion

The aim of this systematic review was to evaluate music interventions as a treatment approach for older people with dementia. More specifically, this review answered the following research questions: 1) of what quality are the included studies? 2) which type of music interventions were used in dementia care? and 3) which psychological outcome variables of dementia patients were affected by music interventions? Accordingly, the quality of the included studies was assessed and a quality rank was created, the delivered music interventions were described in detail, and it was reviewed which changes in psychological outcomes were associated with music interventions. Of the initial 1.662 studies, 12 randomized controlled trials met the eligibility criteria and were included in this review.

Quality and Applicability of Included Studies

The included studies varied significantly in the determined risk of bias. Studies that show significant shortcomings in their quality and their effort to minimize bias have low internal validity, thus reducing the confidence with which conclusions about possible interventions effects can be drawn (Charrois, 2015). More specifically, an increased risk of bias may lead to an overestimation of the "true" effect of an intervention and thus would not represent a true effect in the studied population (Charrois, 2015). The highest risk of bias was determined for Cooke et al. (2010a,b) and Gómez-Gallego et al. (2021). Accordingly, the statistically significant results of these studies should be interpreted with caution as the found effects may be inflated. Comparatively, Chu et al. (2014), Raglio et al. (2015), and Sarkämö et al. (2014) showed the lowest risk of bias, thus representing strong evidence where results are likely to represent true effects without having been influenced by potential sources of bias. Furthermore, these three trials included a follow-up measurement in order to detect whether the effects of the intervention persisted after the intervention was completed. Chu et al. (2014) additionally carried out a power analysis to calculate the sample size needed to detect a significant effect, thus representing the strongest evidence out of all of the included trials.

Adequate and in-depth reporting is key to judging the reliability of a study and later allowing the findings to be translated into practice (Moher, Altman, Schulz, Simera, & Wager,

2014). Additionally, poor intervention reporting is associated with biased results, showing an exaggeration of beneficial intervention effects (Savović et al., 2012). Cho (2018) and Chu et al. (2014) showed the most complete intervention reporting as judged according to the reporting criteria developed by Robb et al. (2010). Out of all the included trials, those trials are thus least likely to show inflated intervention effects and inconsistent results. Kwak et al. (2020) provided the least complete intervention reporting, thus being at risk for biased results and having reduced reliability. Taking these quality criteria into account is essential in determining which conclusions can be drawn from this literature review about the viability of music-based interventions for people with dementia, as some studies are at bigger risk for having inflated and unreliable results than others.

Types of Music Interventions in Dementia Care

The included music interventions for dementia care varied greatly with regards to their content and design. Most commonly, active group music interventions were delivered. Receptive interventions were utilized in dementia care as well, with half taking place in a group setting, and the other half taking place in an individual setting. While listening to music was included by all receptive music interventions, active music interventions were more varied in the included music therapy strategies. All active music trials delivered mixed-strategy interventions with a mixture of singing, playing instruments, and rhythmic movement. In all of the included trials, patients and/or their caretakers were surveyed to determine their musical preferences. For interventions which were delivered in a group setting, these preferences were pooled so that the music appeals to as many patients as possible. In all receptive individual music interventions, the music was based on each participant's individual music preferences. Due to the large variability in clinical outcome variables and measurement instruments, as well as the large differences in quality of the included trials, the effectiveness of different types of interventions could not be compared.

Effect of Music Interventions on Psychological Variables

Most of the included studies aimed at improving behavioral and emotional aspects, whereas trials exploring the effects of music interventions on cognitive measures and quality of life were scarce. Most notably, music interventions seemed to positively impact emotional variables (i.e. positive affect, depression, and anxiety), behavioral variables (i.e. behavioral disorders, functional status, sleep quality), cognitive function, and quality of life. However, these findings are inconsistent across the included studies and not all studies could detect positive

intervention effects on these variables. Therefore, it is relevant to take the determined quality of the included trials into account.

