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REVIEW

Arts-based interventions to improve cognition in older persons with mild cognitive impairment: A systematic review of randomized controlled trials

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ABSTRACT

Objectives: As the global burden of dementia rises, the search for preventive measures such as interventions for mild cognitive impairment (MCI) remains a research priority. While arts-based interventions have demonstrated some success in improving cognitive functioning among older adults and those with dementia, its effectiveness for older persons with MCI remains unexplored. We conducted a systematic review to examine the effects of arts-based interventions on cognition in older persons with MCI.

Method: The following databases were searched in November 2019: PubMed, EMBASE, PsycINFO, and CINAHL Plus, supplemented by Google Scholar and ALOIS. Study inclusion criteria were older persons aged $\geq$ 60 with MCI; arts-based interventions such as dance, drama, music, or visual arts; and randomized controlled trial with cognitive outcome. Database search, study selection, and data extraction were conducted independently by 2 reviewers.

Results: Eleven randomized controlled trials examining 13 interventions (817 participants) were identified, of which 4 involved visual arts, 4 dance/movement, 3 music, and 2 storytelling. Significant improvement on at least one cognitive outcome was reported in 10 of the 13 interventions. These included improvements in global cognition (6/7 interventions), learning and memory (5/9), complex attention (4/10), executive functioning (2/6), language (2/3), and perceptual-motor function (1/4).

Conclusion: This review found that arts-based interventions can potentially improve various aspects of cognitive functioning in older persons with MCI, although our confidence was dampened by methodological limitations such as the moderate-to-high risk of bias present in studies and heterogeneity in the way MCI was defined. Recommendations for future research are discussed.

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Arts; mild cognitive impairment; mild neurocognitive disorder; cognitive functioning; systematic review

Introduction

Mild cognitive impairment (MCI), which maps to mild neurocognitive disorder in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013), is a condition in which modest cognitive decline occurs with no impairment in daily functioning. This is in contrast to major neurocognitive disorder (or dementia), wherein the cognitive decline is substantial and interferes with independent functioning (Sachdev et al., 2014). As a transitional state between normal aging and dementia (Petersen, 2004), individuals with MCI are at elevated risk of developing dementia (Petersen et al., 2018). With the global burden of dementia on the rise (Nichols et al., 2019), secondary prevention of dementia, such as identifying at-risk individuals with MCI for early intervention to prevent further disease progression, remains a priority (Livingston et al., 2017; Shah et al., 2016). Individuals with MCI are prime candidates for early intervention, as data suggests that the condition may be reversible, with an estimated 14.4% to 55.6% of them reverting back to normal cognition (Petersen et al., 2018). Unfortunately, effective interventions for MCI remain elusive (Livingston et al., 2017). Existing reviews found limited evidence to support the use of pharmacotherapy to improve cognitive function in MCI (Cooper, Li, Lyketsos, & Livingston, 2013; Petersen et al., 2018). On the other hand, nonpharmacological approaches, mainly exercise (Gates, Fiatarone Singh, Sachdev, & Valenzuela, 2013; Petersen et al., 2018) and cognitive interventions (Petersen et al., 2018; Reijnders, van Heugten, & van Boxtel, 2013), have shown promise, fueling interest in the use of other psychosocial approaches to treat MCI.

Several lines of research suggest that engaging in the arts, such as visual arts, music, dance, or drama, may improve cognitive functioning. Epidemiological evidence indicates that engaging in leisure activities in later years, such as playing musical instruments or dancing, may have a protective effect against dementia (Fratiglioni, Paillard-Borg, & Winblad, 2004; Verghese et al., 2003; Yates, Ziser, Spector, & Orrell, 2016), possibly by building cognitive reserve (Fratiglioni et al., 2004; Fratiglioni & Wang, 2007). One neuroimaging study further demonstrated evidence of

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increased functional connectivity in the default mode network after older persons engaged in 10 weeks of visual art production (Bolwerk, Mack-Andrick, Lang, Dorfler, & Maihofner, 2014). Reviews of experimental research with older adults and those with dementia also demonstrate a trend for arts-based interventions including music (Fusar-Poli, Bieleninik, Brondino, Chen, & Gold, 2018; Zhang et al., 2017) and dance (Meng et al., 2020) to improve cognitive outcomes (Noice, Noice, & Kramer, 2014; Young, Camic, & Tischler, 2016), although their efficacies remain equivocal (Cowl & Gaugler, 2014; Li, Wang, Chou, & Chen, 2015; van der Steen et al., 2018). It has also been theorized that common active factors in arts therapies, such as aesthetics, hedonism, nonverbal communication, enactive transitional support, and generativity, are what make the arts an effective therapeutic modality (Koch, 2017). Besides being a potential intervention for cognitive function, engaging in the arts is a holistic activity that has the added benefits of improving quality of life and wellbeing for older persons (Ho et al., 2019; Noice et al., 2014), all while experiencing enjoyment at the same time.

While earlier reviews of psychosocial interventions for MCI have mainly focused on physical activity or cognitive interventions, no review to date has systematically examined the evidence for arts-based interventions for MCI. Given promising results from reviews of arts-based interventions for dementia, a review focusing on MCI, a pre-dementia stage that is arguably more amenable to preventive intervention due to greater preserved cognitive function, is warranted. Thus, the purpose of this review is to explore the effects of arts-based interventions on cognition in older persons with MCI and to identify gaps in the literature. In this review, we use the catch-all term 'arts-based interventions' to include both arts therapies (i.e., delivered within a therapeutic relationship by a credentialed therapist) and 'arts as therapy' (i.e., the use of the arts for therapeutic purposes, often delivered by other healthcare workers or arts practitioners, and without establishing a therapeutic relationship), similar to other reviews (Ing-Randolph, Phillips, & Williams, 2015; Sihvonen et al., 2017).

Methods

This systematic review is reported in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2009).

Search strategy

Two reviewers (Z.H., S.H.) independently searched the following databases (from database inception to 8 November 2019): PubMed, EMBASE (Elsevier), PsycINFO (Ovid), and CINAHL Plus (EBSCO). Supplementary searches of Google Scholar for grey literature (first 350 results; Haddaway, Collins, Coughlin, & Kirk, 2015) and ALOIS (trials register maintained by Cochrane Dementia and Cognitive Improvement Group) were also conducted, although no additional relevant articles were retrieved from these sources. A combination of free-text search terms and controlled vocabulary related to the population (MCI), intervention (arts-based), outcome (cognition), and study design (randomized controlled trial; RCT) were used (see Supplementary Table S1 for full search strategy). No limits to language and year of publication were applied. Records were managed on EndNote and deduplicated using the strategy by Bramer, Giustini, de Jonge, Holland, and Bekhuis (2016).

