Effectiveness of music intervention on cognitive function and neuropsychiatric symptoms in the elderly with dementia: a meta-analysis

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Abstract: Dementia is increasing dramatically with an increasing elderly population. Pharmacological interventions are proven to have limited efficacy to treat many of the features of dementia. In such a situation, non-pharmacological means become important to help people with dementia, especially music therapy. The efficacy of music intervention on cognition has been barely explored in the literature, and the few studies that are available present inconsistent results. The aim of this systematic review is to have a meta-analysis on the effect of music therapy for improvements in cognitive functions as well as neuropsychiatric symptoms in the elderly with dementia.

1. Introduction

Dementia is characterized by a progressive decline in cognitive functions. It is a collective name for progressive degenerative brain syndromes including memory, thinking, behavior, and emotion.[1] People with dementia may have loss of memory, difficulty in finding the right words or understanding what people are saying, and difficulty in performing previously routine tasks, as well as personality and mood changes. In the late stage of dementia, they may have difficulty to communicate with words associated with emotional and behavioral problems leading to a reduction in their quality of life.[2]

According to statistics based on Hong Kong, China (2016), the number of aged population (aged 65 or above) will increase by 12% by 2041. At the same time, the numbers of Alzheimer's disease (AD) and other dementias are growing dramatically with the increasing aging population.[2] It is estimated that worldwide, the total number of people with dementia is 46.8 million currently, with an increasing trend of up to 74.7 million by 2030 and 131.5 million by 2050.[1] Medications have proven limited efficacy in slowing the cognitive declines.[3]

Based on the above fact, non-pharmacological intervention becomes vital to help people with dementia.[3]

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Early detection of dementia and interventions will help to treat problem behaviors earlier, reducing the damage to the patient's social support network and preventing burnout to the caregivers.[4] Pharmacological interventions are available but have limited efficacy to treat many of the syndrome's features.[5] Non-pharmacological interventions have become increasingly important in healthcare. As observed, limited research has been directed toward non-pharmacological treatments. A systematic review summarized the recent studies and evaluated non-pharmacological interventions such as music therapy, reminiscence therapy, stimulated presence therapy, validation therapy, acupuncture, aromatherapy, light therapy, and animal-assisted therapy on the behavioral and psychological symptoms of dementia. Positive results are reported from different therapies from the review.[6] Music therapy as one of the non-pharmacological interventions have been suggested to be good for people with dementia. According to the American music therapy association (2011),[7] music therapy is defined as the use of music including rhythm, melody, and sound to improve the quality of life by restoring functions of individual or interpersonal integration. Qualified music therapists work with individuals or groups using music to help and meet the physical, psychological, and social needs of people with dementia.[5]

Consequently, more attention has been paid to the efficacy of music for improving symptoms of anxiety and depression in people with dementia, using diverse music interventions such as group singing, sound training, and playing musical instruments by professional music therapists together with presentation of recorded music to see its effectiveness for the management on behavioral and psychological symptoms of dementia.[8] Furthermore, some researchers are using music therapy together with activities such as dancing and rhythmic movements to see their effcetiveness.[9]

So far, the studies have been focused on the psychological and behavioral symptoms of dementia such as agitation, anxiety, and depression. However, the efficacy of music intervention on cognition has been barely explored in the literature, and the few studies available show inconsistent results.

The aim of this review is to have a meta-analysis on the effect of music therapy to see improvements if any on the cognitive functions apart from neuropsychiatric symptoms in patients with dementia. Music-evoked emotions may in turn become a moderator for the enhancement of cognitive function. It is important to have an in-depth exploration of the potential role of music interventions for improving the cognitive function of people with dementia in the long run by reviewing the duration and type of music interventions.

2. Search methods

The clinical burning question is, "Are dementia people with music intervention compared with those without intervention can improve cognitive function and neuropsychiatric symptoms?" Table 1 shows a comparison between patients of dementia, who are aged 65 or above with music interventions or music therapy such as listening, singing songs, and playing musical instrument, versus those patients without music intervention. Daily activities are continually provided to the comparison groups with usual care such as bathing, reading newspapers, doing physical exercises, and so on. Studies with outcome measures for improving cognition and emotion are included with music interventions for more than 4 weeks.

In sum, the inclusion criteria are people with dementia aged 65 years old or above, with behavioral problems using music therapy conducted by a music therapist, with outcome measures assessing the patient with dementia. The study design was randomized clinical control trials published in English. For the exclusion criteria, those studies without outcome measure assessing for people with dementia or people not yet diagnosed with dementia were excluded. Studies without music therapy or published in a language other than English were also excluded.

