Effects of dance intervention on agitation and cognitive functioning of people living with dementia in institutional care facilities: systematic review

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Abstract

Introduction: Agitation and impaired cognitive functioning are common symptoms of dementia, which require costly medication regimens that are associated with adverse effects. This study investigates the effects of dance interventions on agitation and cognitive function in people living with dementia in institutional care facilities.

Methods: Five electronic databases were searched for eligible studies on dance interventions for people living with dementia published between 2002 and 2021. Standard deviation and post mean values were extracted. Within-group Hedges' g was computed for individual studies.

Results: Six randomised controlled trials and three non-randomised studies of satisfactory quality, with a total of 610 participants, were included. Statistical analysis found significant improvements in agitation and cognitive functioning with dance interventions.

Discussion: This review provided favourable evidence on the effects of dance interventions on agitation and cognitive functions in people with dementia. However, given the limited evidence, more studies are needed to confirm the effects.

Keywords: Dance, dementia; agitation, cognitive functioning.

Introduction

Dementia is a degenerative brain disorder that affects memory, emotions, behaviour, and social functioning.[1] The prevalence of dementia is increasing globally with an estimated 50 million people suffering from this condition.[2] This is expected to increase to 115.4 million, with 13.8 million in older people, by 2050.[3,4] Its clinical manifestations include loss of memory and language comprehension.[1] Almost 90% of individuals living with dementia also demonstrate neuropsychiatric symptoms such as agitation.[5] Cognitive, behavioural, and psychological symptoms of dementia (BPSD), including agitation, apathy, and depression, are commonly seen during the disease progression.[6] These symptoms hinder the communicative ability as well as the social engagement of people with dementia.[7] Cognitive impairment and agitation interact with one another and are of particular concern; thus, assessing them together is particularly important.[8,9]

Cognitive impairment is a crucial feature of dementia and a key predictor of institutionalisation due to the resultant loss of functional independence.[10,11] Agitation is the most commonly observed BPSD.[12] It is manifested by restlessness, aggressive behaviours (physical or verbal), repeated vocalisation, and pacing.[4,8] It is associated with inadequate participation in social activities, increased need for physical restraint, and increased prescription of psychotropic drugs.[10,13] As a result, agitation may lead to serious adverse outcomes, including physical injury, distress, fear, and damage to therapeutic relationships.[14,15] These two common symptoms form a vicious cycle, causing a decline in overall health and quality of life in people with dementia as the

disease progresses, and in some cases leading to mortality.[9,10] Therefore, appropriate management should target these two symptoms simultaneously.

Agitation and cognitive impairment in dementia are primarily treated using pharmacological interventions, but their cost is high, adverse effects are common, and efficacy is limited.[16] Therefore, international guidelines recommend that nonpharmacological interventions for dementia may be a relevant care approach, except for in emergencies.[17] However, the category of nonpharmacological interventions is vast, and the evidence on the efficacy of nonpharmacological interventions to manage cognitive impairment and agitation is conflicting.[18] Complex interventions like communication skills training, person-centred care, and adapted dementia care mapping was found to be efficacious in reducing symptomatic and severe agitation in elderly adults with dementia.[19] Sensory intervention was also useful in reducing clinically significant agitation.[20] However, cognitive training interventions have not been shown to affect the cognitive domains of people with early-stage Alzheimer's disease, though some non-significant modest effects were seen in some domains of cognitive functioning.[21-23] Implementing these complex interventions requires re-engineering care delivery services (e.g., environmental renovation, intensive staff training), which may not be viable in low-resource settings. Recent evidence supports physical activity programmes in reducing agitation and benefitting cognition in people with dementia.[24,25] A systematic review of short-term exercise programmes showed their efficacy in reducing agitation.[26] However, other studies have reported conflicting effects,[27] hence the need for further exploration.

Management of neuropsychiatric symptoms is complex, and an effective approach entails the use of multicomponent interventions.[28] Dance is a preferred approach due to its composition, including the physical, cognitive, and social components of the training and the requirement of attention to the environment and music.[29] Other benefits include sensory stimulation and dance's function as a medium of communication.[30] Dance intervention refers to an organised form of physical activity associated with bodily movement in response to music in an improvised or choreographed style.[31,32] It comprises two potentially effective intervention components, music and physical activity. Music has been reported to activate the neural pathways associated with emotion.[33] Positive emotional behaviours were seen among people with dementia who were exposed to dance.[34] Dancing is a more culturally accepted form of intervention for people with dementia.[35] It is relatively simple and does not require specific prerequisites (e.g., venue, equipment, or highly trained staff). Previous studies on dancing interventions for people with dementia showed significant improvement in cognitive function and memory.[10,36] Some studies also reported a significant reduction in agitation.[15,37] However, the effects are inconsistent across studies.[38-40] Furthermore, the intervention components employed in different dance interventions were different and poorly reported across studies, making it challenging to replicate dance interventions in clinical practice.