Study selection

Two reviewers (Z.H., S.H.) independently screened and identified relevant records using the Rayyan web application (Ouzzani, Hammady, Fedorowicz, & Elmagarmid, 2016), first based on the title and abstract and then in detail by looking at the full text. Discrepancies were resolved by consensus with a third reviewer (T.T.). The inclusion criteria for this review were:

i. **Population:** Older persons aged 60 and above; all participants, or a separately analyzed subgroup, have MCI based on criteria explicated by study authors;
ii. **Intervention:** Arts-based, which includes dance/movement, drama, music, or visual arts;
iii. **Comparator:** Appropriate control group (e.g., age-matched, MCI status, no treatment/waitlist/active control);
iv. **Outcome:** Any cognitive measure;
v. **Study type:** RCT; published in any language.

The exclusion criteria were:

i. Samples with mixed severity of cognitive decline (e.g., MCI and dementia patients; mild-to-moderate dementia);
ii. Multimodal interventions wherein the effect of the arts intervention cannot be singled out;
iii. Not full-text research papers (e.g., protocols or conference abstracts).

Data extraction

Data were extracted by one reviewer (Z.H.) in the first instance using a data extraction form and checked for accuracy by a second reviewer (S.H.). Discrepancies were resolved by discussion between reviewers. The data extracted included information about:

i. **Overall**: Year published, country, RCT design, research question;
ii. **Sample**: Inclusion and exclusion criteria, recruitment strategy, MCI definition, age, gender ratio, sample size;
iii. **Intervention**: Description of intervention and control, individual or group format, who delivered the intervention, length of session, frequency, and overall duration of intervention;
iv. **Outcomes**: Cognitive measure used, timepoints measured, and whether intervention effect was significant.

Assessment of risk of bias was performed independently by 2 reviewers (Z.H., S.H.) using RoB 2 (Sterne et al., 2019). The RoB 2 is the revised version of the risk-of-bias tool recommended by Cochrane to evaluate randomized trials (Higgins et al., 2019). The tool provides a set of signaling questions to guide the assessment of bias across five

Table 1. Characteristics of included studies.

Author (Year) Country RCT design	Recruitment strategy	MCI definition	Mean age (SD)	Gender (% female)	Sample size	Intervention (Individual/Group)	Control (Individual/Group)	Who conducted the intervention	Session length Frequency Overall duration
Aguinaga (2016) USA Crossover	Older Latinos attending adult day service center	MMSE 18-26	IG: 76.0 (6.0) CG: 74.9 (6.8)	IG: 80% CG: 72.7%	IG: 10 CG: 11	Latin dance program (?Group)	Waitlist (Individual)	Professional dance instructor	60 mins 2/week 16 weeks
Chan et al. (2016) Hong Kong Parallel	Community day activity centers	CDR 0.5	IG: 65.9 (5.0) CG: 66.4 (3.7)	IG: 64.3% CG: 93.8%	IG: 14 CG: 16	Chinese calligraphy training (Group: 6-8/group)	Learning functionality of iPad and writing Chinese characters on custom-designed app (Group: 6-8/group)	Professional calligraphy master, research assistant	90 mins 2/week 8 weeks
Chan et al. (2017) Hong Kong Parallel	?	1) MoCA 19-26 2) CDR $\leq$ 0.5 3) Self-report of cognitive decline 4) Independent in ADL	IG: 69.4 (5.9) CG: 68.1 (5.7)	IG: 66.7% CG: 74.5%	IG: 48 CG: 51	Chinese calligraphy training (Group: 8-12/group)	Learning functionality of iPad and copying out Kai script characters using pen and paper (Group: 8-12/group)	Professional calligraphy master, research assistant	90 mins 2/week 8 weeks
Doi et al. (2017) Japan Parallel	Individuals previously enrolled in population study	Peterson's criteria: 1) Subjective cognitive complaints 2) Objective cognitive impairment (age-adjusted scores $<$ 1.5 SD in memory and nonmemory domains) 3) No functional dependency in ADL 4) Does not meet DSM-IV criteria for dementia Consensus case conferences involving neurologists, geriatricians, neuropsychologists	IG: 75.7 (4.1) CG: 76.0 (4.9) IG: 76.2 (4.6) CG: 76.0 (4.9)	IG: 50.7% CG: 46.3% IG: 58.2% CG: 46.3%	IG: 67 CG: 67 IG: 67 CG: 67	Ballroom dance program (Group: 11-16/group) Playing percussion instruments (Group: 11-19/group)	Health education class, 3 $\times$ 90 mins (?Group) Health education class, 3 $\times$ 90 mins (?Group)	Professional dance instructors Professional music instructors	60 mins 1/week 40 weeks 60 mins 1/week 40 weeks
Kropacova et al. (2019) Czech Republic Parallel	Individuals longitudinally followed at Department of Neurology	One of the following: 1) If MoCA $\geq$26 , $<$1.5 SD in 2 tests in at least 1 cognitive domain as assessed by cognitive test battery 2) If MoCA $<$26, $<$1.5 SD in any 2 tests 3) If objective memory deficit on MoCA, $<$1.5 SD in at least 1 test from memory domain	?	?	IG: 15 CG: 19	Dance-movement intervention (Group)	Life-as-usual (Individual)	Professional instructors from Faculty of Sport Studies	60 mins 3/week 6 months, 60 sessions

(*continued*)

Table 1. Continued.

