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Jones, Cindy; Liu, Fangli; Murfield, Jenny; Moyle, Wendy

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A/Prof Cindy Jones[a,b*], Dr Fangli Liu[b,c], Ms Jenny Murfield[b,d] & Prof Wendy Moyle[b,d]

[a]Faculty of Health Sciences & Medicine, Bond University, Gold Coast, Queensland, Australia

[b]Menzies Health Institute Queensland, Griffith University, Nathan, Brisbane, Queensland, Australia

[c]College of Nursing and Health, Henan University, Kaifeng, Henan, P.R. China.

[d]School of Nursing and Midwifery, Griffith University, Nathan, Brisbane, Queensland, Australia.

*Corresponding Author: A/Prof Cindy Jones; Faculty of Health Sciences & Medicine, Bond University, Gold Coast, Queensland, Australia Tel: +61 7 5595 1152; Email: cjones@bond.edu.au

Declarations of interest

None.

Authors' contributions

The review was initially conceptualized by WM and carried out by FL, CJ & JM (i.e. titles and abstracts screening, full-text review, quality appraisal and data extraction). The manuscript was prepared by CJ, FL, JM & WM. All authors provided comment and revisions, and approved the final version of the manuscript.

Highlights

- Most activity interventions for people with dementia in long-term care are facilitated.

- Non-facilitated meaningful activities included music/stimulated family presence, animal-like social robot, lifelike dolls.

- Some beneficial effects for agitation, emotional wellbeing, feelings of pleasure, engagement and sleep quality.

- Future research into the potential benefits of non-facilitated meaningful activities is needed in rigorously designed RCTs.

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ABSTRACT

This systematic review sought to evaluate the effectiveness of non-facilitated meaningful activities for older people with dementia in long-term care facilities. Searches were conducted in PubMed; CINAHL; EMBASE; Web of science; PsycINFO; Cochrane; ProQuest; and ClinicalTrials.gov to identify articles published between January 2004 and October 2019. A total of six studies were included. Results implied that current randomised controlled trials or controlled trials about non-facilitated meaningful activities for people with living dementia in long-term care facilitates are limited, but those included in this review were of adequate methodological quality. Meaningful non-facilitated activities, such as music, stimulated family presence, animal-like social robot PARO/plush toy and lifelike dolls, may have beneficial effects on agitation, emotional well-being, feelings of pleasure, engagement, and sleep quality. However, there remains a lack of conclusive and robust evidence to support these psychological and physiological effects of non-facilitated meaningful activities for older people with dementia living in long-term care facilities by care staff.

Keywords: older people; dementia; non-facilitated; meaningful activities; long-term care

Introduction

The world's population is ageing rapidly, with it estimated that 1.6 billion people would be aged 65 and over by 2050.[1] In developed countries, the proportion of older adults requiring care support has grown in the past decade,[2] either in the form of informal home care or permanent/respite admission to a long-term care (LTC) facility. Despite varied reasons influencing the decision to place an older adult in a LTC facility,[3, 4] a diagnosis of dementia consistently emerges as one of the leading cause of placement, and the presence of neuropsychiatric symptoms is a strong influencing factor.[5]

Neuropsychiatric symptoms, a heterogeneous group of non-cognitive symptoms and behaviours commonly referred to as behavioural and psychological symptoms of dementia (BPSD), can present as agitation, wandering, disinhibition, aggression, vocalisation, sleep disturbance, anxiety, depression, apathy, hallucinations and delusions.[6] For some older adults living with dementia, these symptoms are thought to result from one or more unmet needs due to a disparity in lifelong habits and personality, physical and mental states, and environmental conditions impacting upon social interactions.[7, 8] Given that LTC residents living with dementia are often unable to seek out and engage in activities independently due to impaired cognition, it is important that LTC facilities actively provide opportunities for psychosocial stimulation and wellbeing. Although LTC facilities provide a range of activities, there is a growing body of research suggesting that these activities are not to the standard needed by residents living with dementia, with many often spending a large proportion of their day alone, doing nothing, and with minimal conversation.[9, 10]

Background

Traditionally, LTC facilities have adopted a biomedical framework for the delivery of care.[11] As BPSD can be challenging to manage, causing stress, negatively affecting attitudes,

and reducing job satisfaction,[12, 13] can result in care staff focusing on residents' physical deficits and presentation of dementia rather than their less overt psychosocial needs. Recent years, however, have brought with it the cultural change that aims to move away from the biomedical model towards more person-centred care in LTC facilities.[14] Alongside this comes an increased focus on what constitutes a meaningful activity for residents living with dementia, and how this can be conducted.

For this review, according to previously reported literature[15-17] and a systematic review,[18] meaningful activities are defined as a wide range of activities and interventions, which are relevant and enjoyable to the person living with dementia, leading to improvements in either their physical function, emotional wellbeing, cognitive status, or behavioural problems. Specifically, non-facilitated meaningful activities are considered those that are not delivered or assisted by any individual, such as nursing or care staff, researchers or others.

Meaningful activities can provide a potential window of opportunity to assist people living with dementia and their caregivers to learn ways to remain engaged in activities, which, in turn, may also help address changes in relationships, mood, and quality of life, as well as slow the rate of cognitive decline.[19, 20] Recent reviews have found that meaningful activities can be beneficial for people living with dementia in LTC.[18, 21] However, most activity interventions for people living with dementia were facilitated by nursing or care staff, researchers or others (e.g. volunteers, musicians, clown). While the presence of a facilitator can promote uptake of, and engagement in, meaningful activities by people living with dementia in LTC,[22] questions have been raised about the effectiveness of the activity interventions being confounded by the social contact with or person-to-person attention received from the facilitator, making it unclear and difficult to determine which element (i.e. the activity or the facilitator) has contributed most to the intervention effect.[18] This means that it is difficult to delineate the 'real' effect of the activity interventions being introduced to people

living with dementia, as any positive effect found may either be mediated and/or inflated by their interaction with the facilitator. Further, facilitated meaningful activities in LTC for people living with dementia may be neither cost permissive due to the personnel costs[23] nor sustainable given the shortage of healthcare workers, particularly in aged care.[24, 25] With these concerns in mind, the current systematic review sought to evaluate available literature about the effects of non-facilitated meaningful activities for people living with dementia in LTC facilities.