In the literature, there are only a few systematic reviews of dancing interventions for people with dementia. Two of the reviews reported the effect of dance interventions on cognitive function in people with dementia.[41,42] Another review highlighted that exercising regularly or participating in exercise programmes did not affect

cognition.[43,44] To date, the evidence on the effects of a dance intervention on cognitive function is unconvincing due to the limited number of studies and the lack of quantification of effect sizes of the individual studies. One review broadly explored arts as a care medium for dementia.[45] Another review only focused on identifying dance intervention recommendations for practice for people with dementia.[46] A small amount of review evidence has shown that music therapy can reduce agitation.[47] Recently, an integrative review of evidence indicated that dance might improve agitation for people living with dementia.[48] However, the studies involved were case studies and qualitative studies, which do not allow for the quantification of effect sizes. No reviews have simultaneously assessed agitation and cognitive functioning. Thus, the efficacy of dance interventions and their content and components for people with dementia remains unclear.

Objective

This study aimed to achieve the following:

1. assess the effect of dance interventions on cognitive functioning in people with dementia,
2. assess the effect of dance interventions on agitation in people with dementia, and
3. identify the most commonly used content and components of dancing interventions for people with dementia.

Methods

The adopted design is a systematic review of quantitative studies. We conducted the literature search using the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions. The reporting was completed using the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA).[49]

Eligibility

Inclusion criteria

1. Population: people with dementia
2. Intervention: dance intervention
3. Comparators: no dance intervention
4. Outcome: agitation or cognitive function
5. Design: randomised controlled trials or non-randomised controlled trials
6. Place: clinic/hospital, nursing, or care homes

Exclusion criteria

1. Non-peer-reviewed articles (e.g., thesis)
2. Non-full text articles (e.g., conference papers)
3. Non-experimental designs (e.g., qualitative studies).

Information Sources

The following databases were searched: 1) CINAHL, 2) Medline, 3) SPORTDiscus, 4) PsycINFO, and 5) Cochrane Central Register for Controlled Trials. The databases were searched between 1 January 2002 and 7 March 2021.

Search

We employed the keywords [search terms] of dementia [dement* OR Alzheimer* OR cognitive impairment] AND dancing intervention [dance therap* OR therapeutic dance OR dance movement OR movement therap* OR authentic movement OR movement psycho* OR body psycho*] AND population [elderly OR older people OR old age OR seniors].

We limited our database search to articles published from 2002 to 2021, this is because modern dance therapy became well established by the middle of the 20th century,[50] and well-organised studies were available in databases from the year 2002 and beyond. Full-text articles published in the English language, and articles with abstracts available. A manual search was also conducted using the reference lists of the eligible articles.

Study Selection

The PRISMA framework guided study selection. We exported the results from the five databases to the Endnote citation manager and duplicates were removed. Screening of the titles and abstracts of all studies was conducted based on the inclusion and exclusion criteria. Eligible studies for inclusion were determined after a full-text screening. The screening processes were completed independently by two reviewers (DS and UMB), and any discrepancies were resolved through consultation with a third reviewer (EMW).

Data Collection Process

Data were extracted from the eligible papers to a Microsoft Excel spreadsheet. Data extraction was performed independently by two autonomous reviewers; a third reviewer was involved in resolving any discrepancies. We contacted the authors of the eligible papers with any queries or clarifications.

Data Items

Relevant elements of the data related to the study profile were extracted, including the participant demographics (i.e., age and gender), sample size, study design, population characteristics, intervention, control, and follow-up period.

We also extracted components of the interventions, including the study setting, intervention, dose (i.e., frequency, duration, and course), dance load (i.e., the total dancing minutes), and theories subserving the therapeutic effects of the intervention reported in the papers.

Outcome instruments and their mean and standard deviation values for cognitive function and agitation in all groups (i.e., experimental and control) were extracted at three time points: baseline (T0), immediate post-intervention (T1), and first follow-up (T2). To ensure data accuracy, the extraction was performed by two reviewers (DS and UMB) and was validated by an additional two reviewers (EMW and RK).