Author (Year) Country RCT design	Recruitment strategy	MCI definition	Mean age (SD)	Gender (% female)	Sample size	Intervention (Individual/Group)	Control (Individual/Group)	Who conducted the intervention	Session length Frequency Overall duration
Kwok et al. (2011) Hong Kong Parallel	Nursing home	MMSE 20-25	IG: 85.8 (4.9) CG: 85.8 (6.9)	IG: 64.3% CG: 93.8%	IG: 14 CG: 17	Chinese calligraphy training (?Group)	No calligraphy training (Individual)	Trained research assistant	30 mins 5/week 8 weeks
Lazarou et al. (2017) Greece Parallel	?	Peterson's criteria; neuropsychological assessments and input from multidisciplinary team with expertise in dementia care	IG: 65.9 (10.8) CG: 67.9 (9.5)	IG: 80.3% CG: 76.2%	IG: 66 CG: 63	International ballroom dancing (Group)	Waitlist (Individual)	Dance instructor	60 mins 2/week 40 weeks
Mahendran et al. (2018) Singapore Parallel	Individuals from earlier community cohort study	Peterson's criteria: 1) At least 1 age-education adjusted neuropsychological test Z score < -1.5 2) Does not meet DSM-5 criteria for major neurocognitive disorder 3) Memory/cognitive complaint preferably corroborated by a reliable informant	IG: 71.1 (4.8) CG: 70.6 (5.8) IG: 71.6 (5.3) CG: 70.6 (5.8)	IG: 81.8% CG: 81.8% IG: 83.3% CG: 81.8%	IG: 22 CG: 22 IG: 24 CG: 22	Art therapy (Group) Music reminiscence (Group)	Life-as-usual (Individual) Life-as-usual (Individual)	Trained therapists Trained therapists	60 mins 1/week for 3 months, then 1/fortnight for 6 months 9 months 60 mins 1/week for 3 months, then 1/fortnight for 6 months 9 months
Shimizu et al. (2018) Japan Parallel	Individuals who voluntarily attended a prevention of dementia care class by municipality	Endorsed $\geq$1 item on memory impairment checklist constructed with reference to Peterson's criteria	IG: 74.9 (4.3) CG: 73.3 (7.3)	?	IG: 30 CG: 9	Movement music therapy: Exercising, singing, using Naruko clapper, and synchronizing exercise movements with instructor (Group)	Exercising while counting aloud and synchronizing exercise movements with instructor, without music or Naruko clapper (Group)	?Instructor	60 mins 1/week 12 weeks
Xu et al. (2017) China Parallel	Patients being treated at the hospital for MCI	1) Self-report of memory decline 2) GDS, MMSE and ADL indicating cognitive decline, but does not meet criteria for dementia 3) Decline in daily functioning	?	?	IG: 36 CG: 36	Storytelling based on pictures (Group: 6/group)	Piracetam 0.8g, 3/day (Individual)	?	60 mins 1/week 16 weeks

(*continued*)

Table 1. Continued.

Author (Year) Country RCT design	Recruitment strategy	MCI definition	Mean age (SD)	Gender (% female)	Sample size	Intervention (Individual/Group)	Control (Individual/Group)	Who conducted the intervention	Session length Frequency Overall duration
		4) Hachinski Ischemic Score ≤4 5) Cognitive decline not due to specific cause 6) >3 months in duration							
Zhao et al. (2018) China Cluster	Individuals seen at the Department of Geriatrics/ Neurology at public tertiary hospital who complained of memory issues or had suspected cognitive impairment	1) Memory/cognitive complaint reported by patient or caregiver 2) Clinical record of probable MCI according to DSM-IV 3) Objective cognitive impairment in one or more domains as revealed by neuropsychological assessments 4) Normal ADL	IG: 70.6 (6.9) CG: 69.5 (6.7)	IG: 52.1% CG: 51.1%	IG: 48 CG: 45	Storytelling based on pictures, additional drawing tasks (Group)	Cognitive rehabilitation therapy (Group)	Professional therapists	55-65 mins ? 16 weeks, 25 sessions

Note. ADL, Activities of Daily Living; CDR, Clinical Dementia Rating; CG, Control Group; GDS, Global Deterioration Scale; IG, Intervention Group; MCI, Mild Cognitive Impairment; MMSE, Mini-Mental State Examination; MoCA, Montreal Cognitive Assessment; RCT, Randomized Controlled Trial; ?, Unclear.

domains where bias can be introduced, i.e., bias due to i) randomization process; ii) deviations from intended interventions; iii) missing outcome data; iv) measurement of the outcome; and v) selection of the reported result. A domain-level risk-of-bias judgment is derived by following a decision tree based on responses to signaling questions within the domain. The overall risk-of-bias judgment follows the worst domain-level judgment made. For example, if none of the domains were rated as 'high risk', with the worst rating being 'some concerns', then the study's overall risk-of-bias would be of 'some concerns' (Sterne et al., 2019). For a detailed explanation on how to use the RoB 2 tool, readers may refer to the guidance documents available on the RoB 2 website (Higgins, Savović, Page, & Sterne, 2020).

Results

1382 unique records were retrieved from the database search, of which 11 studies covering 13 interventions (817 participants) met the inclusion criteria (see Figure 1).

Characteristics of included studies

Characteristics of the included studies are displayed in Table 1. The earliest paper was published in 2011. Eight were based in Asia (Hong Kong: 3 (Chan et al., 2017; Chan, Lam, Fong, Pang, & Chan, 2016; Kwok, Bai, Kao, Li, & Ho, 2011); China: 2 (Xu, Deng, & Zhang, 2017; Zhao, Li, Lin, Wei, & Yang, 2018); Japan: 2 (Doi et al., 2017; Shimizu, Umemura, Matsunaga, & Hirai, 2018); Singapore: 1 (Mahendran et al., 2018)), while the remaining 3 were from Czech Republic (Kropacova et al., 2019), Greece (Lazarou et al., 2017), and USA (Aguinaga, 2016). One was published in Chinese (Xu et al., 2017) and another was a doctoral dissertation (Aguinaga, 2016). Nine of them employed a parallel RCT design (Chan et al., 2017; Chan et al., 2016; Doi et al., 2017; Kropacova et al., 2019; Kwok et al., 2011; Lazarou et al., 2017; Mahendran et al., 2018; Shimizu et al., 2018; Xu et al., 2017), while one used cluster randomization (Zhao et al., 2018) and another, a cross-over design (Aguinaga, 2016).

Sample

Sample sizes for the intervention and control group ranged from 10 to 67 and 9 to 67 respectively. The mean age of participants ranged from 65.9 to 85.8. In 6 studies, females comprised more than 70% of the overall sample. Participants were recruited from population (Doi et al., 2017; Mahendran et al., 2018) and MCI (Kropacova et al., 2019) cohort studies, patients seen at public hospitals (Xu et al., 2017; Zhao et al., 2018), day activity centers (Aguinaga, 2016; Chan et al., 2016), nursing home (Kwok et al., 2011), and participants of a dementia care class (Shimizu et al., 2018).