The Review

Aims

This review aimed to summarise the results of these studies to provide the scientific basis in understanding the effects of non-facilitated meaningful activities for older people living with dementia in LTC facilities; identify any existing knowledge gaps; and highlight areas for future research.

Design

This systematic review was registered in the PROSPERO International Prospective Register of Systematic Reviews (*blinded for review*) in July 2018. The review was designed, conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (PRISMA).[26]

Search methods

A search of published, peer-reviewed journal articles was carried out in eight electronic databases to allow access to a multi-disciplinary collection of academic databases worldwide: PubMed; CINAHL; EMBASE; Web of Science; PsycINFO; Cochrane; ProQuest; and ClinicalTrials.gov. The review included English-only publications published between January

2004 and October 2019 that are readily available in electronic format. In keeping with Travers et al.,[18] articles from 2004 onwards were considered in this review, as person-centred care practices were only widely embraced and adopted by nursing homes from 2005.[13] The following subject headings and search terms were used: (1) "Alzheimer disease" OR dementia; AND (2) ("residential care" OR "residential aged care") OR ("long term care" OR "long-term care") OR ("nursing home" OR "nursing-home"); AND (3) occup* OR activit* OR intervention* OR progra* OR ("psycho social" OR "psycho-social") OR (behavio* OR behaviour) OR diversion* OR montessori OR "support group" OR ("leisure activities" OR leisure OR activities) OR "activities of daily living" OR "life stor*" OR "life history review" OR "life story review" OR exercis* OR music* OR (art OR arts) OR pet OR animal OR sensor* OR massag* OR touch* OR aromatherap* OR complementary OR alternative OR validation OR recreation*; AND (4) meaningful OR tailor* OR (individualised OR individualized) OR preferred OR ("preference based" OR "preference-based") OR ("person centred" OR "person-centred") OR pleasur* OR engage*. Full details of each electronic database search are provided in Supplementary File 1. Reference lists of the included studies were also manually screened for additional studies.

Using the PICO (Population, Intervention, Comparison, Outcome) framework to develop criteria for study selection,[27] studies were included if they: (a) involved people living with dementia aged 65 years and over; (b) were a randomised controlled trial (RCT) or quasi-experimental controlled trial (CT) with the comparative control group receiving either usual care or an active control activity to establish causality; (c) provided personalised non-pharmacological activity meaningful to the person living with dementia; (d) were non-facilitated; (e) examined psychological outcome measures, such as quality of life, loneliness, mood and BPSD; and (f) were conducted in LTC facilities. Both individual and group activities were included. Articles that were reviews, study protocols, case studies, observational studies,

cross-sectional studies, qualitative studies, or pre-post studies without a control group were excluded, as were conference abstracts without full text.

Search outcome

All retrieved articles were exported into Endnote X9 (Clarivate Analytics, Philadelphia, PA, USA) for screening. Following the removal of duplicates, two authors (x & x) independently assessed all titles and abstracts of articles obtained from the literature search for eligibility according to the inclusion criteria. Full-text review of shortlisted articles was independently conducted by two authors (x & x), who achieved good levels of inter-rater agreement ($\kappa = .71$). Disagreements arising from the full-text review were resolved following a discussion with the third author (x). A total of 3013 unique records were identified from the database searches (see Figure 1). After discarding duplicate records, 2651 articles were screened based on title and abstract; 2608 articles were excluded, resulting in 34 full-text articles assessed for eligibility. Of these, six articles meet all inclusion criteria and are included in this review.[28-33] The search and study selection process as well as search outcomes are detailed in Figure 1.

[Insert Figure 1 near here]

Quality appraisal

Two authors (x & x) independently assessed the methodological quality of studies using the Mixed Methods Appraisal Tool (MMAT) – Version 2018.[34] The MMAT consists of a 7-question checklist and was chosen due to its applicability to critically appraise study designs that involve both randomised and non-randomised controlled trials, ease of use and established validity.[35] The level of agreement between the two authors was excellent ($\kappa = .82$), with conflicting results resolved through discussions with the third author (x).

Data abstraction

Data from included studies were extracted independently by two authors (x & x) using an excel spreadsheet designed to record information relating to: (a) authors and year of publication; (b) participants' characteristics (i.e. country, setting, sample size, gender, age and cognition); (c) study characteristics (i.e. design, as well as intervention including type of activity, duration and frequency); as well as (d) outcome measures and results.

Synthesis

A descriptive synthesis of data from included studies was performed to evaluate the effects of non-facilitated meaningful activities for people living with dementia in LTC facilities, identify any knowledge gaps and highlight areas for future research. Results are presented narratively and accompanied by data tables and figures, where appropriate. A meta-analysis of the data was precluded because of the heterogeneity of outcome measures used across studies.

Results

Methodological quality of studies

According to the first two screening questions of the MMAT, all included studies had clear research questions, and appropriate data were collected to address the research questions. One study[28] presented insufficient information to determine if appropriate randomisation was performed. Reported findings in two studies[32, 33] did not allow for the comparison of treatment groups at baseline, as an imbalance between groups could imply randomisation problems. Half of the included studies did not report whether complete outcome data were collected,[28, 30, 32] which could impact on the analysis of data. Blinding of outcome assessors, which is important

to eschew assessor bias, did not occur in the Weise et al.,[33] study and was unclear in the studies conducted by Garland et al.[28] and Shiltz et al.[32] Two of the remaining studies involved video observations/coding, where outcome assessors in the study by Moyle et al.[30] were masked to the type of interventions through work allocated to only one group and by separate working locations, while in the other study by Moyle et al.,[31] study intent was concealed to outcome assessors. Lastly, intervention bias in terms of participants' adherence to the intervention or whether the intervention was implemented consistently as intended was also not clearly discussed in both the Garland et al.[28] and Janata[29] studies. Overall, although the methodological quality of included studies was mixed, all studies were deemed to be of adequate quality for inclusion in this review. A summary of the quality assessment can be found in Table 1.