Items	PICOT	Keywords
Population (P)	Dementia people	"Dementia„ "Alzheimer's disease"
Intervention (I)	Music intervention or music therapy (listening, singing songs, and playing musical instrument)	"Music therapy," "Music intervention," "Musical therapy"
Comparison (C)	Without music intervention (usual daily activity or usual care, e.g., reading newspaper, bathing, physical exercise, etc.)	Not available
Outcome (O)	Improve cognition or reduce anxiety or depression or agitation and/or improve quality of life	"Cognitive function," "Cognition function," "Neuropsychiatric symptoms"
Time frame (T)	More than 4 weeks can be included	Not available

Table 1. The clinical burning question with Population (P), Intervention (I), Comparison (C), Outcome (O), Timeframe (T) (PICOT).

A comprehensive search following the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement[10] was done and illustrated with a flow diagram (Figure 1).

Five main electronic databases were used, namely, Medline, PsycINFO, CLINAHL Plus, PubMed, and BioMed Central for the systematic literature search. All of them are healthcare related and were searched by using the keywords "music therapy" OR "music intervention" OR "musical therapy" AND "dementia" OR "Alzheimer disease", "cognitive function "OR "cognition function" AND/OR "neuropsychiatric symptoms." The reference list of all the identified articles was reviewed from 2010 to 2019 as the year of publication, as the non-pharmacological intervention on people with dementia has become more popular since 2010.[2] Further search was restricted to articles in English language from January 2010 to December 2019. Full-text articles were chosen based on the inclusion and exclusion criteria. The electronic search was supplemented by manual searching of reference lists of the included review articles to identify any additional sources. Moreover, we used the EndNote X9 reference management software to detect and discard duplicate academic journals.

All eligible studies were screened with doubt solving, if any, by the reviewers.

3. Search outcomes

From PsycINFO, 285 music therapy and dementia, 191 music intervention and dementia, 116 musical therapy and AD, 20 music intervention and AD and cognitive function, and 3 music therapy and AD, and cognition function and neuropsychiatric symptoms were searched. From BioMed Central, 200 music therapy and dementia, 150 musical therapy and dementia and cognitive function, 44 music therapy, and dementia and cognition function and neuropsychiatric symptoms were searched. From CINAHL Plus, 45 music therapy and dementia, 50 musical therapy and dementia or AD, 4 music therapy and dementia or AD and cognition, and 4 music therapy and dementia or AD, and cognition function and neuropsychiatric symptoms were searched. From PubMed, 50 music therapy and dementia, 64 music intervention and dementia, 10 musical therapy and AD, 45 music therapy and AD and cognitive function, and 5 music therapy and AD, and cognition function and neuropsychiatric symptoms were searched. From
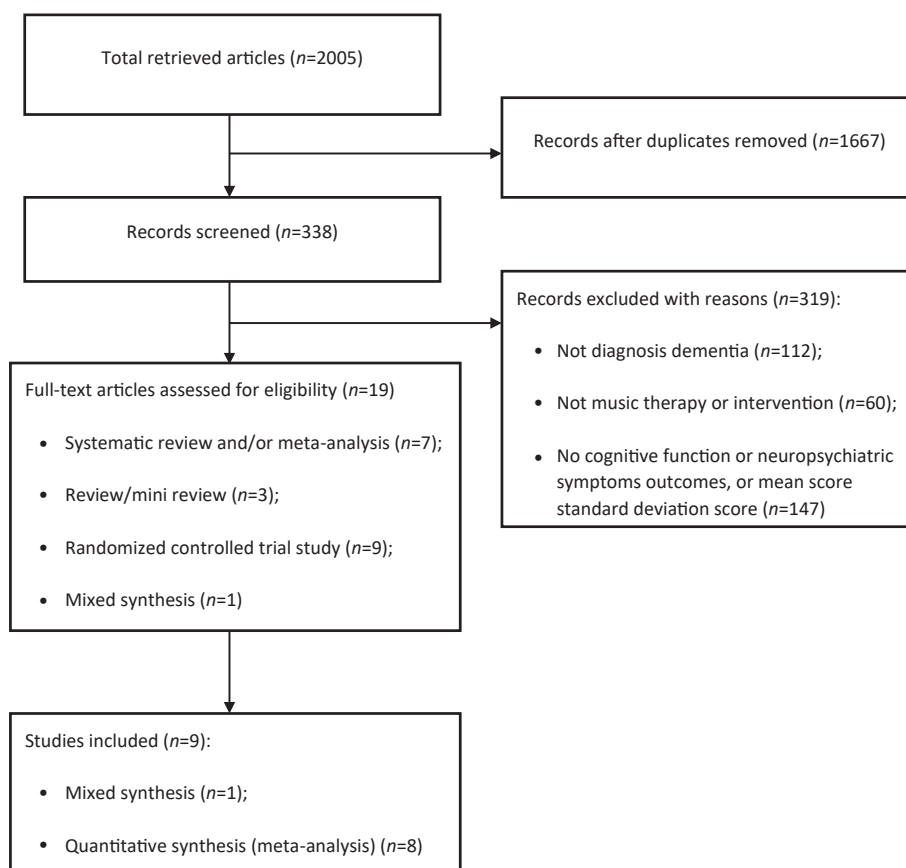
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┌─────────────────────────────────┐
│ Total retrieved articles (n=2005)│
└─────────────────────────────────┘
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         ├────────▶│ Records after duplicates removed (n=1667)│
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         ├────────▶│ Records excluded with reasons (n=319):   │
         │         │  • Not diagnosis dementia (n=112);        │
         │         │  • Not music therapy or intervention      │
         │         │    (n=60);                                │
         │         │  • No cognitive function or               │
         │         │    neuropsychiatric symptoms outcomes,    │
         │         │    or mean score standard deviation       │
         │         │    score (n=147)                          │
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│ Full-text articles assessed for eligibility (n=19)│
│  • Systematic review and/or meta-analysis (n=7);  │
│  • Review/mini review (n=3);                       │
│  • Randomized controlled trial study (n=9);        │
│  • Mixed synthesis (n=1)                           │
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│ Studies included (n=9):                           │
│  • Mixed synthesis (n=1);                          │
│  • Quantitative synthesis (meta-analysis) (n=8)    │
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Figure 1. PRISMA flow diagram of the selection procedure. Abbreviations: PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Items	Maximum points of included studies		
	Randomization	Blinding	An account of all patients
Chen & Pei 2018[13]	2	2	1
Lyu et al. 2018[12]	2	2	1
Thornley et al. 2016[18]	2	2	1
Hsu et al. 2015[17]	2	2	1
Raglio et al. 2015[19]	2	2	1
Chu et al. 2014[11]	2	2	1
Ridder et al. 2013[15]	2	2	1
Sung et al. 2012[14]	2	2	1
Ceccato et al. 2012[16]	2	2	1