MCI definition

In 3 studies, Peterson's criteria for MCI (Petersen, 2004; Petersen et al., 1999) was explicitly referenced to and diagnosis was made in consultation with a multidisciplinary healthcare team (Doi et al., 2017; Lazarou et al., 2017;

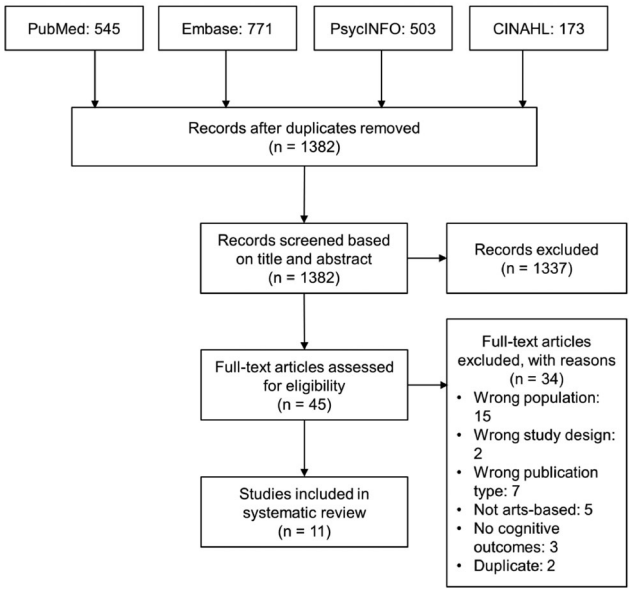

Figure 1. PRISMA flow diagram.

Mahendran et al., 2018). One other study (Zhao et al., 2018) used criteria similar to Peterson's (i.e., self or caregiver report of cognitive decline, objective cognitive impairment in one or more domains as revealed by neuropsychological assessments, and intact activities of daily living). In Shimizu et al. (2018), MCI was defined as having endorsed at least one item on a self-report memory impairment checklist constructed with reference to Peterson's criteria (Petersen, 2004; Petersen et al., 1999). Participants in Chan et al. (2017) were classified as having MCI if they met the following criteria: Montreal Cognitive Assessment (MoCA) score of 19 to 26, Clinical Dementia Rating (CDR) $\leq$ 0.5, self-report of cognitive decline, and independent in daily living. Two studies used a pre-defined score range on the Mini-Mental State Examination (MMSE; $18-26$ and $20-25$)(Aguinaga, 2016; Kwok et al., 2011) while another study operationalized MCI as a CDR of 0.5 (Chan et al., 2016). Participants in Kropacova et al. (2019) were classified as MCI if they fulfilled one of the following: i) if MoCA $\geq$ 26, below 1.5 SD in any 2 tests from cognitive test battery has to be demonstrated; ii) if MoCA $<$ 26, below 1.5 SD in at least one cognitive test from the memory domain; iii) if MoCA suggests objective memory deficit, then below 1.5 SD in at least one cognitive test from the memory domain has to be demonstrated. In Xu et al. (2017), MCI was defined as: self-report of memory decline; demonstrated decline on the Global Deterioration Scale, MMSE, and Activities of Daily Living not amounting to dementia; decline in daily functioning; Hachinski Ischemic Score $\leq$ 4; cognitive decline not due to specific etiology; and disease duration of more than 3 months.

Intervention

Of the 13 arts-based interventions examined, 4 used the medium of visual arts (Chan et al., 2017; Chan et al., 2016; Kwok et al., 2011; Mahendran et al., 2018), 4 dance/movement (Aguinaga, 2016; Doi et al., 2017; Kropacova et al., 2019; Lazarou et al., 2017), 3 music (Doi et al., 2017; Mahendran et al., 2018; Shimizu et al., 2018), and 2 storytelling (Xu et al., 2017; Zhao et al., 2018). All interventions involved active participation. Only in one study (testing 2 interventions) were the interventions delivered by trained art therapists (Mahendran et al., 2018). One other intervention was said to be conducted by "professional therapists", although their professional background was unclear (Zhao et al., 2018). Otherwise, 6 interventions were conducted by art practitioners (Aguinaga, 2016; Chan et al., 2017; Chan et al., 2016; Doi et al., 2017; Lazarou et al., 2017), one by research assistant (Kwok et al., 2011), and another by instructors with background in sport studies (Kropacova et al., 2019). Two studies did not indicate the professional background of those who conducted the intervention (Shimizu et al., 2018; Xu et al., 2017). All interventions were conducted in groups, although in one calligraphy study, participants were said to practice in a quiet room (Kwok et al., 2011). The length of each intervention session ranged from 30 to 90 min (mode: 60 min), and the overall duration ranged from 8 to 40 weeks (median: 16 weeks).

Control

Five studies employed waitlist/life-as-usual as control (Aguinaga, 2016; Kropacova et al., 2019; Kwok et al., 2011; Lazarou et al., 2017; Mahendran et al., 2018). Three studies used active control that differed from the intervention group only by the absence of the arts component (Chan et al., 2017; Chan et al., 2016; Shimizu et al., 2018). For example, in Chan et al. (2017, 2016), control participants wrote Chinese characters on paper or tablet, unlike their intervention counterparts who practiced calligraphy writing first on a tablet, followed by using ink brush on paper. In Shimizu et al. (2018), participants in the control group engaged in movements like those in the intervention (movement music therapy), but without the use of music, singing, and percussion instrument. In 2 studies, the comparator used was an alternative treatment, i.e., cognitive rehabilitation therapy (Zhao et al., 2018) and pharmacotherapy (Xu et al., 2017). One study used health education classes as an active control, although the classes were not equivalent in duration with the intervention (Doi et al., 2017).

Cognitive measures

Measures of cognitive function used by the included studies are summarized in Table 2. We categorized the measures into cognitive domains it primarily assesses, based on principal cognitive domains agreed upon by the DSM-5 Neurocognitive Disorders Workgroup (Sachdev et al., 2014). Of the 11 studies, 2 only used MMSE as a measure of cognitive functioning (Kwok et al., 2011; Xu et al., 2017). One other study only assessed a single cognitive domain (Shimizu et al., 2018). Four studies employed a combination of both global and domain-specific cognitive measures (Doi et al., 2017; Kropacova et al., 2019; Lazarou et al., 2017; Zhao et al., 2018).

Risk of bias

Some concerns of bias were raised for most of the studies (7 out of 11), with the remaining 4 studies assessed to be at a high risk of bias (see Figure 2). Common pitfalls are outlined below.

Bias due to deviations from intended interventions

As blinding of participants and persons delivering the interventions were not possible due to the nature of the interventions, the lack of reporting by study authors on whether there were deviations from the experimental protocol resulted in at least some concerns in the assessment of risk of bias. Further, a small number of studies with dropouts did not perform appropriate analysis (e.g., intent-to-treat).