Risk of Bias in Individual Studies

The rating tools employed for appraising the eligible studies were the Physiotherapy Evidence Database scale (PEDro scale) and the Crowe Critical Appraisal Tool (CCAT). We used two scales due to the multiple designs used in the included studies.

The PEDro scale was selected to rate randomised controlled trials due to its strong construct validity.[51] The PEDro rating was completed by summing Items 2–11 to obtain a total PEDro score. Items 2–9 provide a score for the internal validity subscale, and Items 10 and 11 provide a score for statistical reporting.[52,53] A study with a total score of 4–5 is considered fair, 6–8 is considered good, and 9–10 is considered excellent.[54-56] Non-

randomised controlled trial studies were appraised using the CCAT. This scale does not specify the rating class, though any score > 50 is considered to be of sound quality. The CCAT uses a six-point scale, with 0 corresponding to the lowest score and 5 corresponding to the highest, to assess eight score categories.[57] The categories were 1) preliminaries, 2) introduction, 3) design, 4) sampling, 5) data collection, 6) ethical matters, 7) results, and 8) discussion.[57] The subscores of all categories are summed to obtain the total score which is expressed in a percentage known as Crowe percentage.[57] A study with a score of > 50% is considered of sound quality, while < 40% is interpreted as poor.[16]

Summary of Measures and Synthesis of Results

The Cochrane Handbook for Systematic Reviews of Interventions was used to guide data handling.[58] We intended to conduct a meta-analysis if more than two studies were found to be eligible and measure the same outcome. Data were extracted at multiple time points, T0 (baseline), T1 (immediately after the intervention), and T2 (at follow-up). We adopted a standardised approach (i.e., Hedges' g) to report the effect size of different studies because different studies used different instruments to measure the same outcome. Within- and between-group Hedges' g was computed for individual studies. The hedges' g guide for gerontology was used to determine that an effect size of 0.16 was a small effect, 0.38 was a moderate effect, and 0.76 was a large effect.[59] The clinical significance was determined using the global rating of change (i.e., anchor-based approach).[60] The magnitude of change might range from 0 (i.e., no change), 1 (i.e., tiny bit better or almost the same), 2 (i.e., a little bit better) to 7 (i.e., a very great deal better); others were -1 (i.e., a tiny bit worse or almost the same), -2 (i.e., a little bit worse) to -7 (i.e., a very great deal worse).[61]

Results

Study Selection

As shown in Figure 1, a total of 1,937 results were obtained from the electronic and manual searches. Endnote removed 14 duplicated articles. After title and abstract screening, 1,858 articles were excluded and 43 duplicate articles were manually removed. Eleven articles were removed after the full-text screening. Finally, nine articles were included in the review. Meta-analysis was not performed as only two of the seven randomised controlled trials were eligible for meta-analysis on cognitive function; other studies (n = 2) did not report cognition as an outcome but agitation.

[Insert Figure 1 here]

Study Characteristics

As shown in Table 1, the studies included mostly RCT (n=7) and they were conducted in six countries or regions including, Hong Kong (n=2),[10,15] Malaysia (n=2),[62,63] Taiwan (n=1),[37] Belgium (n=1),[36] Finland (n=1),[64] and Australia (n=1).[65] The sample size of each study ranged from 18 to 165 with a total sample size of 610. The majority of the participants were female (50-100%). The age of the participants ranged from 60 to 86 years. The participants' stage of dementia ranged from mild-moderate to moderate-severe. The stage of dementia was determined by the Global Deterioration Scale (GDS) [possible range: 1-7] at the stage of 3-6. The level of cognitive impairment was measured by the MMSE [possible range: 0-30] at either ≤ 24 or 10-28. In the intervention group, dances included music-based seated dance (n=2), Poco-poco dance (n=2), music-with-movement (n=2), dance movement therapy (n=1), music-mind-movement (n=1), and Ballroom dance

(n=1). In the control group, the majority employed conversation (n=4), followed by usual care (n=3), and relaxation exercise (n=2). The outcomes focused on global cognition which was measured by the Mini-Mental State Examination (MMSE) [possible range: 0-30] and Addenbrooke's Cognitive Examination III (ACE-III) [possible range: 0-100], on frequency of agitated behaviours which was measured by using the Modified Cohens Mansfield Agitation Inventory (CMAI), and on level of agitation which was measured by the Cohens Mansfield Agitation Inventory-Nursing Home (CMAI-NH) [possible range: 21 to 126]. The majority follow-up measured the effects of the interventions at week 4 to 12 (n=5).