Note: RCTs, randomized controlled trials.

Table 2. JADAD scale for reporting RCTs.

Medline, 394 music therapy and dementia, 278 music intervention and dementia, 30 musical therapy and AD and cognitive function and 4 music therapy and AD and cognition function and neuropsychiatric symptoms were searched. The total number of academic journals was 1992.

In addition to electronic search, the reference lists of identified studies were also manually searched, with 13 in total. There were 2005 academic journals initially. According to the incision and excision criteria, 1667 academic journals are excluded; 338 academic journals are screened and removed; 19 full-text eligibility academic journals are assessed including 7 journals with systematic review and/or meta-analysis, 3 journals with review or mini review, 8 randomized controlled trial (RCT) study, and 1 mixed synthesis (Figure 1).

Final inclusion was based on participants with dementia aged 65 or above, diagnosed by physician according to international diagnostic criteria with music interventions conducted by or in consultation with a music therapist compared with the standard care or non-musical intervention. For outcomes, the studies should have at least one cognitive outcome measured such as social cognition, attention and language, and so on.

3.1. Quality appraisal

The Consolidated Standards of Reporting Trial (CONSORT) statement and JADAD scale were used for assessing the risk of bias for conducting the quality assessment. Each selected study was assessed. The CONSORT statement is intended to facilitate better reporting of RCTs by a measure scale. It offers a standard way to prepare reports of trial findings, and

facilitates reporting to reduce the influence of bias on the results.[11] It comprises a 25-item checklist and a flow diagram. The checklist items focus on reporting how the trial was designed, analyzed, and interpreted. It helps to improve the accuracy of the findings.

All 9 RCTs studies scored 5 on the JADAD scale (Table 2), showing a high range of quality score. Although it has been widely used in research, it is too simple with too much emphasis on blindness resulting in low consistency among different evaluators. Therefore, we decided to choose the CONSORT checklist to evaluate the quality of the studies.

3.2. Characteristics and data extraction

Baseline information is extracted from 9 RCT studies including the author(s), the year of publication, the country, the study design, the number of participants, and the characteristics of the participants such as gender, mean age, description of intervention (type, frequency, time, duration), and description of control group (type, frequency, time, duration) to see whether there is any involvement of music therapist in the experimental and control groups. The outcome measure scale scores are extracted at baseline, pretest, and posttest in both the experimental and control groups. The results, outcomes, and finding of the studies are included in Table 3.

Sample size ranged from 13 to 100 participants with a mean age of 68.4 for 9 RCTs. One of the studies applied both quantitative and qualitative methods was applied. They were conducted in different countries and districts with 1 in the UK, 1 in the mainland of China, 1 in Canada, 1 in Denmark, 2 in Italy, and 3 in Taiwan, China. Different music interventions, duration, and period are observed. For music interventions, three studies recommended playing a musical instrument and song listening to be the most effective to the participants. Another three studies suggested playing a musical instrument and singing are more useful. Two studies suggested song singing only and one study suggested having multitasks. Seven out of nine studies recommended a music therapist during the sessions.

For the comparison group, there are some differences in the provision of usual daily care. Seven studies with routine/standard care, one study with self-picking activities, and one study with active attention activity was observed. The definition for routine/standard care is different. One study stated as talking, one study stated as TV watching, one study stated as newspaper reading, one study stated as chaplaincy service, and two studies stated as nothing special.