Bias due to missing outcome data

The main problem in this domain was the high proportion of participants (>5%) with missing outcome data, compounded by the lack of documentation regarding reasons for dropout and/or sensitivity analyses to demonstrate that results were not biased by missing data.

Bias due to selection of the reported result

As most studies did not prospectively register their trial or publish their protocol, we were unable to assess if there was selective reporting, leading to the expression of some concerns for these studies.

Effects of interventions on cognitive outcomes

Table 3 provides an overview of the effects of the interventions on cognitive outcomes.

Visual arts

All 4 interventions using visual arts as the medium for intervention reported some significant effects on cognition. Three of them involved Chinese calligraphy. In Chan et al. (2016), participants who underwent 16 sessions of Chinese calligraphy classes reacted faster compared to controls on both 2-back working memory tasks that involved contextual (*Hang* script or semicursive stroke images) or noncontextual (digits) stimuli, suggesting a generalization of gains. Using a similar protocol, Chan et al. (2017) found that participants who underwent Chinese calligraphy training improved on measures of executive functioning and complex attention, with these improvements maintained at 6 months follow-up. Lastly, Kwok et al. (2011) found that calligraphy training improved MMSE scores. In Mahendran et al. (2018), 3 months of art therapy involving both art production and cognitive evaluation of art pieces led to improvements in complex attention and learning and memory. However, only improvements in learning and memory were maintained by the end of the intervention at 9 months.

Dance/movement

Of the 4 studies using dance/movement intervention, 3 reported significant cognitive effects. Kropacova et al. (2019) found that dance-movement intervention had a significant effect on learning and memory. Similarly, Doi et al. (2017) found a significant effect of a dance program on learning and memory and MMSE scores, compared to those who attended health education classes. Most promisingly, Lazarou et al. (2017) reported that compared to control, engaging in international ballroom dance classes improved several aspects of cognition, as reflected by global and domain-specific measures of complex attention, learning and memory, language, and perceptual-motor function. In contrast, Aguinaga (2016) found no significant effect of a 16-week Latin dance program on measures of cognition covering complex attention, executive function, language, and learning and memory.

Music

Of the 3 studies examining music-based interventions, only one reported significant cognitive effect. Doi et al. (2017) found that playing percussion instruments led to significant improvements on the MMSE. In Shimizu et al. (2018), there was no significant between-group difference in overall score on the Frontal Assessment Battery (which assesses executive functioning) for movement music therapy versus control. In Mahendran et al. (2018), engaging in music reminiscence therapy did not improve cognitive outcomes more so than life-as-usual.

Storytelling

Significant effects on cognition were reported in both interventions that used storytelling as a medium of creative expression. Xu et al. (2017) found that participation in creative storytelling improved MMSE scores compared to pharmacotherapy control. Zhao et al. (2018) also found that storytelling, compared to cognitive rehabilitation therapy, resulted in improved scores on measures assessing global cognition as well as complex attention, language, and learning and memory. Furthermore, gains in global cognition and complex attention were maintained at 6 months follow-up.

Discussion

The aim of this study was to review the effects of arts-based interventions on cognitive outcomes in older persons with MCI. Overall, there was a clear trend for arts-based interventions to improve cognitive functioning, with 10 out of 13 interventions reporting significant improvements on at least one cognitive outcome. However, there is a lack of data to demonstrate maintenance of intervention effects as only 2 studies collected follow-up data. The limited data available is promising, as gains made in areas of executive function and complex attention in Chan et al. (2017), and in global cognitive function and complex attention for Zhao et al. (2018) were maintained at 6 months follow-up.

Improvements were commonly demonstrated in global cognitive function (in 6 out of 7 interventions that assessed it), followed by the domains of learning and memory (5/9), complex attention (4/10), executive functioning (2/6), language (2/3), and perceptual-motor function (1/4). However, these should not be interpreted as a reflection of which domain arts-based interventions exert the biggest effect on, as this would only be answered by a quantitative analysis.

There was heterogeneity in the way cognition was operationalized, the measures used and thus, domains assessed across studies. As noted earlier, 2 studies only assessed MMSE (global cognition) and in another, outcomes from a single cognitive domain. Keeping in mind that the DSM-5's criteria for mild neurocognitive disorder requires evidence of decline in one or more of the 6 cognitive domains (complex attention, executive function, learning and memory, language, perceptual-motor function, and social cognition) as indicated by neuropsychological tests (Sachdev et al.,

Table 2. List of cognitive measures used, organized by domain.

Domain	Measure	Used in
Global	Mini-Mental State Examination	Doi, Kwok, Lazarou, Xu
	Montreal Cognitive Assessment	Kropacova, Lazarou, Zhao
	Neurobehavioral Cognitive Status Examination	Zhao
Complex Attention	Color Trails Test	Chan et al. (2016), Chan et al. (2017), Mahendran
	Trail Making Test	Aguinaga, Doi, Zhao
	Digit Span (Forward)	Aguinaga, Mahendran
	Symbol Digit Modalities Test	Aguinaga, Chan et al. (2017)
	Symbol Search	Kropacova
	Test of Everyday Attention 4	Lazarou
Executive Function	Digit Span (Backward)	Aguinaga, Chan et al. (2016), Chan et al. (2017)
	Digit Ordering	Aguinaga
	Five-Point Test	Kropacova
	Frontal Assessment Battery	Shimizu
	Functional Cognitive Assessment Scale	Lazarou
	Stroop Test	Aguinaga
	Tower of Hanoi	Kropacova
	2-back Task	Chan et al. (2016)
Language	Category Verbal Fluency Test	Aguinaga, Zhao
	F-A-S Verbal Fluency Test	Lazarou
Learning and Memory	Rey Auditory Verbal Learning Test	Lazarou, Mahendran
	Other Auditory Verbal Learning Test	Zhao
	Word List Memory	Chan et al. (2017), Doi
	Wechsler Memory Scale: Logical Memory	Aguinaga, Kropacova
	Rivermead Behavioural Memory Test (Story)	Lazarou
	Other Story Memory	Doi
	Rey-Osterrieth Complex Figure Test (Recall)	Lazarou
	Taylor Complex Figure Test (Recall)	Kropacova
Perceptual-Motor Function	Block Design	Mahendran
	Judgment of Line Orientation Test	Kropacova
	Rey-Osterrieth Complex Figure Test (Copy)	Lazarou
	Taylor Complex Figure Test (Copy)	Kropacova