[Insert Table 1 here]

Risk of Bias within Studies

As shown in Table 2, seven studies were rated by the PEDro scale because they are RCTs. In these seven studies, five studies blinded the assessors. Six studies underwent intention-to-treat analysis. No studies blinded the therapist or participants. All studies had a drop-out rate lower than 15%. All studies reported between-group statistical comparisons, point measures, and variability data. The PEDro total ranged from 5 to 8. The majority of studies (n=6) were rated as "good" in quality. Two studies were rated by the CCAT because they were non-randomised controlled trials. The Crowe total scores of both studies were 70%.

[Insert Table 2 here]

Results on objective 1: The effect of dance interventions on cognitive function in people with dementia

As shown in Table 3, the within-group effects of the individual studies indicated a moderate improvement in global cognitive function in the experimental groups at T1

(g=0.4-0.6). Specifically, in the studies conducted by Shahar et al and Ramli et al, they combined dance with relaxation activities resulting in a larger improvement in global cognitive function at T2 (g=0.9-1.2).[62,63]

A study conducted by Brancatisano et al reported the effects of dance intervention in cognitive functions by domains. A moderate improvement was observed in the verbal fluency (g=0.5) and attention (g=0.7) domains at T1.[65] Small sustained effects were observed in the verbal fluency (g=0.2), memory (g=0.3), and attention (g=0.2) domains at T2.

[Insert Table 3 here]

Results on objective 2: The effect of dance interventions on agitation in people with dementia

As shown in Table 4, two studies reported the effect of dancing on agitation using music with movement interventions. In the first study, a moderate to large improvement in agitation was achieved in the experimental group with effect sizes of 0.5 at T1 and 0.8 at T2.[37] In the second study, a moderate improvement was observed in the intervention group, with effect sizes of 0.4 at T1 and 0.5 at T2.[15] Meta-analysis was not conducted because only two studies assessing agitation were eligible. The mean agitation reduction for the intervention group at post-intervention was in a range of -1.2 to -7.4, and the effect is sustained at follow-up (-1.7 to -7.9). The changes seen in the control group was in a range of -0.2 to -3.9, and -0.2 to -6.3 at post-intervention and follow-up. The global rating of change for the intervention group was from a tiny bit better to a very great deal better. The control group also achieved no change to somewhat better and a great deal better ratings.

The effect sizes of dance intervention on agitation ranged from 0.4 to 0.5 at T1, and 0.5 to 0.8 at T2, respectively.

[Insert Table 4 here]

Objective 3: Identify the content and components of dance interventions for people with dementia

The dance intervention frequency used most often in the studies was twice-weekly (n = 5, 5.6%), followed by once weekly (n = 2, 22.2%). The session duration of all studies was 30–60 min per session (n = 9, 100%), and the most common programme duration was 6 weeks (n = 4, 44.4%; Table 5). Total dancing loads ranged from 240 to 2,520 min. Three theories were proposed in the application of the dance interventions: body-oriented theory, stress threshold model, and person-environment fit theory. None of the included studies reported using a trained dance therapist to administer the interventions.

[Insert Table 5 here]

Discussion

To our knowledge, this is the first review to provide evidence for the effectiveness of dance interventions in reducing agitation and promoting cognitive function in people with dementia in institutional care facilities. In addition, it is the first review to identify the dance intervention content and components used for people with dementia.

Based on our findings, dance interventions resulted in moderate improvements in cognitive function. However, combining dance with relaxation activities caused a more prominent effect and might be more beneficial for people living with dementia. Dance interventions were also found to improve agitation in people with dementia.

The outcome of this review corroborates the findings of Klimova, Valis, and Kuca,[39] who conducted a mini-review and confirmed the efficacy of dance interventions on cognitive function in people with dementia. Physical exercise affects cognitive function through its function of maintaining the circulation of blood and its associated nutrients and oxygen that sustain cerebrovascular integrity.[66,67] Dance exercise might lead to the release of neurotrophic factor and consequently promote the development of synapses needed for neural growth and survival.[68] Review evidence has shown that dance interventions may positively affect agitation.[48] However, this conclusion was based on weaker levels of evidence consisting of case studies and qualitative research. On the contrary, our findings were based on randomised controlled trials, which strengthens the aforementioned evidence and the hypothesis that the exercise component of dance interventions may help reduce agitation while the memorisation component of dancing may train executive function and short-term memory amongst the elderly.[69-71]