[Insert Table 1 near here]

Study characteristics & participants

Studies included in this review were conducted in Australia (n = 3),[28, 30, 31] USA (n = 2),[29, 32] and Germany (n = 1).[33] A range of study designs was adopted, including two-groups parallel RCT,[29, 31-33] three-groups cluster RCT,[30] and three-groups cross-over RCT.[28]

A total of 628 older residents with dementia living in LTC facilities or nursing homes were included in this review. The sample sizes of participants included in each study ranged from 20 to 415. The total number of female and male participants were 455 (72.5%) and 173 (27.5%) respectively, with a mean age ranging from 76 to 89.7 years. Participant characteristics of the included studies are presented in Table 2.

[Insert Table 2 near here]

Meaningful non-facilitated activities & control conditions

The meaningful non-facilitated activities provided in the majority of studies were individualised/personalised or preferred music[28, 29, 32, 33] that was either streamed to

participants' room or delivered by iPod, MP3 or portable cassette players with headphone. Other meaningful non-facilitated activities were: lifelike dolls [31]; an animal-like social robot (PARO - Personal Assistance RobOt, shaped like a baby harp seal) and plush toy (i.e. PARO with robotic features disabled) in Moyle et al.[30] study; an auditory activity (i.e. stimulated family presence), which is an audiotaped conversation prepared by a family member about positive experiences from the past delivered through a portable cassette player with headphone, used in Garland et al.[28] study. Control conditions included usual care,[28-32] neutral audiotape (placebo)[28] and waitlist control.[33] Frequency and duration of activity interventions varied widely across studies. Detailed information is presented in Table 3.

[Insert Table 3 near here]

Key outcome & measures

Studies examined different psychological (i.e. BPSD, mood states, emotional well-being, engagement and social participation) and physiological (i.e. cognition, medication and sleep quality) outcomes using many different measures that included: Neuropsychiatric Inventory (NPI); Cornell Scale for Depression (CSDD); Cohen-Mansfield Agitation Inventory (CMAI); Cohen-Mansfield Agitation Inventory-Short Form (CMAI-SF); Observed Emotions Rating Scale (OERS); Profile of Mood States-Brief (POMS-B); Mini-Mental State Examination (MMSE); single item questions with Visual Analogue Scale (VAS); observed frequency of physical and verbal agitation; video observations/coding; and Electronic Medication Administration Record (eMAR) (See Table 3). Not only were different outcomes measured in different studies, but the same outcome was also assessed using different instruments in different studies. For example, agitation was assessed using observed frequency of physical and verbal agitation,[28] CMAI,[29, 33] CMAI-SF[30-32] and video observations/coding.[30] Consequently, this makes direct comparisons of studies' outcome challenging. Meta-analysis

was not conducted as combining results from different instruments even when measuring the same outcome is not appropriate as the responsiveness of instruments may differ substantially and lead to important between-study heterogeneity and biased meta-analyses.[36] In addition, studies included in this review examined outcomes at baseline, during and/or post-activity intervention. No studies included follow-up assessments of post-activity intervention.

The effects of non-facilitated meaningful activities on behavioural and psychological symptoms of dementia (BPSD)

Agitation was assessed in all six studies using a variety of different measures. Studies using CMAI and CMAI-SF reported disparate results for agitation. For those using CMAI, no significant treatment effect was found.[29, 33] Nevertheless, a trend reflecting lower agitation was detected in both music and usual care groups in the Janata[29] study, as well as in the music group when compared to the waitlist control group in the Weise et al.[33] study. Additionally, while no treatment effect was detected, Shiltz et al.[32] found a significant decline in agitation for all participants, as measured by CMAI-SF ($p = .001$). Studies using PARO, plush toy and lifelike doll activities showed no difference between treatments groups in reducing agitation when assessed by CMAI-SF.[30, 31] However, when assessed via video observations/coding, participants in the PARO group were observed to have significantly less agitated behaviours when compared to those in the usual care group ($p = .008$).[30]

Garland et al.[28] found that both the simulated family presence (placebo, $p = .007$; usual care, $p = .003$) and music (usual care, $p = .039$) activities were effective in reducing physical agitation occurrences. However, simulated family presence (usual care, $p = .037$), but not music, significantly reduced verbal agitation occurrences. Although participants' responses to simulated family presence and music activities varied widely, a respective 43% and 50% showed a reduction of physical and verbal agitation occurrences by half in response to

simulated family presence and music.[28] Finally, Janata[29] reported reduced composite scores of NPI in both music and usual care groups where a main 'shift' effect in BPSD was found, with significantly lower scores found in the morning than in the afternoon ($p < .0001$).

The effects of non-facilitated meaningful activities on mood states

Five studies reported on mood states,[29-33] which included feelings of depression, anger/hostility, anxiety/fear, pleasure, sadness, general alertness and emotional well-being, which were assessed using CSDD, OERS, POMS-B, single item questions with VAS and video observations/coding. In the studies by Janata,[29] Shiltz et al.[32] and Weise et al.,[33] music activity had no significant treatment impact on participants' scores on CSDD, POMS-B depression, anxiety or anger/hostility and emotional well-being respectively. However, a positive effect via reduced composite scores of CSDD in both music and usual care groups, where a main 'shift' effect in depression with significantly lower scores in the morning than in the afternoon ($p < .0001$), was reported by Janata.[29]

Moyle et al.[30] found that, through video observations/coding, both PARO ($p = .022$) and plush toy ($p = .002$) groups significantly reduced neutral affect, and the PARO group had significantly increased pleasure ($p = .008$) when compared to the usual care group. Lifelike doll activities neither reduced feelings of anxiety/fear, anger or sadness, nor increased pleasure or general alertness on OERS when compared to usual care.[31] However, a significant group-by-time group interaction for the outcome of pleasure was detected, whereby the lifelike doll group showed greater displays of pleasure at post-intervention compared to baseline than the usual care group ($p = .044$).