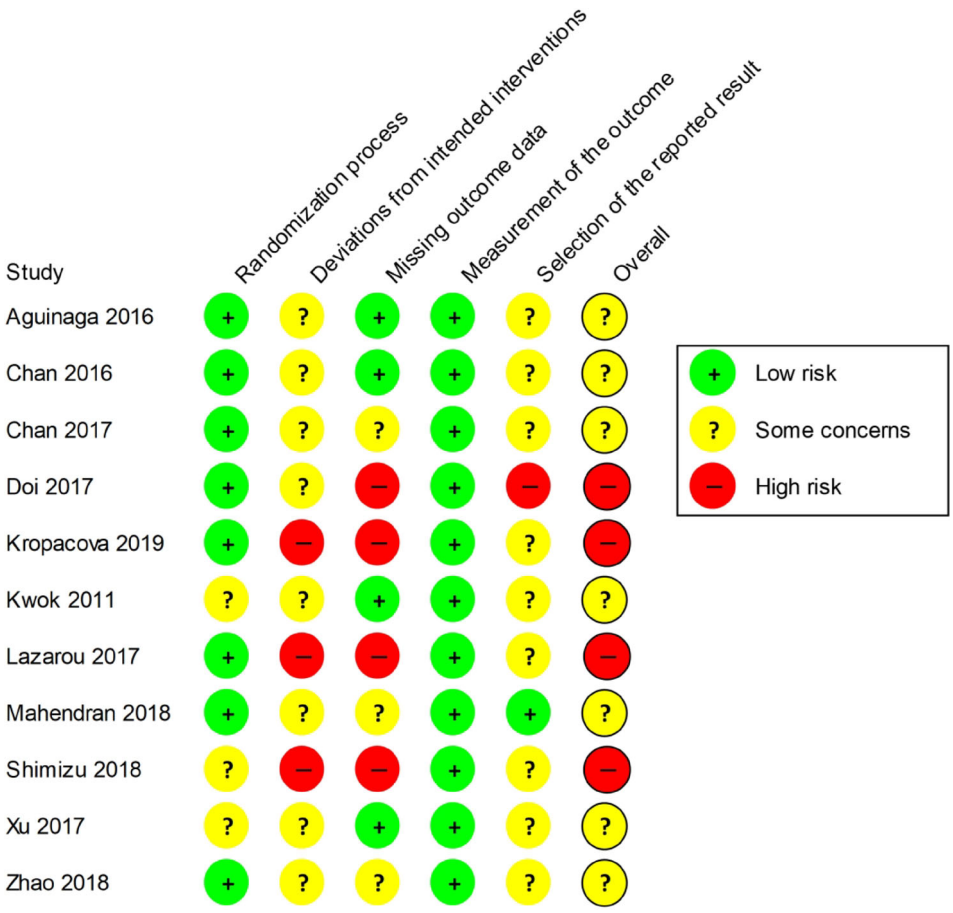

Figure 2. Summary of risk of bias assessment.

2014), it would be prudent for future research to use a variety of measures that cover more than one domain. This would allow finer analyses of which cognitive domain would best benefit from arts-based interventions. Of note, it is our opinion that the use of global cognitive measures such as MMSE or MoCA alone would be insufficient as they are after all meant to be used as screening tools and not substitutes for neuropsychological testing. Further, it was observed that none of the studies assessed social cognitive outcomes – a missed opportunity given that there have

Table 3. Summary of intervention effects on cognitive outcomes.

Author (Year)	Intervention	Cognitive measure	Domain	Time point	Intervention effect (0/+)
Aguinaga (2016)	Latin dance program	Logical Memory I: Immediate recall	L&M	2m	0
		Logical Memory I: Immediate recall	L&M	Post-I	0
		Logical Memory II: Delayed recall	L&M	2m	0
		Logical Memory II: Delayed recall	L&M	Post-I	0
		Stroop Test: Word	EF	2m	0
		Stroop Test: Word	EF	Post-I	0
		Stroop Test: Color	EF	2m	0
		Stroop Test: Color	EF	Post-I	0
		Digit Span Test (Forward)	CA	2m	0
		Digit Span Test (Forward)	CA	Post-I	0
		Digit Span Test (Backward)	EF	2m	0
		Digit Span Test (Backward)	EF	Post-I	0
		Trail Making Test A	CA	2m	0
		Trail Making Test A	CA	Post-I	0
		Trail Making Test B	CA	2m	0
		Trail Making Test B	CA	Post-I	0
		Word fluency	L	2m	0
		Word fluency	L	Post-I	0
		Digit ordering	EF	2m	0
		Digit ordering	EF	Post-I	0
		Symbol Digit Modalities Test	CA	2m	0
		Symbol Digit Modalities Test	CA	Post-I	0
Chan et al. (2016)	Chinese calligraphy training	Digit Span Test (Backward)	EF	Post-I	0
		Color Trails Test 2 − 1	CA	Post-I	0
		2-back Accuracy: Calligraphy strokes	EF	Post-I	0
		2-back Reaction Time: Calligraphy strokes	EF	Post-I	+
		2-back Accuracy: Digit	EF	Post-I	0
		2-back Reaction Time: Digit	EF	Post-I	+
Chan et al. (2017)	Chinese calligraphy training	Digit Span Test (Backward): Sequence	EF	Post-I	+
		Digit Span Test (Backward): Sequence	EF	6m f/u	+
		Digit Span Test (Backward): Span	EF	Post-I	+
		Digit Span Test (Backward): Span	EF	6m f/u	+
		Color Trails Test 1	CA	Post-I	0
		Color Trails Test 1	CA	6m f/u	0
		Color Trails Test 2	CA	Post-I	+
		Color Trails Test 2	CA	6m f/u	+
		Color Trails Test 2 − 1	CA	Post-I	0
		Color Trails Test 2 − 1	CA	6m f/u	0
		Symbol Digit Modalities Test: Accuracy Rate	CA	Post-I	0
		Symbol Digit Modalities Test: Accuracy Rate	CA	6m f/u	0
		Symbol Digit Modalities Test: Correct Attempts	CA	Post-I	0
		Symbol Digit Modalities Test: Correct Attempts	CA	6m f/u	0
		Symbol Digit Modalities Test: Total Attempts	CA	Post-I	0
		Symbol Digit Modalities Test: Total Attempts	CA	6m f/u	0
		CERAD-NAB: J4 subtest (Immediate recall)	L&M	Post-I	0
		CERAD-NAB: J4 subtest (Immediate recall)	L&M	6m f/u	0
		CERAD-NAB: J6 subtest (Delayed recall)	L&M	Post-I	0
		CERAD-NAB: J6 subtest (Delayed recall)	L&M	6m f/u	0
		CERAD-NAB: J7 subtest (Word recognition)	L&M	Post-I	0
		CERAD-NAB: J7 subtest (Word recognition)	L&M	6m f/u	0
Doi et al. (2017)	Ballroom dance program	Story memory	L&M	Post-I	+
		Word list memory	L&M	Post-I	0
		MMSE	G	Post-I	+
		Trail Making Test A	CA	Post-I	0
		Trail Making Test B	CA	Post-I	0
	Playing percussion instruments	Story memory	L&M	Post-I	0
		Word list memory	L&M	Post-I	0
		MMSE	G	Post-I	+
		Trail Making Test A	CA	Post-I	0
		Trail Making Test B	CA	Post-I	0
Kropacova et al. (2019)	Dance-movement intervention	MoCA	G	Post-I	0
		Taylor Complex Figure Test: Copy	PMF	Post-I	0
		Taylor Complex Figure Test: 3 min	L&M	Post-I	+
		Taylor Complex Figure Test: 30 min	L&M	Post-I	0
		WMS-III Logical Memory: Immediate	L&M	Post-I	0
		WMS-III Logical Memory: 30 min	L&M	Post-I	0
		WAIS-III Symbol Search	CA	Post-I	0
		WAIS-III Digit Span	Unclear	Post-I	0
		Tower of Hanoi (3 disks): Time	EF	Post-I	0
		Tower of Hanoi (3 disks): Movements	EF	Post-I	0
		Tower of Hanoi (4 disks): Time	EF	Post-I	0
		Tower of Hanoi (4 disks): Movements	EF	Post-I	0
		Five-Point Test	EF	Post-I	0
		Judgment of Line Orientation Test	PMF	Post-I	0
Kwok et al. (2011)	Chinese calligraphy training	MMSE	G	Post-I	+
Lazarou et al. (2017)	International ballroom dancing	MMSE	G	Post-I	+
		MoCA	G	Post-I	+

