

## REVIEW ARTICLE

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## MUSIC CUED EXERCISES FOR MOTOR AND NON-MOTOR SIGNS IN PEOPLE WITH DEMENTIA: PROTOCOL FOR A SYSTEMATIC REVIEW

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## ABSTRACT

**Background:** Movement disorders and non-motor problems such as cognitive decline, anxiety, depression and behavioural problems, are common in people with dementia and can progress over time. Exercise coupled with music is a promising form of therapy designed to improve both the motor and non-motor manifestations of this debilitating neurological condition.

**Objectives:** To present a protocol for a systematic review and critical analysis of the literature to answer the following questions:  
(i) Is music-cued exercise more effective than usual care for the treatment of motor and non-motor symptoms of dementia?  
(ii) What are the outcomes of music-cued exercise for people living with dementia?

**Methods:** We provide the protocol for a systematic review and critical analysis of the literature using the PRISMA guidelines. Studies shall be reviewed that use music cued exercises aimed at improving the management of physical and non-physical problems associated with dementia. Eligibility criteria will be applied to the title and abstract of each citation as a first step followed by full text screening. Data extraction and quality appraisal are to be performed by two reviewers.

**Data sources:** This protocol documents the comprehensive search strategy to be performed using MEDLINE, CINAHL, EMBASE, PSYCHINFO, PUBMED, SCOPUS and web of science databases. Science, technology and engineering databases will also be searched.

**Eligibility criteria:** All study designs incorporating data will be included in this review. The following selection criteria shall be applied:

- Participants will be people diagnosed with dementia, including Alzheimer's disease, of any stage and severity, all ages, any range of co-morbidities, any medications.
- Interventions will use rhythmic music with any physical exercise or rehabilitation program.
- Outcomes shall include motor impairments such as gait, postural stability and general mobility. Studies considering non-motor signs such as anxiety, depression, behavioural disturbances and cognitive decline will also be included.

**Results:** Evidence will be built from this review regarding the effectiveness of using music-cued exercises to optimise physical abilities and improve non-motor disorders in people with dementia.

**Conclusions:** This protocol paper documents the methods that we shall use for a forthcoming systematic review. The knowledge obtained from the review will provide guidance to people with dementia, caregivers and clinicians by clarifying the strength of the evidence for music-cued movement rehabilitation.

**Keywords:** Dementia, Alzheimer's disease, Music, Exercise, Motor, Non-motor.

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## BACKGROUND

This manuscript details the protocol for a systematic review and critical analysis of the literature on music-cued exercises for people living with dementia. Dementia is a chronic neurodegenerative disorder characterised by a gradual deterioration in cognitive and behavioural functions, emotional regulation, and also movement control [1]. The incidence increases with age, with the rate of dementia increasing especially rapidly in the age range 85-89 years, where more than 7% of people are affected [2,3]. Over 90 years of age, more than 10% of people have dementia [2]. A study of global prevalence [4] estimated the number of people living with dementia to double every 20 years, to eventually reach 81 million by 2040. According to a study done in 2015, it will increase to more than 135 million by 2050 [5]. Alzheimer's disease (AD) is the most common form of dementia and accounts for 60-70% of cases [6]. It mostly affects people aged over 65 years and early onset AD is less common [7].

According to The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-IV) [8], the most common feature for probable diagnosis of dementia is deterioration of at least one cognitive function resulting in interference with daily life activities. Cognitive functions affected include memory, speech, language, judgment, reasoning, planning and other cognitive abilities. There are other features that are specific for each dementia subtype. The following criteria characterize Alzheimer's disease [8]:

- (i) Either family history or genetic evidence of Alzheimer's disease.
- (ii) Deterioration of memory or learning plus at least one other cognitive function.
- (iii) Gradual progressive decline in cognition.
- (iv) Apathy and depression.
- (v) Absence of other aetiologies that contribute to cognitive decline.

These symptoms can progress to a level of severity that impairs a person's daily life functions [9]. People with dementia may also require assistance in basic activities of daily living, such as eating, dressing, bathing, toileting and transferring [10]. This deterioration of function can increase the risk of secondary complications such as pneumonia, which is a common cause of death [11, 12].