Chu et al. (2018), who ranked best on both the risk of bias assessment as well as the reporting quality assessment, found that for those who participated in singing and listening to familiar songs while moving and playing instruments in a group setting, depression scores decreased over the course of the intervention until immediately after the intervention. However, that effect dissipated at one-month follow-up. The same was found by Särkämö et al. (2014), who ranked second on the quality assessment. Depression scores improved significantly for both music interventions, i.e. for those who participated in group intervention involving singing and moving to familiar songs in a group, and those who actively listened to familiar songs in a group setting. No statistical significance was reached at the 6-month follow-up measurement. Four other included studies, all of which ranked lower with regards to their methodological quality, included depression as an outcome variable and did not detect significant intervention effects (Liu et al., 2021; Kwak et al., 2020; Cooke et al., 2010b; Raglio et al., 2015). Cho (2018), ranking third on the quality assessment, compared how listening to familiar music and singing familiar songs affects positive and negative affect. Both intervention groups showed significant improvements in positive affect, and no significant changes in negative affect scores. The same seems to be true for quality of life: while Cooke et al. (2010b) and Raglio et al. (2015) found no improvements in quality-of-life scores for those participating in an active music intervention, Cho (2018) found significant improvements in quality-of-life scores for both their active and their receptive music intervention. Methodological quality is an important factor in determining the weight of the evidence. It thus seems that the results of this literature review hint at a positive effect of different types of music interventions on depression, affect, and quality of life in the context of dementia care, although these effects seem to be only short-term.

There may also be a positive effect of music interventions on cognitive functioning. Both Chu et al. (2014) and Gomez-Gallego et al. (2021) found positive intervention effects for both their active and the receptive group music interventions. Chu et al. (2014) found these effects to still be statistically significant at one-month follow-up, hinting at longer-term effects of music interventions for individuals living with dementia. In comparison, Tang et al. (2018) explored how an active group music intervention might be associated with changes in dementia severity. Using the Mini Mental State Exam (MMSE), the same measuring instrument that was utilized by

Chu et al. (2014) and Gomez-Gallego et al. (2021), Tang et al. (2018) found no changes in MMSE scores. It has to be considered that Tang et al. (2018) scored lower than Chu et al. (2014) on the quality assessment, but higher than Gomez-Gallego et al. (2021). For that reason, the evidence regarding the efficacy of music interventions on cognitive functioning is inconclusive. A follow-up analysis by Chu et al. (2014) found that if patients in the experimental group were further divided into three sub-groups based on the severity of their dementia at baseline, cognitive functioning improved significantly only for those with mild and moderate dementia. Dementia severity may thus be a confounding variable that should be considered and examined in future research. A literature review by Baird et al. (2015) examining on changes in musical abilities in dementia patients indicated that musical memory is differently impaired across different types of dementia (Baird et al., 2015). Their analyses hint that although musical memory seems to remain stable, research on how musical perception and musical production is affected by dementia is scarce (Baird et al., 2015). Although the evidence is speculative at best, it remains possible that different patient populations respond differently to music interventions, making music more or less appropriate for specific patient groups (Baird et al., 2015).

With regards to behavioral variables, only Gómez-Gallego et al. (2021) found a positive effect of their active group music intervention on agitation. Other studies found no similar effects, thus indicating that music interventions do not positively influence agitation in a sample of older adults living with dementia (Cooke et al., 2010a; Kwak et al., 2020; Sung et al., 2012; Weise et al., 2020). These findings are contradictory to the results by Tsoi et al. (2018), who performed a literature review and meta-analysis examining the differential effects of active and receptive music interventions on agitation in a sample of individuals living with dementia. He found both active and receptive music intervention to have a positive effect on agitation, although these results were only significant after a sensitivity analysis was conducted to account for the use of different assessment scales. Additionally, the effect was only observed in studies who included a care-as-usual control group. No significant differences were found between the intervention groups and the control group when an active control condition was used. However, Tsoi et al. (2018) combined the results from both randomized and non-randomized clinical trials with varying quality rankings (range four to nine), possibly skewing the results of the meta-analysis. Then again, the evidence included in this systematic literature review on music interventions on agitation in people with dementia is of moderate quality as well. At this point,

no conclusions can be drawn about the effect of music interventions on agitation in people living with dementia due to inconsistent and inconclusive results.