The theoretical foundation supporting these clinical changes remains unclear in the included studies. The effect of the dance interventions on agitation might be due to the interplay of many mechanisms.[72] Evidence has shown that programmed activities that promote coordination might influence the brain differently compared to other structured fitness activities.[73] Theoretically, the effects of a dance intervention on agitation and cognitive function in people with dementia are supported. The need-driven dementia-compromised behaviour (NDB) model views aggressive behaviours as a response to psychosocial and physical needs along with environmental support.[74] According to this model, dancing interventions may provide the necessary stimulation for older people with dementia to satisfy their social and physical activity needs through recreational dancing

activities, leading to reduced agitation.[74] The progressively lowered stress threshold (PLST) model explains that challenging behaviours in dementia occur as people with cognitive decline find it challenging to process, receive, and respond to stimuli.[75] Previous studies have already proven the relationship between stress and cognitive dysfunction or dementia.[76,77] Evidence supports dance interventions as beneficial to stress reduction,[78] and potentially to the facilitation of positive emotions in people living with dementia.[34] Dance provides an avenue for physical and social self-expression for people with dementia, and the social interaction might be responsible for alleviating agitation behaviours.[79] Therefore, dance interventions may promote cognition and reduce agitation by lowering stress and satisfying unmet needs. According to the NDB model, meeting the psychosocial needs of patients with dementia through recreational activities including dancing may provide the necessary stimulation needed for reducing aggression, which reduces agitation.[74] Other factors may evoke emotional or physiological changes and socialisation.[80,81] The PLST model might play a role here for people with dementia who exhibit challenging behaviours. Dancing interventions can influence an individual's mood through the group element, playfulness, echoing and mirroring, communication, and interaction involved in the activity.[82,83]

To organise a dancing intervention for people with dementia, a venue and trained practitioner are needed in the care home, hospital, or community centre. The dance intervention should be conducted at a minimum frequency of one to two times per week with a duration of 30 min per session. However, we did have concerns regarding the technical competencies of those who administered the interventions in the studies, as dancing can only be therapeutic if administered by a specialist or certified therapist.[84]

Implications

This systematic review generated insight into dance interventions as useful and beneficial tools for people with dementia. This review strengthens the evidence of the effect of dance interventions on agitation and cognitive function. It is recommended that additional empirical studies be conducted on specific types of dance interventions and their effect on other psychological outcomes such as depression and anxiety, rather than agitation only. Preliminary evidence has shown positive outcomes supporting dance use.

The clinically meaningful change of cognitive function, taking MMSE as an example, depends on the baseline cognitive function of the participants.[85] A 1-point change on subjects whose baseline MMSE scores are high (i.e., 27-30) might not be considered clinically meaningful; however, for those whose MMSE scores at baseline are intermediate (i.e., 10-20), a 1-point change can be interpreted as substantial.[85] Experts consensus submitted that a 1 to 2 point change in MMSE test in a trial might be considered clinically important.[86] In this study, the change scores seen in cognitive functioning may be clinically meaningful using the anchor-based approach.[87] Compared to the drug trials, a 5-10mg/day of donepezil (cholinesterase inhibitors) results in mean changes in MMSE scores (-1.5 to 2.0).[88] Therefore, the effect of dance intervention on cognitive function in people with dementia is clinically meaningful and the effect size is seemingly comparable with the drug.

The agitation has been a significant predictor of healthcare costs in care homes that a 1-point increase in CMAI score is associated with a 0.5% increase in an annual cost of care.[89] In a systematic review of drug trials, antidepressants (e.g., citalopram and sertraline)

reduced agitation for 3.6-3.9 CMAI scores.[90] In this review, the effect of dance interventions on agitation showed a mean reduction of 1.2 to 7.4 CMAI points. The effect of dance interventions may be clinically meaningful to save the cost of care and its peak effect is larger than that of the medications, such as antidepressants.

The included studies did not report adverse events or any participant safety concerns during the interventions and the reported drop-out rates were low. We therefore recommend the use of dance due to its minimal risk and potential benefits. Clinically, these results should be considered when planning a nonpharmacological care approach for people living with dementia. Dance intervention might be useful clinically to reduce agitation in people with dementia. Healthcare providers may consider adopting dance interventions as an adjunct to existing treatment options.

Policymakers might use these findings during the planning of care strategies for people living with dementia in the community or non-acute care setting.