Some of the defining symptoms of dementia are non-motor. These include cognitive decline, behavioural symptoms such as wandering, and psychological problems such as anxiety and depression [3, 13, 14]. Impairment of motor functions such as gait, postural stability and general mobility may also occur in the early stages of the disease [15-18]. Motor dysfunction is sometimes detected before cognitive decline [19]. For some dementia subtypes, such as Lewy body disease, motor function in the early stages shows greater deterioration than other conditions such as idiopathic Parkinson's disease [20].

Several studies have shown beneficial effects of physical

activity and exercises for enhancing physical performance and functional ability in people living with dementia [6, 16,21,22,23,24]. Physical exercise can also improve behavioural, psychological and cognitive manifestations of dementia [6, 25, 26]. Engagement in physical activity may be quite challenging for some people living with dementia [27]. Confusion, poor short-term memory, lack of motivation, apathy and lethargy can be barriers to physical activities and some structured activity programs [28,29]. Combining movement with music was reported to be an effective intervention in dementia, especially in the early to middle stages of Alzheimer's disease [30]. Combining physical exercises with music can sometimes be helpful for motor and non-motor signs [31]. It is also argued to promote general wellbeing in some individuals with dementia [30].

A growing number of studies provide evidence on the positive effects of music for behaviour and cognitive function in people living with dementia [32,33,34]. Music can play an important role in the facilitation of movement and can motivate some people with dementia to exercise [27,35]. Musical abilities may remain relatively preserved, even in severe dementia [5]. Using music as an auditory cue during movement is argued to increase the activation of the cerebellum, mainly lobule IV of the left cerebellum [36]. This area of the cerebellum is involved in musical processing [37,38], and also involved in different cognitive and motor tasks [39]. It also arguably subserves memory and motor learning in some people with dementia [36, 40]. The emotional and affective features of the music might motivate individuals and facilitate synchronization of movement to the beat, and in some people is thought to enhance the learning process [40].

Some have argued that changes in motor patterns in reaction to external rhythmic cues is due to re-programming of executive motor systems in the brain which allow for optimum anticipation, planning and execution of movement [41]. It has also been proposed that, for music to be effective in improving motor and non-motor signs when combined with physical activity, it needs to follow a specific rhythm that aligns with the exercises [42]. Rhythm influences motor control and may facilitate motor performance, especially when movement to music is enjoyable [27, 42,43,44].

This protocol paper details the procedure that we shall be using in a forthcoming systematic review that will analyse the evidence of the effectiveness of music-cued exercises for improving physical abilities and non-motor symptoms in people living with dementia. There are two main questions for the review:

- (i) Is music-cued exercise more effective than usual care for the treatment of select motor and non-motor symptoms of dementia?
- (ii) What are the outcomes of music-cued exercise for people living with dementia?

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## METHODS/DESIGN

### Description

This protocol is reported according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols (PRISMA-P 2015) [45]. It uses the PRISMA-P checklist which contains 17 items considered to be essential in a systematic review protocol.

### Eligibility criteria

Studies will be selected according to the criteria outlined below:

#### Study designs:

All study designs incorporating data will be included in this review.

#### Population:

We will include studies examining music-cued exercise therapy for people diagnosed with dementia, including Alzheimer's disease, and with the following criteria: any stage of the disease and any severity, all ages, any range of co-morbidities, any medications, and any duration of intervention.

#### Interventions:

Studies addressing rhythmic music with any designed physical exercise or rehabilitation program. Studies will be excluded if music therapy is used as mental practice only, or when the only activity is instrumental playing of music. Music studies not designed as part of an exercise program will also be excluded.

#### Outcomes:

Outcomes will involve motor signs such as gait problems, postural instability and slowness of movement. In addition, non-motor signs (anxiety, depression, behavioural disturbances and cognitive decline) shall be measured, with any outcome measuring tool.

#### Timeframe:

Studies conducted and published in the last 30 years.

#### Language:

Articles reported in English only.

#### Information sources

A comprehensive search of the literature will be performed using the following:

- (i) Health sciences databases including MEDLINE, CINAHL, EMBASE, PSYCHINFO, PUBMED, SCOPUS and web of science.
- (ii) Science, technology and engineering databases including Science Direct (Elsevier), Wiley Online Library, and Journal of Visualized Experiments (JoVE) which have access to the following six sections: General, Neuroscience, Immunology & Infection, JoVE Medicine, Bioengineering, JoVE Engineering.
- (i) The reference lists of retrieved papers and review articles.
- (i) Hand searching of specific journals such as Journal of Alzheimer's Disease and Other Dementias, Clinical

Rehabilitation, Archives of Physical Medicine and Rehabilitation, Dementia and Geriatric cognitive disorder and Journal of Music Therapy.