The effects of non-facilitated meaningful activities on engagement

Only two studies examined engagement as an outcome measure.[30, 33] From video observations/coding, the use of PARO was found to significantly increase verbal ($p = .011$) and visual ($p < .0001$) engagement when compared to the plush toy.[30] Participants in the music group demonstrated a trend, albeit non-significant, towards improvements in social participation when compared to the waitlist control group.[33]

The effects of non-facilitated meaningful activities on cognition, medication and sleep quality

Shiltz et al.[32] reported no significant changes in cognition via MMSE and psychotropic medication exposure from eMAR between the music and usual care groups. In contrast, Weise et al.[33] found significant improvements in the sleep quality of participants in the music group when compared to the waitlist control group ($p = 0.38$).

Discussion

The small number of literature included in this systematic review highlights a continued lack of studies that examine non-facilitated meaningful activities (i.e. relevant with potential for health and well-being benefits and personalised to individual preferences) for people living with dementia in LTC facilities. This finding is consistent with an earlier review that found the majority of meaningful activity interventions for people living with dementia are facilitated by nursing or care staff, researchers or others (e.g. volunteers, musicians, clowns).[18] To date, it appears that researchers have provided limited attention to understand the facilitator effect when determining the effectiveness of the activity interventions being introduced to people living with dementia in LTC, thus making it challenging to ascertain whether the intervention effect is attributed to the activity or the facilitator.[18] Understanding the effects of non-facilitated meaningful activities for people living with dementia in LTC is important to ascertain whether the activity interventions are truly effective without the person-to-person social interaction.

Further, given the reported long periods people with dementia spend alone by themselves in LTC,[9, 10] which are further exacerbated by the shortage of care staff,[24, 25] and projected rising costs of dementia care,[37] there is, therefore, a need for studies on non-facilitated meaningful activities in a bid to identify effective non-facilitated meaningful activities that do not require the involvement of care staff or other personnel. As such, this systematic review evaluated the effects of non-facilitated meaningful activities for older people with dementia living in LTC facilities.

Overall effects of non-facilitated auditory activities (music and stimulated family presence)

First, music has been suggested to be an environmental modifier to mask unpleasant stimuli and reduce neuropsychiatric symptoms,[38] as well as prevent the occurrence of agitation.[39] Unlike other studies of facilitated music activities showing a reduction of agitation in people living with dementia,[18, 40-43] non-facilitated auditory activities only reduced physical (both music and stimulated family presence) and verbal (stimulated family presence only) agitated behaviours in one study,[28] despite trends of improvements in BPSD and agitation being reported in other music studies.[29, 32, 33] Hence, this review did not find robust evidence to support the effectiveness of meaningful non-facilitated auditory activities (music and stimulated family presence) to reduce BPSD and agitation in people living with dementia.

Second, basic emotions can be communicated through music[44] and personal emotions and memories can be induced through familiar and memorable music.[45] The extant literature suggests that people living with dementia can perceive the emotions emitted by music and continue to recognise not only the melodies but also the titles of familiar songs.[45-48] Some studies of facilitated music activities have alluded to the possibility of an improvement in mood states of people living with dementia.[49, 50] A recent Cochrane review[51] found that music therapy may bring mild to moderate improvement in emotional well-being, depression and anxiety post

intervention, but had no or little sustained effect. An earlier review[52] highlights a continued lack of quality studies and robust evidence showing music activities can reduce depression and anxiety in older people living with dementia. Findings of this review support this notion, as non-facilitated music activities were found to be ineffective in improving mood states or emotional well-being in older people living with dementia.[29, 32, 33] Support for non-facilitated music as a meaningful activity to improve mood states is, therefore, not established in this review.

Third, similar to BPSD, agitation and mood states, non-facilitated music activities neither increase social participation nor improve medication usage and cognition. This finding on cognition is similar to a meta-analysis of thirty-eight trials involving 1418 participants living with dementia, where no significant difference was found for cognitive function between participants who received interactive or receptive music therapy and those who received usual care.[43] Interestingly, there is preliminary evidence to suggest that non-facilitated music can improve sleep quality in people living with dementia.[33] However, this is unsurprising given that music can have a direct effect on the parasympathetic nervous system, which helps the body relax and prepare for sleep.[53, 54]

Overall effects of non-facilitated lifelike doll, animal-like social robot (PARO) & plush toy activities

The other forms of meaningful non-facilitated activities included in this review were the introduction of lifelike dolls[31] and animal-like social robot PARO and plush toy (i.e. PARO with robotic features disabled) in the Moyle et al.[30] study. Compared to usual care, the lifelike doll activity was only found to display increased pleasure between post-treatment and baseline.[31] Therefore, there is yet to be any established evidence to support the introduction of

a lifelike doll as a meaningful non-facilitated activity to improve agitation, mood states and engagement. Further research is needed in this area.

Animal-assisted therapy studies are reported to have beneficial effects on people living with dementia.[55-58] For example, Wesenberg et al.[58] found that an animal-assisted intervention (i.e. a dog) led to significantly longer and more frequent periods of positive emotions (pleasure) and social interaction (touch and body movement). Furthermore, the systematic review by Pu et al.[59] on animal-like social robot activities to enhance the well-being of older people with and without cognitive impairment found that it has the potential to promote health and well-being by increasing perceived emotional support and social interaction. Findings of this review were congruent with the aforementioned studies, where lower agitation and greater pleasure, assessed via video observations/coding, was found in PARO activity when compared to usual care activity. Additionally, video observations/coding revealed that people living with dementia demonstrated increased verbal and visual engagement when they were undertaking PARO than usual care activities. While meaningful non-facilitated animal-like social robot PARO and plush toy activities demonstrated similar outcomes to previous assisted-animal therapy studies, conclusive evidence to support the introduction of meaningful non-facilitated animal-like social robot PARO and plush toy activities to improve agitation, mood states and engagement is yet to be established.

Facilitated or non-facilitated meaningful activity – which is more appropriate?