Implementation costs associated with space, music, and recruiting a therapist or specialist to lead dance programmes may present a challenge if dance is accepted for use in care facilities. If these costs are prohibitive, facilities should consider collaborating with an organisation for assistance.

Limitations

There were several limitations in this review. First, only the studies published in English language were included, which did not capture other potential articles in other languages. Second, the populations in different studies were slightly heterogeneous, such

as the types of dance and stages of dementia. Particularly, most of the studies did not include people with advanced stage of dementia. The effects of the intervention in this group of people might not be clear. Nevertheless, we disclosed these demographic and clinical characteristics in each study for easy interpretation and generalisation. Third, different studies used slightly different instruments measuring the outcomes that the effect quantity might not be comparable across studies. To minimize the impact of this possible bias, we used a standardised effect size (i.e., Hedges' g) to compare the effects among different studies using different scales. Finally, the reliability of the included studies was also influenced by the risk of bias as none of the studies blinded the participants or therapists due to the nature of the intervention, only five studies blinded the assessors, and two articles reported findings from the same research.[10, 15]

Conclusions

This systematic review indicates that dance interventions may reduce agitation and improve cognitive function in people with dementia. Further studies are needed to delineate the effects of different types and components of dance therapy interventions, including dancing only compared to a combination of dancing and other interventions in people with dementia.

Conflict of interest

The Author(s) declare(s) that there is no conflict of interest.

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List of Figures

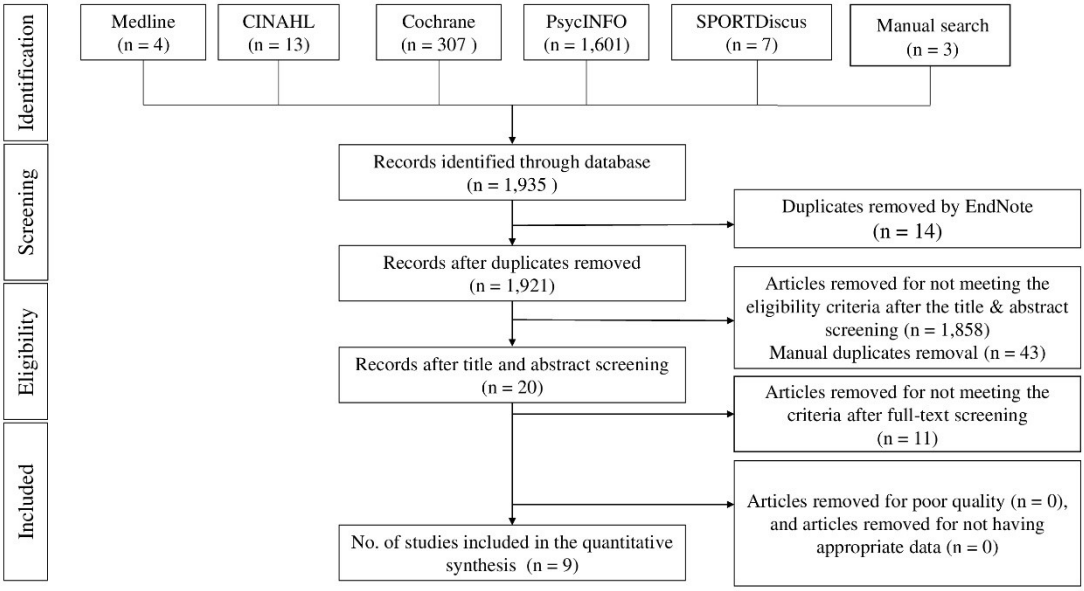

Figure 1: Prisma flowchart

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Table 1 Characteristics of the studies