For the classification of measurement tools to assess cognitive function (Table 4), Mini-Mental State Examination (MMSE)[12,13] was used to assess the cognitive ability

Study/year country	Study design	Patient & characteristic	Description of intervention (type, frequency, time, duration)	Music therapist (Yes/No)	Control group(s)	Measurement tool(s)	Neuro Psychiatric symptom(s) outcome(s)	Neuro psychiatric symptoms results/findings/outcomes
Chen & Pei, Taiwan, China 2018[13]	RCTs	Intervention group (n = 15), F:M = 9:6, (mean age = 77.3) Control group (n = 13), F:M = 5:8, (mean age=77.3)	Singing with percussion instrument x 60 min weekly for 8 weeks and follow-up after 8 weeks (with music therapist)	Control group (Yes)	Self-choose activities e.g. chess games, playing cards, reading, writing, mathematical exercise and walking exercises x 60 min for 8 weeks and follow-up after treatment	CMAI-C- to assess agitated behaviors	CMAI-C mean score: Intervention group: Pretest: 44.3 Posttest: 41.9 Control group: Pretest: 34.7 Posttest: 39.0	The results of the study showed music therapy can improve agitation. The posttest mean score of intervention group is lower pretest mean score.
Sung et al., Taiwan, China 2012[14]	RCTs	Intervention group (n = 27), F:M = no data (mean age = 81.37) Control group (n=28), F:M=no data (mean age=79.5)	Percussion instruments with familiar music x 30 min delivered in the afternoon twice a week x 6 weeks (total 12 sessions) and follow-up at 4th & 6th weeks after treatment (no involvement of music therapist)	Control group (No)	Usual care: e.g.,TV watching, family visiting and parties, basic nursing care, meal provision for 6 weeks and follow-up at 4th & 6th weeks after treatment	CMAI-C- to assess agitated behaviors	CMAI-C mean score: Intervention group: Pretest: 36.26 Posttest:33.59 (at 4th week) Posttest: 32.70 (at 6th week) Control group: Pretest: 35.79 Posttest: 33.54 (at 4th week) Posttest: 31.00 (at 6th week)	The results of the study reported the level of anxiety, agitated behaviors can be reduced. The mean score of CMAI-C are consistent with low level of agitated behavior.
Thornley, Canada 2016[18]	RCTs	Intervention group (n = 10), F:M = no data, (mean age = 83.5) Control group (n = 6), F:M=no data, (mean age=68.4)	Singing and playing simple instruments, including maracas and small drums x 30 min biweekly for 4 weeks (total 8 sessions) and follow-up at 1st week of treatment and the end of treatment (no involvement of music therapist)	Control group (No)	Active engagement and attention intervention using "online randomization program" for 4 weeks and follow-up at1st week of treatment and the end of treatment	CMAI-to assess agitated behaviors	CMAI mean score: Intervention group: Pretest:67.8 Posttest: 54.3 (at 1st week) Posttest: 84.3 (at 4th week) Control group: Pretest: 64.2 Posttest: 56.2 (at 1st week) Posttest: 79.0 (at 4th week)	The results of the study show agitated behavior items with music therapy can improve. The posttest CMAI mean score in intervention group was greater than pretest mean score
Ridder et al., 2013 Denmark and Norway[15]	RCTs	Intervention group Participants (n = 20) F:M = 14:7, (mean age=82.17) Control group: Participants (n=20) F:M=14:7, (mean age=80.20)	Singing songs, dancing/ moving for biweekly x 6 weeks (total 12 sessions) and follow up at 7th & 14th weeks after end of treatment no data on duration of each session. (with music therapist)	Control group (No)	Standard care: Talking, walking for 6 weeks and follow up at 7th & 14th weeks after end of treatment	CMAI-fr -to assess agitated behaviors frequency	CMAI-fr mean score: Intervention group: Pretest: 30.21 Posttest: 29.05 (at 7th week) Posttest: 28.0 (at 14th week) Control group: Pretest:30.98 Posttest:32.12 (at 7th week) Posttest:26.09 (at 14th week)	This study showed that 6 weeks of music therapy can reduce agitation frequency. The mean score of CMAI-fr is consistent with low agitation frequency.