As previously indicated, understanding of the *'true'* effects of meaningful activities, independent of the facilitator, is beneficial when providing activities for people living with dementia in LTC with limited resources (e.g. personnel) and during virus outbreaks (e.g. coronavirus (COVID-2019) when social distancing may be required. However, reliance on only non-facilitated meaningful activities for people with dementia in LTC is cautioned due to

a number of reasons. First, person-to-person social interactions (e.g. via one-on-one or group activities) can contribute positively to the health and wellbeing of people living with dementia,[60] especially for those in LTC where social interactions is often already limited.[9, 10] Second, the value of facilitated meaningful activities should not be overlooked, as the roles of facilitator in (a) the initiation of activity; (b) encouraging and sustaining activity participation (particularly for those with more advanced cognitive impairments); (c) adjusting activities according to observed/assessed response; as well as (d) social interaction, can potentially yield greater benefits than non-facilitated activities alone for people living with dementia.

Strengths, limitations & future research/considerations

The key strength of this review is the inclusion of only randomised controlled trials which is considered Level II evidence, according to National Health and Medical Research Council Evidence Hierarchy for intervention studies.[61] Further strengths of this review include the use of defined inclusion/exclusion criteria, application of a rigorous search strategy from eight databases and quality assessment of the studies using the validated MMAT tool. However, it should be noted that generalisability of the outcomes from this review may be influenced by the inherent challenges of conducting RCTs/CTs studies in LTC, and the innate difficulties in accommodating participants' preferences in interventions for a homogeneous effect.[62]

Limitations of this review should be considered when interpreting the findings. First, the small number of studies included in this review reflects the paucity of RCTs/CTs in the research field of non-facilitated meaning activities for older people living with dementia in LTC facilities. Second, the heterogeneity of activity interventions (i.e. types, duration and frequency) as well as the outcomes being assessed, and the instruments used to measure the outcomes make it unfeasible to conduct further analysis that pools the results of the studies

included in this review. Although results from this review offer narrative guidance regarding non-facilitated meaning activities for older people living with dementia in LTC facilities, they should be interpreted with caution due to the lack of a meta-analysis. Third, language bias should be considered because only studies published in the English language were selected, thereby omitting the possible inclusion of studies published in other languages. Further, the age selection for participants was 65 years old and over, which excludes people with younger onset dementia who may also benefit from non-facilitated meaningful activities. Finally, the small sample sizes in five out six studies reviewed (i.e. music and lifelike dolls), the gender imbalance across studies (i.e. almost three-quarter of participants were female), the quality shortcomings determined through the reported methodology of included studies (e.g. treatment fidelity) as well as the focus on non-facilitated meaningful activities provided only in LTC setting warrant caution in the elucidation and generalisability of findings.

By and large, meaningful activities included in this review (i.e. music/stimulated family presence, animal-like social robot PARO/ plush toy and lifelike dolls) have shown varying benefits on agitation, emotional well-being, feelings of pleasure, engagement (i.e. verbal and visual) and sleep quality. These benefits are mostly only observed when the activities are taking place (i.e. "in the moment"). For example, improvements in agitation were only noted via video observations/coding and behaviour frequency count when an activity is occurring and not when assessed over a previous two-week period using CMAI/CMAI-SF. Consideration is thus needed as to whether any benefits can realistically be sustained beyond the occurrence of the meaningful activity itself and its resulting influence on the overall quality of life. It should be noted that non-pharmacological interventions, like pharmacological interventions, often need to be provided on a continuous basis for its benefits or effects to be maintained. Consequently, careful selection of outcome measures for "in the moment" activity effect and associated sustained or longer-term effect (if assessed), as well as the instruments used to measure these

outcomes, are needed. Further work is also needed to ascertain if and/or when facilitated or non-facilitated meaningful activities are most appropriate for people living with dementia in LTC.

Conclusions

Non-facilitated meaningful activities provide a promising way for care staff, including nurses, to manage behavioural and psychological symptoms and improve quality of life in older people with dementia in LTC facilities, while also eliminating the need for facilitation involving the limited numbers of available care staff. This systematic review syntheses evidence from RCTs/CTs of non-facilitated meaningful activities for older people living with dementia in LTC facilities. A total of six studies were included. The results implied that current RCTs/CTs about non-facilitated meaningful activities for people with living dementia in LTC facilitates are limited, but those included in this review were of adequate methodological quality. Meaningful non-facilitated activities, such as music, stimulated family presence, animal-like social robot PARO/plush toy and lifelike dolls, may have beneficial effects on agitation, emotional well-being, feelings of pleasure, engagement (i.e. verbal and visual) and sleep quality. However, there remains a lack of conclusive and robust evidence to support these psychological and physiological effects of non-facilitated meaningful activities for older people with dementia living in LTC facilities by care staff. Additional rigorously designed RCT/CT studies with larger sample size are needed to confirm these benefits found in this review. In particular, the potential for meaningful non-facilitated activities to improve mood states, social interaction, cognition and medication usage requires further investigation.

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Table 1. Methodology quality of included studies* (n=6)

Study	S1	S2	2.1	2.2	2.3	2.4	2.5
Garland et al. (2007)	Yes	Yes	Can't Tell	Yes	Can't Tell	Can't Tell	Can't Tell
Janata (2012)	Yes	Yes	Yes	Yes	Yes	Yes	Can't Tell
Moyle et al. (2017)	Yes	Yes	Yes	Yes	Can't Tell	Yes	Yes
Moyle et al. (2019)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shiltz et al. (2018)	Yes	Yes	Yes	Can't Tell	Can't Tell	Can't Tell	Yes
Weise et al. (2019)	Yes	Yes	Yes	Can't Tell	Yes	No	Yes

Mixed Methods Appraisal Tool – Version 2018 [34]; S1: Screening - Are there clear research questions?; S2: Screening - Do the collected data address the research questions?; 2.1: Is randomization appropriately performed?; 2.2: Are the groups comparable at baseline?; 2.3: Are there complete outcome data?; 2.4: Are outcome assessors blinded to the intervention provided?; 2.5: Did the participants adhere to the assigned intervention?