- (iii) Searching of grey literature and associated databases (including these): Proquest Dissertations and Theses Global, CINAHL, SCOPUS, Web of Science and Google Scholar.

#### Search strategy

All study designs will be included. The search will be limited to studies in the English language in the last 30 years. MEDLINE, CINAHL, EMBASE, PSYCHINFO, PUBMED, SCOPUS and web of science databases will be searched using two groups of keywords: the first group includes Alzheimer OR Dementia. The second pertains to music (including rhythm or auditory or acoustic) and exercise (including movement or mobility or training). Keywords were selected by the reviewer in collaboration with an experienced health sciences librarian. A draft of the MEDLINE search strategy is presented in Appendix I. This strategy will be adapted for use in the other databases.

Reference lists of the relevant articles will also be searched for additional studies that may be eligible. Auto alerts will be activated to provide a continuous update and detection of relevant studies. Eligibility criteria will be applied first on the title and then the abstracts of the studies followed by full text screening.

#### Study records

##### Data management and selection process:

The search results and citations will be uploaded to an EndNote© [46] software program which shall be used to store and organize citation information. EndNote© will also be used to check for duplicates.

Titles and abstracts will be screened by two reviewers. These two independent reviewers will screen the full text of each relevant article to decide whether it meets the inclusion criteria. If there are disagreements, they will be resolved through discussion between reviewers until consensus is reached.

##### Data extraction

In the forthcoming systematic review, data will be extracted and checked for accuracy and validity of information by the two reviewers. The data will be extracted using a standardized form (Appendix II) and any disagreement between the reviewers will be resolved by discussion until consensus is reached.

##### Data

The data to be collected from each eligible study will include the study title, author names, publication source, study design, duration of the study, whether included or excluded and the reasons for exclusion. Participant characteristics shall include age, sex, type of dementia, severity of dementia and presence of co-morbidities. Intervention characteristics shall include the type of music used, criteria for music selection, type of exercise accompanying music, co-interventions and the duration of each session. Out-



come assessment shall appraise whether the outcome measure was motor or non-motor and whether it was primary or secondary. The assessors shall also ascertain if subjective or objective measurement tools were used and the presence of follow-up assessments. The results of each study shall be summarised.

### **Outcomes and prioritization**

The outcomes of interest include motor signs such as gait, balance and mobility, and non-motor signs such as anxiety, depression, behavioural disturbances and cognitive decline.

### **Risk of bias assessment**

Two reviewers will independently conduct the quality evaluation for the studies involved in the forthcoming systematic review. Disagreements will be resolved by discussion, and then by consultation of a third party if required until consensus is reached. Two methodological quality assessment tools will be used in this review. These are the Cochrane collaboration tool for assessing the risk of bias [47] (Appendix III) and the Downs and Black [48] checklist.

For the randomized controlled trials (RCTs), the Cochrane collaboration tool for assessing the risk of bias will be used [49]. This tool includes six domains: sequence generation, allocation concealment, blinding of participants, personnel and outcome assessors, incomplete outcome data (e.g. dropouts and withdrawals), selective outcome reporting, and the presence of other sources of bias. For each item, the procedures undertaken in each study will accurately be described.

A judgement about the possible risk of bias for each domain of the Cochrane tool will depend on the extracted information which will be rated as either “yes” (low risk of bias), or “no” (high risk of bias). If the detail of the procedure is insufficient or not obviously reported in the study, the item will be rated as “unclear”. Verbatim quotes from the eligible studies will be included to describe the procedure related to each domain. A conclusion shall be drawn about the overall risk of bias.

The risk of bias for the non-randomized studies will be assessed by using the Downs and Black checklist [48]. This consists of 27 questions with the following items: reporting (10 questions), external validity (3 questions), internal validity; control of bias (7 questions), confounding, which identify bias in subjects selection (6 questions) and power (1 question), with additional explanation provided beside each item [50]. Each item shall be marked as “yes”, “no”, or “unable to determine”. Items shall be scored (yes=1 and no=0 except for the reporting item which is scored from 1-5) and summed to provide a total score, with a maximum score of 31. The higher the score, the higher the quality [48].