Table 3. continued

Study/year country	Study design	Patient & characteristic	Description of intervention (type, frequency, time, duration)	Music therapist (Yes/No)	Control group(s)	Measurement tool(s)	Neuro Psychiatric symptom(s) outcome(s)	Neuro psychiatric symptoms results/findings/outcomes
Lyu et al., 2018 China[12]	RCTs	Intervention groups: (n=32), F:M=17:15 (mean age=68.9) Control group (n = 30), F:M = 17:13, (mean age = 69.9)	Singing song twice daily for 180 sessions x 40 min for 3 months and follow up after the 3rd and 6th months after start of treatment (with music therapist)	Control group (No)	Routine care x 40 min x 180 sessions for 3 months and follow-up at the 3rd and 6th months after start of treatment	NPI -to assess behavioral, mood	NPI mean score: Intervention groups: Pretest:16.37 Posttest:13.52 (at 3rd month) Posttest:13.01 (at 6th month) Control group: Pretest test:15.77 Posttest:15.14 (at 3rd month) Posttest:15.42 (at 6th month)	The results of the study showed improvement over time in behavioral, mood symptoms by the consistent reduction in NPI mean score. The posttest of NPI mean score in intervention is lower than pretest
Raglio et al., 2015 Italy[19]	RCTs	Intervention group: (n = 40), F:M = 29:11 (mean age = 81.0) Control group (n = 40), F:M = 33:7, (mean age = 82.4)	Listening to music with playing instrument x 30 min twice a week for 10 weeks (total 20 sessions) and follow up after treatment and at 2 months after end of treatment (with music therapist)	Control group (No)	Standard care, e.g. Reading the newspaper, playing cards, personal care and physical activities for 10 weeks and follow-up after treatment and at 2 months after treatment	NPI -to assess behavioral, mood	NPI mean score: Intervention group: Pretest: 33.1 Posttest: 23.7 (after treatment) Posttest: 22.4 (at 2 months) Control group: Pretest: 36.7 Posttest: 28.9 (after treatment) Posttest:26.8 (at 2 months)	The results of the study showed improvement over time in behavioral, mood symptoms by the consistent reduction in NPI mean score of intervention group.
Hsu et al., 2015 United Kingdom[17]	Mixed method trial design: RCTs, intervein and observation	Intervention group (n = 6), F:M = 5:1 (mean age = 84.56) Control group (n=7), F:M=7:0, (mean age = 82.5)	Singing along with instrument playing and talking x 30mins weekly for 7 months (total 22 sessions), and 15min pre & post resting time at the 3rd, 5th, and 7th months of treatment and no follow-up after end of treatment (with music therapist)	Control group (No)	Standard care, e.g., Chaplaincy service, entertainment and leisure activities x 30 min at 3rd, 5th, and 7th months of treatment and no follow-up after end of treatment	NPI -to assess behavioral, mood	NPI mean score: Intervention group: Pretest: 17.33 Posttest: 10.83 (at 3rd month) Posttest: 12.33 (at 5th month) Posttest: 8.67 (at 7th month) Control group: Pretest: 17.57 Posttest: 24.29 (at 3th month) Posttest: 26.57 (at 5th month) Posttest: 34.43 (at 7th month)	The results of the study showed music therapy can improve neuropsychiatric symptoms of dementia. The mean score of NPI is consistent with low level of neuropsychiatric symptoms.
Raglio et al., 2015 Italy	RCTs	Intervention group: (n = 40), F:M = 29:11 (mean age = 81.0) Control group (n=40), F:M=33:7, (mean age=82.4)	Listening to music with playing instrument x 30 min twice a week for 10 weeks (total 20 sessions) and follow up after treatment and at 2 months after end of treatment (with music therapist)	Control group (No)	Standard care e.g. Reading the newspaper, playing cards, personal care and physical activities for 10 weeks and follow-up after treatment and at 2 months after treatment	CSDD -to assess depression symptoms	CSDD mean score: Intervention group: Pretest: 9.0 Posttest: 6.5 (after treatment) Posttest: 7.0 (at 2 months) Control group: Pretest: 8.0 Posttest: 7.0 (after treatment) Posttest: 7.0 (at 2 months)	The results of the study showed improvement in depression symptoms and reduced posttest mean score in intervention group.

Table 3. continued

Study/year country	Study design	Patient & characteristic	Description of intervention (type, frequency, time, duration)	Music therapist (Yes/No)	Control group(s)	Measurement tool(s)	Neuro Psychiatric symptom(s) outcome(s)	Neuro psychiatric symptoms results/findings/outcomes
Chu et al., 2014 Taiwan, China[11]	RCTs	Intervention group (n = 49), F:M = 26:23, (mean age=82) Control group (n = 51), F:M = 27:24, (mean age = 82)	Listening, singing with playing instrument x30mins twice a week for 6 weeks (total 12 sessions) and follow-up at the 6th and 12th sessions and 4 weeks after treatment (with music therapist)	Control group (No)	Usual care: e.g., watching television, afternoon tea and taking walks for 6 weeks and as follow-up at 6th and 12th sessions and 4 weeks after treatment	CSDD -to assess depression symptoms	CSDD mean score: Intervention group: Pretest: 17.39 Posttest: 11.47 (at 6th session) Posttest: 8.22 (at 12th session) Posttest: 11.23 (at 4weeks) Control group: The mean score of CSDD in control group: 15.70, 14.66, 13.78 and 11.43 (at baseline, 6th and 12th sessions & 4 weeks after treatment)	The results of the study showed improved in depression. The mean scores of CSDD in intervention group was consistent low levels of depression.