Table 2. Participant characteristics of included studies (n = 6)

Study	Country	Setting	Number of participants	Gender (F/M)	Age (years)	Cognition
Garland et al. (2007)	Australia	9 Long-term care facilities	30	19/11	79 (66-93)[a]	Residents with dementia (MMSE): 2.5 (0-12)[a]
Janata (2012)	USA	1 Long-term care facility	38	25/13	Music: 80.9 (9.6)[b] Control: 81.7 (7.5)[b]	Residents with moderate-to-severe dementia (MMSE): Music: 7.5 (5.8)[b] Control: 4.9 (5.4)[b]
Moyle et al. (2017)	Australia	28 Long-term care facilities	415	314/101	PARO: 84 (8.4)[b] Plush toy: 86 (7.6)[b] Usual care: 85 (7.1)[b]	Residents with dementia (RUDAS): PARO: 6.5 (6.5)[b] Plush toy: 7.1 (6.5)[b] Usual care: 8.3 (7.2)[b]

Moyle et al. (2019)	Australia	5 Long-term care facilities	33	33/0	Lifelike dolls: 86.1(8.6)[b] Usual care: 89.7(8.4)[b]	Residents with dementia (MMSE): Lifelike dolls: 4.9 (4.8)[b] Usual care: 5.8 (4.9)[b]
Shiltz et al. (2018)	USA	1 Long-term care facility	92	48/44	Music:76 (57-93)[a] Control: 80 (55-96)[a]	Residents with moderate-to-severe dementia (MMSE) *(scores are not reported)*
Weise et al. (2019)	Germany	1 Long-term care facility	20	16/4	85.1 (5.9)[b]	Residents with mild (10%), moderate (70%) and severe (20%) dementia *(instrument and scores are not reported)*

Note: [a] = Mean (Range); [b] = Mean (Standard Deviation); RUDAS, The Rowland Universal Dementia Assessment Scale: A Multicultural Cognitive Assessment Scale; MMSE, Mini-Mental State Examination.

Table 3. Study characteristics of included studies (n = 6)

Study	Design	Intervention Group	Control Group	Frequency & Duration	Outcome Measures	Results
Garland et al. (2007)	3-group cross-over RCT	• 15-minutes audiotape of simulated family presence • 15-minutes audiotape of preferred music Delivered via portable cassette player with headphone	• Usual care • 15-minutes neutral audiotape (placebo) Delivered via portable cassette player with headphone	• Once a day for three days each during weeks 1, 2, 3 & 4 • Included 2 days wash-out between each treatment	• Frequency of physical agitation (aggressive & non-aggressive) • Frequency of verbal agitation (aggressive & non-aggressive)	• Simulated family presence (placebo, $p = .007$; usual care, $p = .003$) & preferred music (usual care, $p = .039$) were effective in reducing physically agitated behaviours • Simulated family presence (usual

care, $p = .037$)

resulted in reduced

verbally agitated

behaviours

- Responses to

  simulated family

  presence & music

  varied widely

- Placebo tape

  proved more

  effective than

  expected

| Janata (2012) | 2-group parallel RCT | • Customised music programs (individualised music list based on music preference, listening history & demographic characteristics) Streamed to the rooms of participants | • Usual care (incidentally exposed to music programming in the course of daily living) | • 4 times daily (total of several hours) for 12 weeks | • BPSD (NPI)
 • Mood state - depression (CSDD)
 • Agitation (CMAI) | • Reduction in composite scores of NPI, CMAI & CSDD in both groups
 • Significant shift effects where NPI ($p < .0001$) & CSDD ($p < .0001$) were found to be lower in the morning than afternoon in both groups |

| Moyle et al. (2017) | 3-group cluster-RCT | • PARO
• Plush toy (i.e. PARO with robotic features disabled)

Introduced using a standardised script and left with participants to interact as they liked | • Usual care | • 15 minutes per session
• 3 times per week (Monday, Wednesday, & Friday) for 10 weeks | • Engagement, mood states & agitation (video observations/coding)
• Agitation (CMAI-SF) | • Video coding
  ○ PARO group was more verbally (p = .011) & visually ($p < .0001$) engaged than plush toy group
  ○ PARO (p = .022) & plush toy (p = .002) had greater reduced neutral affect compared with usual care |

o PARO was more effective than usual care in improving pleasure (p = .008)

o PARO was more effective than usual care in improving agitation from video observation (p = .008)

					• No difference in CMAI-SF between groups
Moyle et al. (2019)	2-group parallel RCT	• Lifelike dolls Introduced using a standardised script and left with participants to interact as they liked	• Usual care	• 30 minutes per session • 3 times per week for 3 weeks	• Mood states (OERS) • Agitation (CMAI-SF)	• No significant reduction in anxiety, agitation, or aggression between two groups • Significant group-by-time interaction for the outcome of pleasure where the lifelike doll group showed a greater

						increase in displays of pleasure at week 3 compared to baseline than the usual care group ($p = .044$)
Shiltz et al. (2018)	2-group parallel RCT	• Music: usual care plus personalised music Delivered via iPod shuffle with headphone	• Usual care	• 30 minutes per session • 3 times per week on 3 different non-consecutive days for 3 months	• Mood states (POMS-B) • Agitation (CMAI-SF) • Cognition (MMSE) • Medication (Scheduled & PRN via eMAR)	• Agitation decreased for all participants ($p = .001$) • No significant changes in affect, cognition & psychotropic medication exposure

| Weise et al. (2019) | 2-group parallel RCT | • Personally relevant music playlist

Delivered via MP3 player with headphone | • Waitlist control | • 30 minutes every other day for 4 weeks | • BPSD (CMAI)
• Emotional well-being, sleep quality, resistance to care & social participation (Single item questions with VAS) | • Significant improvements in sleep quality ($p = 0.38$) along with trends towards improvements in social participation & agitation |