### **Data synthesis**

The data shall be double entered and we shall pool the quantitative data for a meta-analysis where possible, using Rev-Man Review Manager [51]. Statistical analysis will fo-

cus on the primary outcomes and pooled risk ratios (RR) with 95% confidence intervals (CI) will be determined employing a random effect model, given the variability in studies reviewed. Descriptive data and study characteristics and quality assessment results of each study will also be presented in tables and the manuscript. The results obtained from data extraction and methodological quality assessments shall be tested for homogeneity. If the studies are sufficiently homogeneous, data will be synthesized through conducting meta-analysis.

### **RESULTS**

This protocol paper has described the procedures to be employed in a future systematic review. The systematic searching process is currently underway. Data extraction and quality appraisal processes will be completed in March 2017, where the results of this systematic review will be obtained.

### **DISCUSSION**

This protocol paper has documented methods to use in the systematic review. From this a body of evidence will be compiled regarding the role of music cued exercise for both motor and non-motor manifestations of dementia.

### **CONCLUSION**

The information that will be obtained from the future systematic review and critical appraisal of the literature will provide guidance to patients, caregivers and specialists in the clinical decision-making process, in order to better support people living with dementia.

### **Authors Contributions**

The first author wrote this protocol with contribution, mentorship and feedback from the other co-authors. The final manuscript has been read and approved by all authors.

### **Conflicts of Interest**

None declared.

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### Appendix I: MEDLINE search strategy

1. Exp Dementia/ or exp Alzheimer Disease/
2. Limit 1 to English language
3. (Alzheimer\* or Dementia).mp.
4. Limit 3 to English language
5. 2 or 4
6. (Music or Rhythmic or auditory or acoustic).mp.
7. Limit 6 to English language
8. (Exercise\* or cue\* or training or move\* or mobility).mp.
9. Limit 8 to English language
10. #5 and #7 and #9

**Appendix II: Data extraction form**

**Data extraction form**

Name of the reviewer: .....

**Study title:**

Study ID	
First author name	
Year	
Publication source	
Study design type	
Duration of the study	

Participants characteristics	
Age (mean or range)	
Sample size	
Number of groups and number of participants in each group	
Sex	Males: Females:
Type of dementia	
Severity of dementia	
Co-morbidities	

Intervention Characteristics	
Type of music	
Criteria for music selection	
Type of exercise accompanying music	
Co-interventions used	
Number of sessions	
Duration of sessions	

Outcome assessment	
Type of outcome	Motor: Non-motor:
Primary outcome	
Measurement tools	
Secondary outcome	
Measurement tools	

Outcome	Results

Final conclusion

**Appendix III: Cochrane collaboration tool for assessing the risk of bias\***

<b>Domain</b>	<b>Support for judgement</b>	<b>Review authors' judgement</b>
<i>Selection bias.</i>		
<b>Random sequence generation.</b>	Describe the method used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups.	Selection bias (biased allocation to interventions) due to inadequate generation of a randomised sequence.
<b>Allocation concealment.</b>	Describe the method used to conceal the allocation sequence in sufficient detail to determine whether intervention allocations could have been foreseen in advance of, or during, enrolment.	Selection bias (biased allocation to interventions) due to inadequate concealment of allocations prior to assignment.
<i>Performance bias.</i>		
<b>Blinding of participants and personnel</b> <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Describe all measures used, if any, to blind study participants and personnel from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective.	Performance bias due to knowledge of the allocated interventions by participants and personnel during the study.
<i>Detection bias.</i>		
<b>Blinding of outcome assessment</b> <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Describe all measures used, if any, to blind outcome assessors from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective.	Detection bias due to knowledge of the allocated interventions by outcome assessors.
<i>Attrition bias.</i>		
<b>Incomplete outcome data</b> <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Describe the completeness of outcome data for each main outcome, including attrition and exclusions from the analysis. State whether attrition and exclusions were reported, the numbers in each intervention group (compared with total randomized participants), reasons for attrition/exclusions where reported, and any re-inclusions in analyses performed by the review authors.	Attrition bias due to amount, nature or handling of incomplete outcome data.
<i>Reporting bias.</i>		
<b>Selective reporting.</b>	State how the possibility of selective outcome reporting was examined by the review authors, and what was found.	Reporting bias due to selective outcome reporting.
<i>Other bias.</i>		
<b>Other sources of bias.</b>	State any important concerns about bias not addressed in the other domains in the tool.  If particular questions/entries were pre-specified in the review's protocol, responses should be provided for each question/entry.	Bias due to problems not covered elsewhere in the table.

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