Study Profile						Population				Intervention	Comparison	Outcome (Instruments)	Follow-up
No	Author	Year	Study design	Country/ Region	Sample size, N	Gender, female N (%)	Age, years (range or mean)	Stage of dementia	Level of cognitive impairment				
1	Van de Winckel	2004	RCT	Belgium	25	25 (100)	77-86	NA	MMSE≤24	Music-based seated dance	Conversation	Cognition (MMSE)	NA
2	Sung	2006	RCT	Taiwan	18	7 (38.9)	E: 76.8 C: 78.4	Mod-sev	GDS=3-6	Music-based seated dance	Conversation	Agitation (MCMAI)	NA
3	Hokkanen	2008	RCT	Finland	29	22 (76)	E: 79.9 C: 84.5	NA	NA	DMT	Usual acre	Cognition (MMSE)	4 weeks
4	Shahar	2016	QE	Malaysia	84	42 (50)	>60	Mild-mod	MMSE=10-28	Poco-poco + relaxation	Relaxation exercise	Cognition (MMSE)	NA
5	Ramli	2016	QE	Malaysia	84	42 (50)	>60	Mild-mod	MMSE=10-28	Poco-poco + relaxation	Relaxation exercise	Cognition (MMSE)	NA
6	Cheung	2018	RCT	Hong Kong	165	125 (76)	82.3	Mod	GDS=5-6	MWM	Conversation	Cognition (MMSE)	6 weeks
7	Cheung	2020	RCT	Hong Kong	165	125(76)	82.27	Mod	GDS=5-6	MWM	Conversation	Agitation (C-CMAI-NH)	6 weeks

8	Borges	2018	RCT	Brazil	60	NA	E: 66 C: 67	Mild-mod	MMSE=18-23	Ballroom dance	Usual care	Cognition (MMSE)	12 weeks
9	Brancatisano	2019	Non RCT	Australia	20	12 (60)	E: 84.4 C: 82.2	Mild-mod	ACE-III ≤82.	MMM	Usual care		7 weeks
Total					N=610								

Note: NA= Not Available; N=Number; E=Experimental group; C=Control group; DMT= Dance Movement Therapy; RCT= Randomized Controlled Trial; MMM= Music, Mind and Movement; GDS= Global Deterioration Scale (possible range: 1-7); ACE-III: Addenbrooke's Cognitive Examination (possible range: 0-100); MMSE: Mini-Mental State Examination (possible range: 0-30); MCMAI: Modified Cohen-Mansfield Agitation Inventory; C-CMAI-NH: Chinese Cohen-Mansfield Agitation Inventory-Nursing Home (possible range: 21-126); QE: Quasi-Experimental; E=Experimental group; C=Control group; M=Mean; Mild-mod=Mild to moderate; Mod-sev=Moderate to severe; MWM=Music with Movement.

Table 2 Risk of Bias within Studies

PEDro scale																
No	**Author**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PEDro total score**	**Internal validity subscale**	**Statistical reporting subscale**	**Quality rating**
1	Van de Winckel (2004)	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7	5	2	Good
2	Sung (2006)	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	6	4	2	Good
3	Hokkanen (2008)	No	Yes	No	Yes	No	No	No	Yes	No	Yes	Yes	5	3	2	Fair
4	Cheung (2018)	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8	6	2	Good
5	Cheung (2020)	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8	6	2	Good
6	Borges (2018)	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	5	3	2	Good
7	Brancatisano (2019)	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	6	3	2	Good
Crowe Critical Appraisal Tool																
		Total score			**Crowe total score (%)**											
8	Ramli (2016)	28			70%											
9	Sahar (2016)	28			70%											

Table 3 Effect sizes of the dance intervention on cognitive functions

No	Authors	Year	Group	Instruments	T0 M(SD)	T1 M(SD)	MΔ (ES)	T2 M(SD)	MΔ (ES)
1	Van de Winckel	2004	Intervention	MMSE	12.87(5.0)	15.5(4.4)	2.7 (0.6)	NA	NA
			Control	MMSE	10.8(5.0)	11.5(5.2)	0.7	NA	NA
2	Hokkanen	2008	Intervention	MMSE	12.1(5.5)	14.2(6.7)	2.1(0.4)	NA	NA
			Control	MMSE	NA	NA		NA	NA
3	Shahar	2016	Intervention	MMSE	25.4(2.9)	25.83(2.48)	0.4(0.5)	27.5(2.1)	2.1(1.2)
			Control	MMSE	22.5(3.1)	22.35(2.94)	-0.1	21.8(3.31)	-0.7
4	Ramli	2016	Intervention	MMSE	23.7(3.4)	25.0(3.3)	1.3(0.4)	26.6(3.0)	2.9(0.9)
			Control	MMSE	22.6(3.2)	22.5(3.2)	-0.1	21.2(3.7)	-1.4
5	Cheung	2018	Intervention	MMSE	10.9(4.2)	13.1(4.1)	2.1(0.5)	12.0(3.97)	1.1(0.3)
			Control	MMSE	11.9(4.4)	12.5(3.72)	0.48	11.3(3.9)	-0.6
6	Borges	2018	Intervention	MMSE	NA	NA	NA	NA	NA
			Control	MMSE	NA	NA	NA	NA	NA
7	Brancatisano	2019	Intervention	ACE-III: Total	NA	NA	NA	NA	NA
				ACE-III: Attention	10.7(3.2)	12.9(3.2)	2.3(0.7)	11.42(3.89)	0.8(0.2)
				ACE-III: Memory	12.1(6.2)	12.8(5.9)	0.7 (0.1)	14.08(5.42)	2.0(0.3)
				ACE-III: Verbal Fluency	4.3(2.7)	5.6(2.4)	1.3(0.5)	5.0(2.92)	0.7(0.2)
				ACE-III: Language	20.6(4.8)	20.4(5.9)	-0.2(-0.03)	20.5(5.93)	-0.08(-0.01)
				ACE-III: Visuospatial	9.4(4.4)	8.9(4.3)	-0.5(-0.1)	9.5(3.87)	0.08(0.02)
			Control	ACE-III: Total	NA	NA	NA	NA	NA
				ACE-III: Attention	12.0(4.8)	10.7(4.4)	-1.3	NA	NA
				ACE-III: Memory	14.2(6.2)	13.4(8.5)	-0.8	NA	NA
				ACE-III: Verbal Fluency	5.8(3.8)	3.9(3.1)	-1.9	NA	NA
				ACE-III: Language	18.7(8.3)	19.4(7.0)	0.7	NA	NA
				ACE-III: Visuospatial	8.7(4.4)	7.8(3.9)	-0.9	NA	NA