The results of this literature review are contradictory to other systematic literature reviews conducted in terms of the associations between music interventions and BPSD in dementia patients. For example, Sherratt & Hatton (2004) conducted a qualitative literature review on music interventions for people with dementia and found them to be effective in improving aggression, agitation, and irritability, findings which this review could not replicate. Notably, that review included only case studies, philosophical papers, and evaluations given by patients' primary caretakers: randomized controlled trials were not included. Randomized controlled trials are the only study design which allow researchers to examine the cause-effect relationship between the intervention and clinical outcomes (Hariton & Locascio, 2018). For that reason, the effect of music interventions on behavioral and psychological symptoms of people with dementia reported by Sherratt et al. (2004) cannot be solely attributed to the intervention and conclusions about the effectiveness of music interventions should be made with caution. In comparison, a quantitative study performed a systematic review and meta-analysis on the efficacy of music interventions for BPSD (Ueda, Suzukamo, Sato, & Izumi, 2013). The authors concluded music therapy to be effective in alleviating behavioral and psychological symptoms of people with dementia. Notably, the authors made no distinction between active and receptive music interventions. Randomized controlled trials which compared both active and receptive music interventions showed that effect sizes and affected clinical outcomes vary between the two approaches (Cho, 2018, Särkämö et al., 2014). This may account for the diverging results of this systematic review and the analysis performed by Ueda et al. (2013).

Limitations

This review searched three scientific databases, namely Scopus, PubMed, and Web of Science, with detailed and rigorous inclusion and exclusion criteria. It is the first review that provided an overview of specific contents and features implemented in music interventions in the context of dementia care. This systematic review examined the theoretical framework underlying the implemented music interventions. Additionally, this paper reviewed which psychological complaints of dementia patients can be addressed with music interventions, taking into account the methodological quality of the included trials and weighing the evidence according to the quality assessment. However, some limitations must be considered. It may be that grey literature,

such as unpublished studies or studies only listed on other databases, although meeting the inclusion criteria of this study, were not included. Furthermore, this systematic literature review could not compare the effectiveness of the included music interventions due to the significant heterogeneity in intervention contents, application, clinical outcomes, and outcome measurements. Additionally, all types of dementia and levels of dementia severity were included in this trial, creating notable variability in the included samples. As a systematic literature on the clinical presentation of BPSD in patients with dementia shows, behavioral changes and psychological symptoms can differ across type of dementia and dementia severity (McKeith et al., 2005). Accordingly, type of dementia may act as a third variable that was not accounted for in this review. In general, music interventions are complex and contain multiple therapeutic elements. In research, it is difficult to discriminate which intervention elements contributed to the found positive effect. It may be the case that some effects found in this literature review are not attributable to the intervention itself but, for example, to the social group setting or the therapeutic relationship.

Conclusion

This systematic review showed that some music interventions seem to have a positive effect on emotional variables, such as positive affect, depression, and quality of life. However, results about the effect of music interventions on cognitive and behavioral measures are inconclusive and are conflicting with results from other literature reviews. Conflicting research findings are a common issue in music therapy research, as is emphasized by other systematic literature reviews on the efficacy of music therapy(Baird et al., 2015; Vink et al., 2003). This issue is exacerbated by lack of standardized methods, coinciding measurement variables, and consistent measuring instruments, making cross-study comparisons difficult. Future research should aim at reporting meticulously on how their interventions were developed, what methods were included, which musical parameter were used, and finally how the intervention was delivered. This way, music interventions in dementia care can be properly compared, allowing more concrete conclusions to be drawn about their intervention effects. Additionally, researcher investigating the application of music interventions in a dementia care context should control for third variables such as type of dementia, dementia severity, and music parameters such as pace, volume, and rhythm. It is still unclear who is most likely to benefit from which type of music intervention. In addition, more research should include follow-up measurements. If there is no

longer-term impact of music interventions beyond the treatment period, it should be considered whether it is feasible to implement music therapy in the context of dementia care if it has to be applied constantly in order for patients to experience a positive effect. High-quality research is needed to explore the distinct elements that affect the effectiveness of music interventions in order for targeted interventions to be developed.