Notes: CMAI, Cohen-Mansfield Agitation Inventory scale; CMAI-C, Chinese version of Cohen-Mansfield Agitation Inventory scale; CMAI-fr, Cohen-Mansfield Agitation Inventory scale-frequency; NPI, neuropsychiatric Inventory; CSDD, Cornell Scale for Depression in Dementia; RCTs, randomized controlled trials.

Table 3. Characteristics of the included randomized controlled trials of music therapy on the neuropsychiatric symptoms of dementia patients.

within a wide range of domains, including memory, calculation, language, and orientation with a maximum score of 30. A score below 23 on the MMSE generally indicates cognitive impairment; a score of 19–23 indicates a mild degree of dementia; 10–18 indicates moderate level, 1–9 indicates severe levels of dementia; and a score of 0 indicates extremely severe dementia.

Trial Making Test (TMT)[14] is used to measure the attention control from executive function associated with visual searching to sequencing and sustained attention. Sequential order of numbers and number of seconds were used to complete the task. The lower the scores are the better the performance.

For the classification of measurement tools to assess the neuropsychiatric symptoms (Table 5), Cohen-Mansfield Agitation Inventory scale (CMAI), Chinese version of Cohen-Mansfield Agitation Inventory scale (CMAI-C), and Cohen-Mansfield Agitation Inventory scale -frequency (CMAI-fr)[14–17] were used to assess 29 agitated behaviors, rated by a proxy caregiver. For example, pacing, hiding or hoarding things, hitting (including self-harm), repetitive sentences, or questions. The 29 items are divided into 4 subgroups, namely, physical aggressive, physical non-aggressive, verbal aggressive, and nonverbal non-aggressive. The frequency of each symptom is rated on a 7-point scale (1–7) ranging from "never" to "several times an hour." Summing all symptom scores reveals a total score that ranges from 29 to 203. The higher the score is the greater the occurrence of agitated behaviors.

Neuropsychiatric Inventory (NPI)[13] is used to evaluate 12 common neuropsychiatric disturbances in dementia including delusions, hallucinations, agitation, dysphoria, anxiety, apathy, irritability, euphoria, disinhibition, aberrant motor behavior, nighttime behavior disturbances, as well as appetite and eating abnormalities. The levels of severity (1 = mild, 2 = moderate, 3 = severe) and frequency (1 = occasionally, less than once per week; 2 = often, about once per week; 3 = frequently, several times per week but less than every day; 4 = very frequently, once or more per day or continuously) of each neuropsychiatric symptoms are rated on the basis of scripted questions administered to the patient's caregiver. The total score of these 12 items varies from 0 to 120. Caregiver distress is rated by the caregiver on a 6-point scale from 0 to 5, with no distress to extreme distress.

Cornell Scale for Depression in Dementia (CSDD)[12] is used to assess the signs and symptoms of depression in the elderly with dementia. The level of severity is based on a scale of 0–2 (0 = absent, 1 = mild or intermittent, 2 = severe). A score above 10 indicates a probable major depression, above 18 indicates a definite major depression, and a score below 6 indicates the absence of significant depression symptoms.

Study/year	Use of measurement tool(s)				Outcome measures	
	MMSE	(CDR)	The WHO-UCLA AVLT	TMT	To assess cognitive function	To assess attention control
Ceccato (2012)[16]	√				√	
Thornley (2016)[18]	√				√	
Chu et al. (2014)[11]	√				√	
Lyu et al. (2018)[12]	√				√	
Chen & Pei (2018)[13]	√				√	
Ridder et al. (2013)[15]	√				√	
Raglio et al. (2015)[19]	√				√	
Thornley (2016)[18]		√			√	
Chen & Pei (2018)[13]		√			√	
Raglio et al. (2015)[19]		√			√	
Lyu et al. (2018)[12]			√		√	
Chen & Pei (2018)[13]				√		√

Notes: CDR, clinical dementia rating; MMSE, mini-mental state examination; RCT, randomized controlled trial; WHO-UCLA, World Health Organization-University of California, Los Angeles; AVLT, Auditory Verbal Learning Test; TMT, trail making test.

Table 4. Classification of the measurement tools to assess cognitive function included RCT studies.