Note: RCT, Randomised Controlled Trial; NPI, Neuropsychiatric Inventory; CSDD, Cornell Scale for Depression; CMAI, Cohen-Mansfield Agitation Inventory; CMAI-SF, Cohen-Mansfield Agitation Inventory-Short Form; PARO, Personal Assistance RobOt; OERS, Observed Emotions Rating Scale; POMS-B, Profile of Mood States-Brief; MMSE, Mini Mental State Examination; PRN, Pro Re Nata; eMAR, Electronic Medication Administration Record; VAS, Visual Analogue Scale.
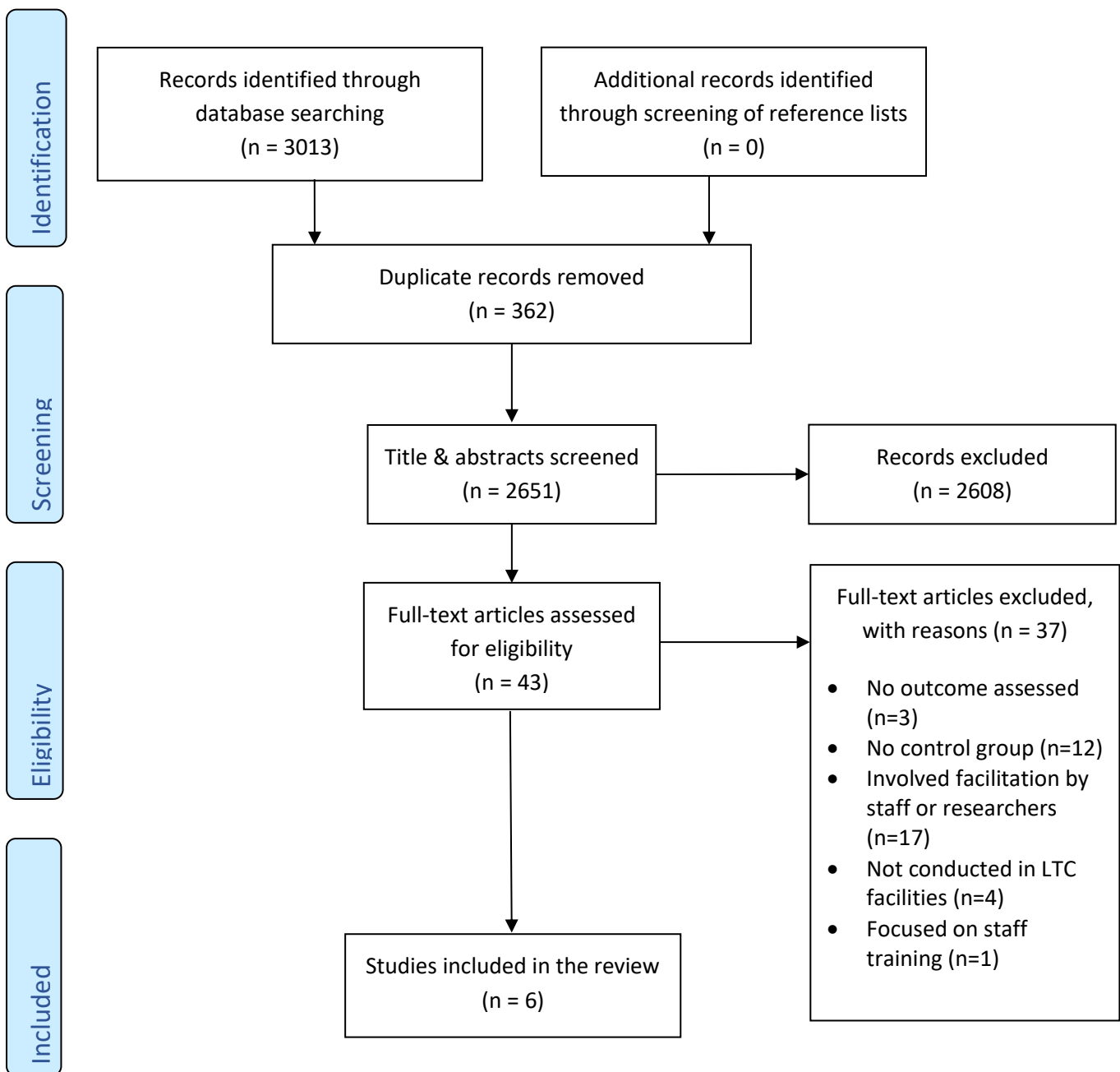
Figure 1. PRISMA flowchart diagram

[No colour reproduction in print]

Supplementary File 1

Search strategy for eight databases up to the date 31st October 2019

1. PubMed

#1:   (("residential care" OR "residential aged care") OR ("long term care" OR "long-term care")) OR ("nursing home" OR "nursing-home")

#2:   ((((((((((((((((((((((occup*) OR activit*) OR intervention*) OR progra*) OR ("psycho social" OR "psycho-social")) OR (behavio* OR behavior)) OR diversion*) OR montessori) OR "support group") OR ("leisure activities" OR leisure OR activities)) OR "activities of daily living") OR "life stor*") OR "life history review") OR "life story review") OR exercis*) OR music*) OR (art OR arts)) OR pet) OR animal) OR sensor*) OR massag*) OR touch*) OR aromatherap*) OR complementary) OR alternative) OR validation) OR recreation*

#3:   (((((((meaningful) OR tailor*) OR (individualised OR individualized)) OR preferred) OR ("preference based" OR "preference-based")) OR ("person centred" OR "person-centred")) OR pleasur*) OR engage*

#4:   (("alzheimer disease"[MeSH Terms]) OR dementia [MeSH Terms]) OR dementia

#5:   #1 AND #2 AND #3 AND #4

2. CINAHL

#1:   TX ("residential care" OR "residential aged care") OR TX ("long term care" OR "long-term care") OR TX ("nursing home" OR "nursing-home")

#2: TX occup* OR TX activit* OR TX intervention* OR TX progra* OR TX ("psycho social" OR "psycho-social") OR TX (behavio* OR behavior) OR TX diversion* OR TX montessori OR TX "support group" OR TX ("leisure activities" OR leisure OR activities) OR TX "activities of daily living"

#3: TX "life history review" OR TX "life story review" OR TX exercis* OR TX music* OR TX (art OR arts) OR TX pet OR TX animal OR TX sensor* OR TX massag* OR TX touch OR TX aromatherap*