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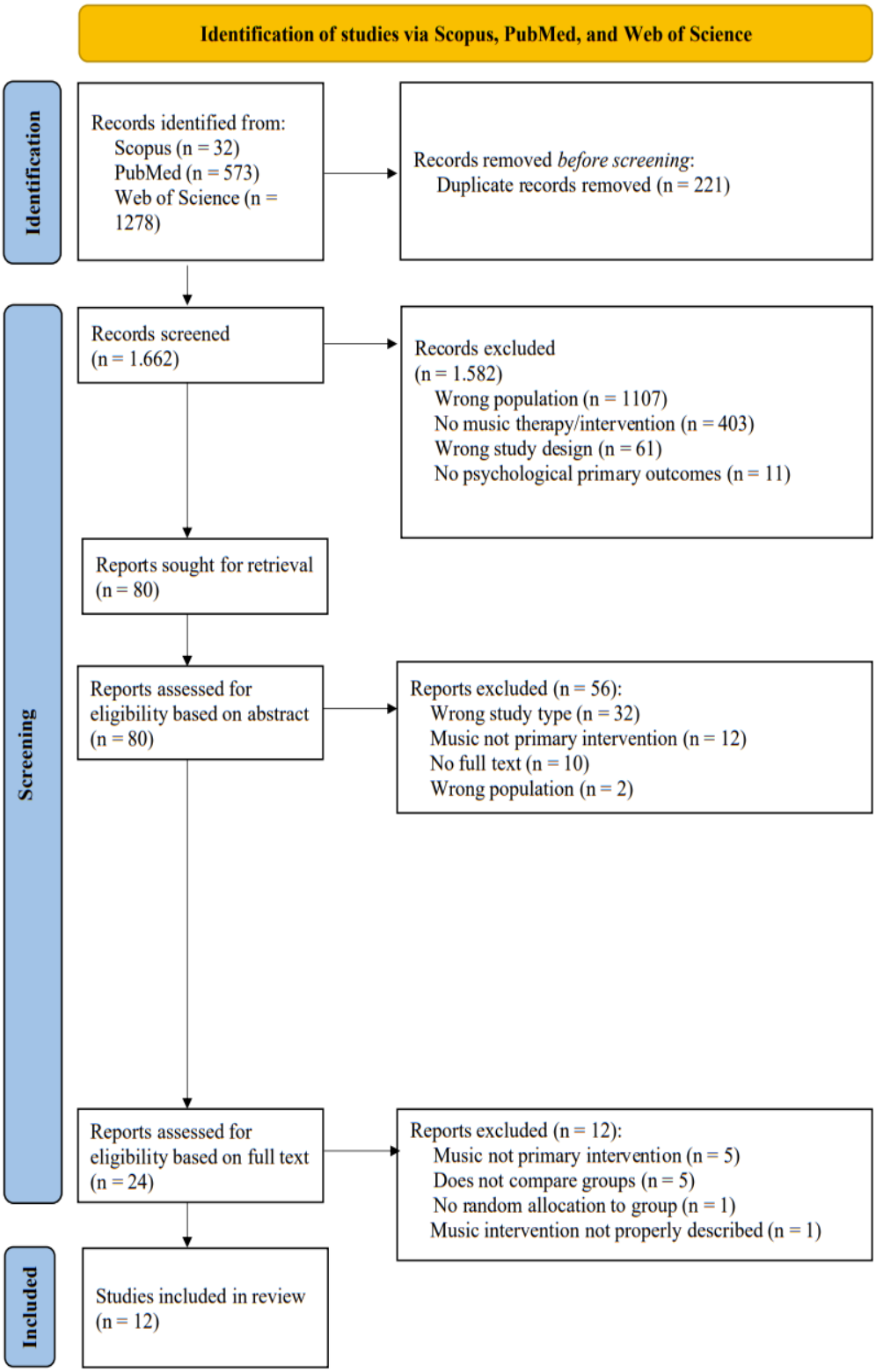
Appendix A. Figure 1.