Study/year	Use of measurement tool(s)	Outcome measures
Chen & Pei (2018)[13]	CMAI-C/CMAI/CMAI-fr/CMAI-di	To assess agitated behaviors
Ridder et al. (2013)[15]	CMAI-C/CMAI/CMAI-fr/CMAI-di	To assess agitated behaviors
Thornley (2016)[18]	CMAI-C/CMAI/CMAI-fr/CMAI-di	To assess agitated behaviors
Sung (2012)[14]	CMAI-C/CMAI/CMAI-fr/CMAI-di	To assess agitated behaviors
Ceccato (2012)[16]	CMAI-C/CMAI/CMAI-fr/CMAI-di	To assess agitated behaviors
Ceccato (2012)[16]	GDS	To assess depression symptoms
Ridder et al. (2013)[15]	GDS	To assess depression symptoms
Raglio et al. (2015)[19]	CSDD	To assess depression symptoms
Chu et al. (2014)[11]	CSDD	To assess depression symptoms
Chu et al. (2014)[11]	Salivary Cortisol	To assess depression symptoms
Sung et al. (2012)[14]	RAID scale	To measure anxiety levels
Hsu et al. (2015)[17]	DCM	To observe behavior, mood, and engagement
Hsu et al. (2015)[17]	NPI/NPI-NH	To assess behavioral, mood, and quality of life
Lyu et al. (2018)[12]	NPI/NPI-NH	To assess behavioral, mood, and quality of life
Raglio et al. (2015)[19]	NPI/NPI-NH	To assess behavioral, mood, and quality of life
Thornley (2016)[18]	NPI/NPI-NH	To assess behavioral, mood and quality of life
Lyu et al. (2018)[12]	BI	To assess behavioral, mood, and quality of life
Raglio et al. (2015)[19]	BI	To assess behavioral, mood, and quality of life
Ridder et al. (2013)[15]	QOL-AD	To assess quality of life
Raglio et al. (2015)[19]	CBS-QoL/(CBS)	To assess behavioral and psychological outcomes and quality of life

Notes: BI, Barthel Index; CBS-QoL, Cornell-Brown Scale for Quality of Life in Dementia; CMAI, Cohen-Mansfield Agitation Inventory; CMAI-C, Chinese version of Cohen-Mansfield Agitation Inventory scale; CMAI-fr, Cohen-Mansfield Agitation Inventory scale -frequency; CSDD, Cornell Scale for Depression in Dementia; DCM. Dementia Care Mapping; GDS, Geriatric Depression Scale; RAID scale, Rating of Anxiety in Dementia scale; NPI, Neuropsychiatric Inventory; NPI-NH, Neuropsychiatric Inventory-Nursing Home; QOL-AD, The Quality of Life- Alzheimer's Disease; RCT, randomized controlled trial.

Table 5. Classification of the measurement tools to assess neuropsychiatric symptoms included RCT studies.

3.3. Statistical analysis

Review Manager version 5 (RevMan 5) is used. The pretest and posttest of outcome measures and the number of participants are entered generating the plot after analysis. The forest plots of the effect of the music therapy on cognitive function in patients with dementia

are shown in Figure 2. The results of meta-analysis are of the effect of music therapy on cognitive function with 240 patients: 123 patients in the music therapy group and 117 patients in the control group. A high effect of music therapy with a mean difference = −8.76, 95% confidence interval (CI) = −31.85 to −5.67 and $P = 0.005$ on cognitive function was concluded. Significance of heterogeneity with $\chi^2 = 96.70$, $P < 0.00001$ and $I^2 = 97\%$ were also observed.

Another 8 trials with 394 patients, 199 patients in the music therapy group and 195 patients in the control group, were included in the meta-analysis. A high effect of music therapy with mean difference = −2.39, 95% CI = −4.51 to −0.27 and $P = 0.03$ on neuropsychiatric symptoms were observed. Heterogeneity with $\chi^2 = 27.92$, $P < 0.00002$ and $I^2 = 75\%$, as observed in Figure 3. It was concluded that the studies had high heterogeneity; meta-analysis provided evidence that music therapy may significantly improve neuropsychiatric symptoms in patients with dementia.

3.4. Synthesis

The findings after analysis have proven that music interventions are effective on elderly people with dementia on both aspects of cognitive and neuropsychiatric functions. As observed,[17] listening to songs and playing a musical instrument twice a week for 12 weeks with 45 min per session are the most effective measures to improve cognitive function of dementia in the elderly (Figure 2). In the study of Hsu et al.,[17] singing with playing a musical instrument weekly for 7 months at 30 min per session are the most effective measures for improving neuropsychiatric symptoms of dementia in the elderly. Both groups required the presence of a music therapist throughout the sessions. As the studies were carried out in different countries, they recommended different music interventions with different sessions and duration, which may not be tailor-made for dementia in the elderly in Hong Kong. For example, one study suggested to sing or listen, to reminiscence songs, but the result shown was not significantly effective. Moreover, some studies recommended singing or listening to familiar old songs, but there were really various types such as Chinese opera and folk songs depending on the individual's preference.