(*continued*)

Table 3. Continued.

Author (Year)	Intervention	Cognitive measure	Domain	Time point	Intervention effect (0/+)
		Functional Cognitive Assessment Scale	EF	Post-I	0
		Test of Everyday Attention 4	CA	Post-I	+
		Rey AVLT: Total	L&M	Post-I	+
		Verbal Fluency F-A-S Test	L	Post-I	+
		ROCFT: Copy	PMF	Post-I	+
		ROCFT: Delayed recall	L&M	Post-I	+
		RBMT Story: Immediate recall	L&M	Post-I	+
		RBMT Story: Delayed recall	L&M	Post-I	+
Mahendran et al. (2018)	Art therapy	Rey AVLT: List Learning	L&M	3m	+
		Rey AVLT: List Learning	L&M	Post-I	+
		Rey AVLT: Delayed recall	L&M	3m	0
		Rey AVLT: Delayed recall	L&M	Post-I	0
		Rey AVLT: Recognition	L&M	3m	0
		Rey AVLT: Recognition	L&M	Post-I	0
		Rey AVLT: Memory domains	L&M	3m	+
		Rey AVLT: Memory domains	L&M	Post-I	+
		WAIS-III Digit Span (Forward)	CA	3m	+
		WAIS-III Digit Span (Forward)	CA	Post-I	0
		WAIS-III Block Design	PMF	3m	0
		WAIS-III Block Design	PMF	Post-I	0
		Color Trails Test 2	CA	3m	0
		Color Trails Test 2	CA	Post-I	0
	Music reminiscence	Rey AVLT: List Learning	L&M	3m	0
		Rey AVLT: List Learning	L&M	Post-I	0
		Rey AVLT: Delayed recall	L&M	3m	0
		Rey AVLT: Delayed recall	L&M	Post-I	0
		Rey AVLT: Recognition	L&M	3m	0
		Rey AVLT: Recognition	L&M	Post-I	0
		Rey AVLT: Memory domains	L&M	3m	0
		Rey AVLT: Memory domains	L&M	Post-I	0
		WAIS-III Digit Span (Forward)	CA	3m	0
		WAIS-III Digit Span (Forward)	CA	Post-I	0
		WAIS-III Block Design	PMF	3m	0
		WAIS-III Block Design	PMF	Post-I	0
		Color Trails Test 2	CA	3m	0
		Color Trails Test 2	CA	Post-I	0
Shimizu et al. (2018)	Movement music therapy	Frontal Assessment Battery	EF	Post-I	0
Xu et al. (2017)	Storytelling	MMSE	G	Post-I	+
Zhao et al. (2018)	Storytelling	MoCA	G	Post-I	+
		MoCA	G	6m f/u	+
		Neurobehavioral Cognitive Status Examination: Normal domain	G	Post-I	+
		Neurobehavioral Cognitive Status Examination: Normal domain	G	6m f/u	+
		Neurobehavioral Cognitive Status Examination: Composite domain	G	Post-I	+
		Neurobehavioral Cognitive Status Examination: Composite domain	G	6m f/u	+
		AVLT: Immediate recall	L&M	Post-I	+
		AVLT: Immediate recall	L&M	6m f/u	0
		AVLT: Delay recall	L&M	Post-I	+
		AVLT: Delay recall	L&M	6m f/u	0
		Category Verbal Fluency Test	L	Post-I	+
		Category Verbal Fluency Test	L	6m f/u	0
		Digit Span Test	Unclear	Post-I	+
		Digit Span Test	Unclear	6m f/u	+
		Trail Making Test A	CA	Post-I	0
		Trail Making Test A	CA	6m f/u	0
		Trail Making Test B	CA	Post-I	+
		Trail Making Test B	CA	6m f/u	+

Note. AVLT, Auditory Verbal Learning Test; CA, Complex Attention; CERAD-NAB, Consortium to Establish a Registry for Alzheimer's Disease-Neuropsychological Assessment Battery; EF, Executive Functioning; f/u, Follow-up; G, Global Cognition; L, Language; L&M, Learning and Memory; MMSE, Mini-Mental State Examination; MoCA, Montreal Cognitive Assessment; PMF, Perceptual-Motor Function. Post-I, Post-Intervention; RBMT, Rivermead Behavioral Memory Test; ROCFT, Rey-Osterrieth Complex Figure Test; WAIS, Wechsler Adult Intelligence Scale.

been demonstrated success in using the arts to improve social cognition in persons with social cognitive deficits (Corbett et al., 2019; Koch, Mehl, Sobanski, Sieber, & Fuchs, 2015; Koehne, Behrends, Fairhurst, & Dziobek, 2016; Muller, Naples, Cannon, Haffner, & Mullins, 2019). Future research is encouraged to include some measure of social cognitive functioning (Henry, von Hippel, Molenberghs, Lee, & Sachdev, 2016) to allow for a more holistic assessment of the effects of arts-based interventions on cognition.