#4: TX complementary OR TX alternative OR TX validation OR TX recreation*

#5: S2 OR S3 OR S4

#6: TX meaningful OR TX tailor* OR TX (individualised OR individualized) OR TX preferred OR TX ("preference based" OR "preference-based") OR TX ("person centred" OR "person-centred") OR TX pleasur* OR TX engage*

#7: MH "alzheimer disease" OR MH dementia OR dementia

#8: S1 AND S5 AND S6 AND S7

3. EMBASE

#1: 'residential care' OR 'residential aged care' OR 'long term care' OR 'long-term care' OR 'nursing home' OR 'nursing-home'

#2: occup* OR activit* OR intervention* OR progra* OR 'psycho social' OR 'psycho-social' OR behavio* OR behavior OR diversion* OR montessori OR 'support group'/exp OR 'support group' OR 'leisure activities' OR leisure OR activities OR 'activities of daily living' OR 'life

stor*' OR 'life history review' OR 'life story

review' OR exercis* OR music* OR art OR arts OR pet OR animal OR sensor* OR m

assag* OR touch* OR aromatherap* OR complementary OR alternative OR validatio

n OR recreation*

#3:   meaningful OR tailor* OR individualized OR preferred OR 'preference

based' OR 'preference-based' OR 'person centred' OR 'person-

centred' OR pleasur* OR engage*

#4:   'alzheimer disease':lnk OR dementia:lnk OR dementia

#5:   #1 AND #2 AND #3 AND #4

4. Web of Science

#1:   TOPIC: ("residential care" OR "residential aged care") OR TOPIC: ("long term care"

OR "long-term care") OR TOPIC: ("nursing home" OR "nursing-home")

#2:   TOPIC: (occup*) OR TOPIC: (activit*) OR TOPIC: (intervention*) OR TOPIC:

(program*) OR TOPIC: ("psycho social" OR "psycho-social") OR TOPIC: (behavio*

OR behaviour) OR TOPIC: (diversion* OR montessori OR "support group")

OR TOPIC: ("leisure activities" OR leisure OR activities) OR TOPIC: ("activities of

daily living") OR TOPIC: ("life stor*") OR TOPIC: ("life history review") OR TOPIC:

("life story review") OR TOPIC: (exercis*) OR TOPIC: (music*) OR TOPIC: (art OR

arts) OR TOPIC: (pet) OR TOPIC: (animal) OR TOPIC: (sensor*) OR TOPIC:

(massag*) OR TOPIC: (touch*) OR TOPIC: (aromatherapy*) OR TOPIC:

(complementary) OR TOPIC: (alternative) OR TOPIC: (validation) OR TOPIC: (recreation*)

#3:   TOPIC: (meaningful) OR TOPIC: (tailor*) OR TOPIC: (individualised OR individualized) OR TOPIC: (preferred) OR TOPIC: ("preference based" OR "preference-based") OR TOPIC: ("person centred" OR "person-centred") OR TOPIC: (pleasur*) OR TOPIC: (engage*)

#4:   TITLE: ("alzheimer disease") OR TITLE: (dementia) OR TOPIC: (dementia)

#5:   #4 AND #3 AND #2 AND #1

#6:   #4 AND #3 AND #2 AND #1

5. PsycINFO

#1:   ("residential care" or "residential aged care" or "long term care" or "long-term care" or "nursing home" or "nursing-home").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]

#2:   (occup* or activit* or intervention* or progra* or "psycho social" or "psycho-social" or behavio* or behavior or diversion* or montessori or "support group" or "leisure activities" or leisure or activities or "activities of daily living" or "life stor*" or "life history review" or "life story review" or exercis* or music* or art or arts or pet or animal or sensor* or massag* or touch* or aromatherap* or complementary or alternative or validation or recreation*).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]

#3:   (meaningful or tailor* or individualised or individualized or preferred or "preference based" or "preference-based" or "person centred" or "person-centred" or pleasur* or

engage*).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]

#4:   "alzheimer disease".mp. or exp Alzheimer's Disease/

#5:   exp DEMENTIA/ or dementia.mp.

#6:   dementia.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]

#7:   4 or 5 or 6

#8:   1 and 2 and 3 and 7

6. Cochrane

"residential care" or "residential aged care" or "long term care" or "long-term care" or "nursing home" or "nursing-home" in All Text AND occup* or activit* or intervention* or progra* or "psycho social" or "psycho-social" or behavio* or behavior or diversion* or montessori or "support group" or "leisure activities" or leisure or activities or "activities of daily living" or "life stor*" or "life history review" or "life story review" or exercis* or music* or art or arts or pet or animal or sensor* or massag* or touch* or aromatherap* or complementary or alternative or validation or recreation* in All Text AND meaningful or tailor* or individualised or individualized or preferred or "preference based" or "preference-based" or "person centred" or "person-centred" or pleasur* or engage* in All Text AND "alzheimer disease" OR dementia in All Text

7. ProQuest

noft("residential care" OR "residential aged care" OR "long term care" OR "long-term care" OR "nursing home" OR "nursing-home") AND noft(occup* OR activit* OR intervention* OR progra* OR "psycho social" OR "psycho-social" OR behavio* OR behavior OR diversion* OR montessori OR "support group" OR "leisure activities" OR leisure OR activities OR "activities of daily living" OR "life stor*" OR "life history review" OR "life story review" OR exercis* OR music* OR art OR arts OR pet OR animal OR sensor* OR massag* OR touch* OR aromatherap* OR complementary OR alternative OR validation OR recreation*) AND noft(meaningful OR tailor* OR individualised OR individualized OR preferred OR "preference based" OR "preference-based" OR "person centred" OR "person-centred" OR pleasur* OR engage*) AND mainsubject("alzheimer disease" OR dementia)

8. ClinicalTrials.gov

("residential care OR long term care OR nursing home") AND ("alzheimer disease" OR dementia) AND ("psychosocial" OR "psycho-social" OR "leisure activities" OR leisure OR activities OR "activities of daily living" OR "life stor*" OR "life history review" OR exercis* OR music* OR art OR arts OR pet OR animal OR sensor* OR massag* OR touch*)