Music intervention is an inexpensive and user friendly treatment to dementia in the elderly. However, involvement of the family members of dementia in the elderly is essential to understand the client more before further interventions, so as to provide individual care to each client instead of over-generalizing. Each client is uniquely affected by his or her own cultural, educational, and religious backgrounds. The studies we obtained from other countries can act as our reference points for future planning in our own home. It is worth paying some more time to study on different perspectives of the current elder generation group to help to improve their quality of life as well as for earlier intervention in the aging population. Furthermore, it is practical to use it as a supplement to drug therapy with small groups with similar background for the optimal effect.
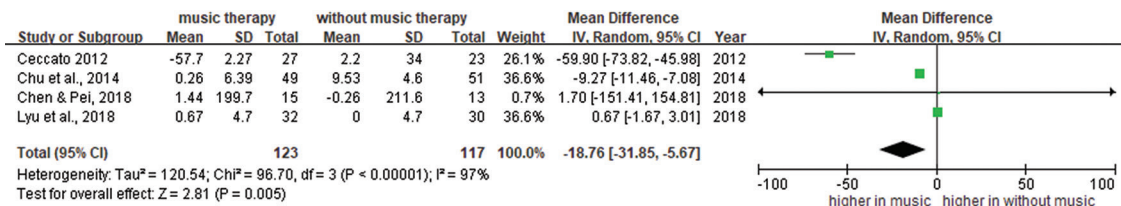

Figure 2. Forrest plots of the effect of music therapy on cognitive function in patients with dementia. Abbreviation: CI, confidence interval.
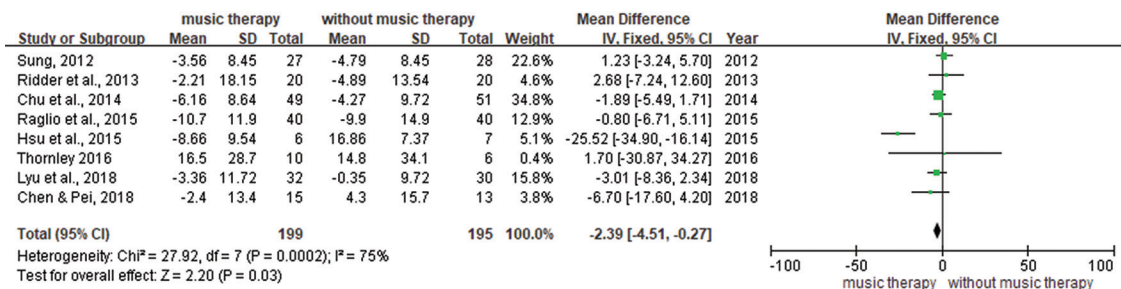

Figure 3. Forrest plots of the effect of music therapy on neuropsychiatric symptoms in patients with dementia. Abbreviation: CI, confidence interval.

4. Results

Music intervention on people with dementia has shown improvement in both the neuropsychiatric and cognitive aspects over those without any music interventions, as evidenced by the findings of all RCTs after meta-analysis.

5. Discussion and limitation

Since 4 RCT studies aimed at providing an overview on the possible effects of music therapy on cognitive impairment of patients with dementia, we performed a meta-analytic review focused on cognitive symptoms and restricted to those studies with music therapist involvement. Our meta-analysis results of 4 studies confirmed the conclusions of previous reviews, which were compatible with a significant improvement in global cognition.

Meanwhile, the meta-analytic review focused on 9 RCTs of neuropsychiatric symptoms of patients with dementia and was restricted to those studies with or without music therapist involvement. Our meta-analysis results of 9 RCT studies confirmed the conclusions of previous reviews which did find significant improvement in both the behavior and mood of participants. Our systematic review showed positive evidence to support the use of music therapy to treat disruptive behavior frequency, depression, and agitation.

The limitation of studies is related to sample size, stages of dementia, design, techniques, and approaches of music therapy as well as time, duration, and frequency of interventions. All these are subjected to further improvements for future studies such as the geographical and culture factors.

Certainly, music is a non-pharmacological, noninvasive, inexpensive intervention therapy with no adverse effects. There was positive evidence to support the use of music therapy to reduce or minimize the disruptive behavior, depression, and agitation of the participants. Moreover, there were positive trends supporting the treatment of behavior and mood, agitation frequency, as well as to reduce psychotropic medication and to prevent caregiver burnout for improving the quality of life in the long run. Further studies should emphasize on larger sample size, appropriate methods, duration and frequency of intervention used for randomized, properly blinded studies that have the appropriate populations for analyses, including intention to treat and per protocol population.

6. Conclusions

Music is closely associated with strong emotional feelings. Some studies showed a significant difference between the experimental and control groups on the reduction of agitation, depression, and anxiety. Music therapy activates the limbic system which is involved both in processing of emotions and in controlling memory. The presence of a music therapist may help people with dementia to maintain their attention on the task and to regulate the emotional arousal. According to statistics in Hong Kong (2016), the numbers of aging population (aged 65 or above) is escalating and the number of dementias are growing dramatically at the same time.[2] It is worth putting more effort on in-depth studies in order to help more people in slowing their cognitive declines[3] and improve their quality of lives.

Ethical approval

Ethical issues are not involved in this paper.

Conflicts of interest

There are no conflicts of interest.

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