Apart from how cognition was operationalized, there was also variability in the way MCI was defined. This was perhaps owing to the lack of consensus regarding how MCI should be defined prior to the DSM-5 (Petersen, 2004). However, the introduction of the term mild neurocognitive disorder and its diagnostic criteria in the DSM-5 should henceforth serve as a common terminology and unify research in this field. Moving forward, the onus is on researchers to align their definitions of MCI with

international standards, such as the DSM-5, to ensure that their sample is recruited from specific populations, remains comparable with other studies, and relevant to clinical practice.

While there is a general indication that arts-based interventions can improve cognitive functioning, it remains unclear what the mechanisms of action are due to methodological limitations of existing literature. It was noted that 5 of the 11 studies employed waitlist/life-as-usual as control. Thus, significant results could reasonably be attributed to non-specific factors such as i) increased social activity: interventions were mostly conducted in a group format, which increased social interactions among participants compared to controls; ii) increased physical activity: participating in the interventions, especially those involving dance/movement, increased physical activity; iii) enriched environment or cognitive stimulation. Alternatively, other active factors particular to arts-based interventions, such as aesthetics, hedonism, nonverbal communication, enactive transitional support, and generativity (Koch, 2017), or active factors specific to the art medium used may also be what is at work. With the evidence base now established with studies using waitlist/life-as-usual controls, the next step for researchers interested in parsing the mechanisms of action for arts-based interventions would be to use active comparators that control for non-specific therapeutic factors (Schnurr, 2007). Future research could look to theoretical frameworks, such as that by Koch (2017) or Windle et al. (2018) (developed specifically for dementia research), to identify and test theorized mechanisms of action of arts-based interventions.

While most of the interventions demonstrated positive results, the 3 that did not, deserve mention. Two of them used music (Mahendran et al., 2018; Shimizu et al., 2018) and another involved dance (Aguinaga, 2016). We offer some reasons for their non-significant results. First, the use of less stringent criteria for MCI (i.e., self-report of at least one memory impairment based off a checklist, without corroborative objective tests in Shimizu et al. (2018), and MMSE 18-26 in Aguinaga (2016)) may have inadvertently resulted in the inclusion of healthy or mildly impaired participants in their samples and diluted the effects. Second, the issue of publication bias may have eclipsed null results, as we noted that one paper with non-significant results is an unpublished doctoral dissertation (Aguinaga, 2016). Third, there were potential problems with power. In Shimizu et al. (2018), an additive design was used wherein the intervention differed from the control only by the addition of the arts component. That is, participants in the intervention group engaged in group movement therapy like the control group, but with the addition of music, singing, and percussion instruments. The expected effect size of such an additive study design would be smaller, and correspondingly, a larger sample size would be needed to achieve the statistical power to detect an effect (Schnurr, 2007). Unfortunately, the study by Shimizu et al. (2018) might not be adequately powered, as the sample size was small and participants were disproportionately assigned to intervention compared to control (30 to 9). A similar problem of inadequate power might also be said for Aguinaga's (2016) study, as we note that it had the smallest sample size with only 21 participants in total.

Recommendations for future research

Based on our review, the following is a summary of our recommendations for future research on arts-based interventions for MCI:

i. Endeavour to prospectively publish or register protocol with a trial registry to improve reporting transparency and reduce risk of bias.
ii. Take into account the effect of sample size on power of the study.
iii. When missing data is anticipated, plan to conduct sensitivity analyses to demonstrate robustness of results under a variety of assumptions (see Thabane et al. (2013)) and/or clearly document reasons for dropouts.
iv. Conform to established international standards in defining MCI (e.g., DSM-5 criteria for mild neurocognitive disorder).
v. When assessing cognitive outcomes, use a variety of neuropsychological tests spanning more than one cognitive domain (refer to Table 2 for commonly used measures). Use of global cognitive screening tools alone is discouraged.
vi. Consider assessing for social cognitive outcomes (see Henry et al. (2016) for a review of such measures).
vii. Consider using active control rather than life-as-usual to explore mechanisms of action. Refer to theoretical frameworks (e.g., Koch (2017) or Windle et al. (2018)) for theorized mechanisms of action of arts-based interventions.
viii. Consider collecting follow-up data to examine if gains are maintained after intervention ends.
ix. In essence, more well-conducted RCTs are needed to strengthen the evidence base on arts-based intervention for MCI.

Strengths and limitations

To our knowledge, this systematic review is the first to focus on the use of arts-based interventions to improve cognitive outcomes in older persons with MCI. Our use of a robust review methodology, such as conducting procedures in duplicate by 2 reviewers to reduce error and bias, using Google Scholar to search for grey literature, and including only RCTs (which are evidence ranked high on the hierarchy of evidence; Burns, Rohrich, & Chung, 2011), bolsters confidence in the conclusions of this review. On the other hand, that the included studies were assessed to be of moderate (some concerns) to high risk of bias leaves much to be desired. We were also unable to conduct a meta-analysis due to the heterogeneity in the way MCI was operationalized, interventions used, and cognitive outcomes measured. When more high-quality studies are available, future studies can narrow their reviews to specific art mediums and conduct meta-analyses where possible.

Conclusion

In this systematic review of arts-based interventions for older persons with MCI, we found a trend for these interventions to improve multiple aspects of cognitive

functioning, with 10 out of the 13 included interventions reporting at least one significant outcome. However, the moderate-to-high risk of bias of the included studies and heterogeneity in the way MCI was defined preclude firm conclusions to be made. As potentially effective interventions for cognition that are also enjoyable, improves quality of life, with minimal side effects, and scalable, more rigorous research using arts-based interventions as a treatment modality for MCI is warranted.

Disclosure statement

R.M. and E.H. are co-authors on one of the included studies. Both were not involved in study selection, data extraction, or bias assessment of included studies. The other authors report no conflict of interest.

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