PRISMA Flow diagram of selection of studies



Appendix B. Table 1.

Checklist for Reporting Music-Based Interventions.

	Reporting Criteria	Elements
1	Intervention theory	Provide a rationale for the music selected; specify how qualities and delivery of the music are expected to impact targeted outcomes.
2	Intervention content	Provide precise details of the music intervention and, when applicable, descriptions of procedures for tailoring interventions to individual participants.
	a. Person selecting music	Preselected by investigator; 2) participant selected from limited set; 3) participant selected from own collection; 4) tailored based on patient assessment.
	b. Music	When using published music, provide reference for sheet music or sound recording. When using improvised or original music, describe the music's overall structure (i.e. form, elements, instruments, etc.).
	c. Music delivery method	When using live music specify who delivered the music and the size of the performance group (e.g. interventionist only, interventionist and participant). When using recorded music, specify placement of playback equipment and the use of headphones vs. speakers. Specify who determined/controlled volume (i.e. interventionist, participant). Specify decibel level of music delivered and/or use of volume controls to limit decibels.
	d. Intervention materials	Specify music and/or non-music materials.
	e. Intervention strategies	Describe music-based intervention strategies under investigation (examples: music listening, songwriting, improvisation, lyric analysis, rhythmic auditory stimulation, etc.).
3	Intervention delivery schedule	Report number of sessions, session duration, and session frequency including practice sessions.

4	Interventionist	Specify interventionist qualifications and credentials. Specify how many interventionists deliver study conditions.
5	Treatment fidelity	Describe strategies used to ensure that treatment and/or control conditions were delivered as intended (e.g. interventionist training, manualized protocols, and intervention monitoring).
6	Setting	Describe where the intervention was delivered: include location, privacy level, and ambient sound.
7	Unit of delivery	Specify whether interventions were delivered to individuals or groups of individuals, including the size of the group.

Note. Reprinted from "Reporting guidelines for music-based interventions" by S. Robb, J. S. Carpenter, and D. S. Burns, 2010, *Journal of Health Psychology, 16*(2), p. 349. Copyright 2010 by SAGE Publications.

Appendix C. Table 2.

Characteristics and Outcomes of Included Studies

	Author, Year, Country	Recruit-ment Site	Study Design	*N*	Male %	Mean Age	Type(s) of Music Intervention, Control Condition	Num-ber of sessions	Outcome Variable(s)	Quality Ranking
1	Cho, 2018, USA	Nursing home	Parallel design	52	82.7%	86.7	Active group music intervention, Receptive group music intervention, TV-control condition	8	Quality of life (+), positive affect (+), negative affect (O)	3
2	Chu et al., 2014, Taiwan	Nursing home	Parallel design	104	47%	82	Active group music intervention, care-as-usual control condition	12	Depression (+), cognitive function (+)	1
3	Cooke et al., 2010a, Australia	Nursing home	Cross-over design	47	29.8%	-	Active group music intervention, reading-control condition	24	Anxiety (O), agitation (O)	7
4	Cooke et al., 2010b, Australia	Nursing home	Cross-over design	47	29	-	Active group music intervention, reading-control condition	24	Quality of life (O), depression (O)	7
5	Gómez-Gallego et al., 2021, Spain	Nursing home	Cluster design	90	-	-	Active group music intervention, receptive group music intervention, TV-control condition	-	Functional status (+), global cognition (+), agitation (+), motor functioning (O)	7
6	Kwak et al.,	Nursing	Cross-	59	22.1%	86.9	Receptive individual music	-	Agitation (O),	8