NA: Not Available; M: Mean; SD: Standard Deviation; MΔ: mean difference ES: Effect Size (within-group-Hedges' g); T0: Baseline; T1: Post-intervention; T2: Follow-up; MMSE: Mini-mental State Exam; ACE-III: Addenbrooke's Cognitive Exam - III

Table 4. Results of individual studies (Agitation)

No	Author	Year	Group	Instrument	T0 M(SD)	T1 M(SD)	MΔ (ES)	T2 M(SD)	MΔ (ES)
1	Sung	2006	Intervention	MCMAI	5.1(2.5)	3.9(1.9)	-1.2(0.5)	3.4(1.3)	-1.7(0.8)
			Control	MCMAI	4.7(1.8)	4.6(1.8)	-0.2	4.5(1.7)	-0.2
2	Cheung	2020	Intervention	CMAI-NH	40.9(20.0)	33.5(14.4)	-7.4(0.4)	33.1(14.7)	-7.9(0.5)
			Control	CMAI-NH	37.2(15.0)	33.3(11.8)	-3.9	30.9(11.4)	-6.3

M: Mean; SD: Standard Deviation; MΔ: mean difference; ES: Effect Size (within-group-Hedges G); T1: Baseline; T2: Post-intervention; T2: Follow-up; MCMAI: Modified Cohens Mansfield Agitation Inventory; CMAI-NH: Cohen Mansfield Agitation Inventory – Nursing Home

Table 5. Intervention Components

No	Authors	Year	Place of intervention	Who administered the intervention	Dose	Total dance load (total time in minutes)	Theories/model used
1	Van de Winckel	2004	Public psychiatric hospital	Physiotherapist	F: 7 times D: 30 minutes C: 12 weeks	2,520	NA
2	Sung	2006	Residential care facilities	Nursing researcher & trained research assistants	F: Twice D: 30 minutes C: 4 weeks	240	NA
3	Hokkanen	2008	Nursing homes	Undefined	F: Once D: 37.5 minutes C: 9 weeks	337.5	NA
4	Shahar	2016	Publicly funded residential homes	Physical therapist	F: Twice D: 60 minutes C: 6 weeks	720	NA
5	Ramli	2016	Publicly funded residential homes	Physical therapist	F: Twice D: 60 minutes C: 6 weeks	720	NA
6	Cheung	2018	Residential care facilities	Nurse	F: Twice D: 30 minutes C: 6 weeks	360	STM, PEFT
7	Cheung	2020	Residential care facilities	Nurse	F: Twice D: 30 minutes C: 6 weeks	360	STM, PEFT
8	Borges	2018	Hospital	Undefined	F: Thrice D: 50 minutes C:12 weeks	1,800	NA
9	Brancatisano	2019	Residential care facility	Facilitators	F: Once D: 45 minutes C: 7 weeks	315	NA

Note: NA=Not Available; F= Frequency (times per week); D= Duration (minutes per session); C=Course; STM: Stress Threshold Model, PEFT; Person-Environment Fit Theory.

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