	Author, Year, Country	Recruit-ment Site	Study Design	*N*	Male %	Mean Age	Type(s) of Music Intervention, Control Condition	Num-ber of sessions	Outcome Variable(s)	Quality Ranking
	2020, USA	home	over design				intervention, care-as-usual control		irritability (+), disinhibition (O), depression (O)	
7	Liu et al., 2021, Taiwan	Veterans' home	Parallel design	50	100%	86.8	Active group music intervention, reading-control condition	12	Anxiety (+), depression (O)	5
8	Raglio et al., 2015, Italy	Nursing home	Parallel design	120	21.7%	81.7	Active individual music intervention, receptive individual music intervention	20	Behavioral disorders (O), depression (O), quality of life (O)	5
9	Särkämö et al., 2014, Finland	Nursing home	Parallel design	89	32.6%	78.8	Active group music intervention, receptive group music intervention, care-as-usual-control condition	10	Depression (+), quality of life (+)	2
10	Sung et al., 2012, Taiwan	Nursing home	Parallel design	55	34.2%	80.4	Active group music intervention, care-as-usual-control condition	12	Agitation (O), anxiety (+)	7
11	Tang et al., 2018, China	Nursing home	Parallel design	77	51%	75.9	Active group music intervention, care-as-usual-control condition	36	Apathy (O), dementia severity (O)	4

	Author, Year, Country	Recruit-ment Site	Study Design	*N*	Male %	Mean Age	Type(s) of Music Intervention, Control Condition	Num-ber of sessions	Outcome Variable(s)	Quality Ranking
12	Weise et al., 2020, Germany	Nursing home	Parallel design	20	20%	85.1	Receptive individual music intervention, waitlist-control condition	14	Agitation (O), emotional well-being (O), sleep quality (+), resistance to care (O)	6

Note. + = Significant difference between groups; O = No significant difference between groups.

Appendix D. Table 3.

Risk of Biases Assessment of Included Studies

Author(s)	Selection Bias		Performance Bias	Detection Bias	Attrition Bias	Reporting Bias	Other Bias
	RSA	AC	BPP	BOA	IOD	SR	
Cho (2018)	L	L	-	H	L	L	L
Chu et al. (2014)	L	L	L	-	L	L	L
Cooke et al. (2010a)	H	L	H	L	H	H	L
Cooke et al. (2010b)	H	L	H	L	H	H	L
Gómez-Gallego et al. (2021)	H	L	H	L	H	H	L
Kwak et al. (2020)	H	-	-	-	L	L	L
Liu et al. (2021)	L	H	L	L	L	L	L
Raglio et al. (2015)	L	L	-	L	L	L	L
Särkämö et al. (2014)	L	L	-	L	L	L	L
Sung et al. (2012)	L	-	H	H	L	L	L
Tang et al. (2018)	L	-	-	L	L	L	L
Weise et al. (2020)	L	-	H	H	L	L	L

Note. AC = Allocation concealment; BPP = Blinding of participants and personnel; BOA = Blinding of outcome assessment; H = High risk of bias; IOD = Incomplete outcome data; L = Low risk of bias; RSA = Random sequence allocation; SR = Selective reporting; - = Unclear.

Appendix E. Table 4.

Reporting Quality of Included Studies

Reporting Criteria	Cho (2018)	Chu et al. (2014)	Cooke et al. (2010a,b)	Gómez-Gallego et al. (2021)	Kwak et al. (2020)	Liu et al. (2021)	Raglio et al. (2015)	Särkämö et al. (2012)	Sung et al. (2012)	Tang et al. 2018)	Weise et al. (2020)
Intervention theory	+	+	-	-	-	+	-	+	-	+	+
Intervention content	+	+	-	+	-	-	-	+	+	+	-
Person selecting music	+	+	+	+	-	+	-	+	+	+	+
Music	-	-	-	-	-	-	-	-	-	-	-
Music delivery method	+	-	-	-	-	-	-	+	-	+	-
Intervention materials	+	+	-	-	-	+	-	+	+	+	-
Intervention strategies	+	+	+	+	+	+	+	+	-	+	+
Intervention delivery schedule	+	+	+	-	-	+	+	+	+	+	+
Interventionist	+	+	-	+	+	-	+	+	-	-	+

Treatment fidelity	+	+	+	-	-	-	-	-	-	-	+
Setting	-	+	-	+	-	-	+	-	-	-	-
Unit of delivery	+	+	+	+	-	+	+	+	-	+	+

Note. + = Reported; - = Not adequately reported.