JCN Journal of Clinical Nursing

Journal of Clinical Nursing

REVIEW

Sensory stimulation for persons with dementia: a review of the literature

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Aims and objectives. To provide an overview of available sensory stimulation interventions, and their effect on persons with dementia and to present theoretical and methodological characteristics of the studies included.

Background. Different sensory stimulation interventions are used for persons with dementia to increase alertness, reduce agitation and improve quality of life. However, the effect of these interventions is not clear, neither are their characteristics.

Design. A systematic search and review of the literature with description of the content and an evaluation of theoretical and methodological approaches.

Methods. Systematic searches in CINAHL, PubMed (Medline), The Cochrane library and PsycINFO. Studies included have been subject to quality assessment by means of Critical Appraisal Skills Programme.

Results. Fifty-five studies were included and thirty of these documented significant effect. The effect of the sensory stimulation interventions mainly reported on negative behaviours, except from five studies assessing quality of life and well-being. The majority of the studies had methodological limitations. The different sensory stimulation interventions were organised into eight categories: music, light therapy, acupressure/reflexology, massage/aromatherapy and doll therapy/pet therapy/toy therapy, the Sonas programme and Snoezelen.

Conclusions. More studies are needed to clarify appropriate substantial background for the specific interventions. However, most of the studies based their interventions on a theoretical foundation. Furthermore, more research is needed to measure the effect of sensory stimulation on communication as well as quality of life. In addition, studies are to focus on whether the effect depends on the stage of dementia.

Relevance to clinical practice. Nurses are to be aware of sensory stimulation as a possible intervention to improve persons' quality of life.

What does this paper contribute to the wider global clinical community?

- This article provides an overview of available sensory stimulation interventions for persons with dementia.
- This review suggests limited theoretical and methodological characteristics of the interventions available for persons with dementia.

Key words: communication, dementia, nonpharmacological methods, psychosocial nursing, quality of life, review

Accepted for publication: 27 November 2015

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Introduction

Approximately 46·8 million persons worldwide are estimated to live with dementia and there are 9·9 million new cases of dementia every year. In accordance with Alzheimer's Disease International (Prince *et al.* 2015) these numbers will nearly double every 20 years to an estimation of 74·7 million in 2030, and 131·5 million in 2050, especially in Asia.

Dementia is a life changing condition and a diagnosis of dementia has often great consequences for the individuals and for immediate family members. It affects the memory, thinking, orientation, comprehension, calculation, learning capacity, language and judgment (World Health Organization, 2012), as well as leaving many persons with physical, cognitive and behavioural and psychological symptoms (BPSD) (Cerejeira *et al.* 2012, van der Ploeg *et al.* 2012). The most common BPSD is reported to be: depression, psychosis, aggression, motor or behavioural dysregulation and apathy (Lawlor & Bhriain 2001), irritability (Selbaek *et al.* 2007, Bergh *et al.* 2011) and anxiety (Selbaek *et al.* 2007, Seignourel *et al.* 2008, Bergh *et al.* 2011). Other symptoms reported are decreased mood, sexual disinhibition, eating problems, abnormal (repetitive) vocalisation and wandering (Finkel 1997, 2001). The causes of for example depression and aggression in persons with dementia have been documented to be associated with damage in the brain (Lyketsos *et al.* 2000). However, this behaviour might also be an expression of an unmet care need (Dewing 2010) or a symptom the person displays in an attempt to communicate physical or psychological needs that are not being met (Algase *et al.* 1996, Kovach *et al.* 2005).

It is well known that all the five human senses deteriorate as part of the normal ageing process. However, limited knowledge exists about how the senses are changing due to dementia except olfactory – and gustatory dysfunction, which is well documented (Wittmann-Price 2012). What we know is that the way a person with dementia interprets what they see, hear, taste, feel and smell seems to change due to the disease (National Institutes of Health, 2002), and according to the stage of dementia (Alves *et al.* 2014).

A variety of psychosocial interventions, sometimes referred to as 'activities, method, therapy or stimulation', have been developed mainly to deal with BPSD. Since neuroleptics is reported to have serious side effects in the management of BPSD, the use of psychosocial interventions in dementia care is highly recommended (Fossey *et al.* 2006, Kolanowski *et al.* 2010).

In spite of the fact that the treatment goals for persons with advanced dementia are to optimise quality of life (QoL), dignity and comfort (Volicer & Hurley 2003, Rabins *et al.* 2006, Heggestad *et al.* 2013), several of the available psychosocial interventions have limited focus on this aspect. Most studies (Cohen-Mansfield 2001, Douglas *et al.* 2004, O'Neil *et al.* 2011, Carrion *et al.* 2013) divide the interventions into four broad categories: emotion-oriented, behaviour-oriented, cognitive-oriented and sensory stimulation-oriented. Sensory stimulation refers to different techniques used to stimulate the senses to increase alertness and reduce agitation, as well as to enhance QoL which is the overall aim of sensory stimulation methods (Lykkeslet *et al.* 2014). Most sensory stimulation interventions considered are single sensory, while few are multi-sensory (MSS) interventions. Single stimulation requires stimulation to only one sensory modality, while multi-sensory stimulation requires stimulation of two or more senses, within a session (Wilson *et al.* 1996). In the literature, multi-sensory interventions are often equated with the Snoezelen concept; however, there are other interventions also that stimulate two or more senses, among them are sensory garden and the Sonas programme. The Sonas programme is a multi-sensory stimulation programme which involves cognitive, sensory, and social stimulation, including all five senses; touch, smell, taste, hearing and sight (Sonas aPc, 2011).

Despite several sensory stimulation interventions available, there is a challenge to find appropriate interventions which can awaken latent memories and abilities (Bakker 2003). Few of the sensory stimulation interventions include gustatory stimulation (the Sonas programme) and olfactory stimulation (the Sonas programme and Snoezelen), although research documents that these are the only two senses which are known to alter as a result of the dementia process (Alves *et al.* 2014). Stimulating these specific senses is important, since we know they are closely connected and that lack of smell and taste can affect person's QoL (Alves *et al.* 2014).

Previous reviews of sensory stimulation

Several reviews have been conducted in recent years, to give an overview of the effect of some of the sensory stimulation interventions for persons with dementia. *Massage and touch* (Hansen *et al.* 2006, O'Neil *et al.* 2011) and *aromatherapy* (Thorgrimsen *et al.* 2003, Kong *et al.* 2009, Kverno *et al.* 2009, Forrester *et al.* 2014) is documented to reduce agitation and behaviour symptoms in persons with dementia. *Music* is frequently used and shows a decrease in a range of BPSD (Vink *et al.* 2003) and apathy (Kverno *et al.* 2009), as well as an increase in reality orientation, memory recall, time spent with one's meal, levels of engagement (Sherratt *et al.* 2004) and QoL (Vasionyte &

Madison 2013). *Animal assisted therapy* is reported to have a positive effect on communication and coping ability (Bernabei *et al.* 2013) and reduces agitation and disruptive behaviour, increases social and verbal interactions and decreases passivity (O'Neil *et al.* 2011). The benefit of *Snoezelen* is equivocal as well: some refer to no effect on behaviour, mood, cognition or communication (Chung & Lai 2002) while others (Verkaik *et al.* 2005) refer to some evidence of reduced apathy. Forbes *et al.* (2009) review of *light therapy* on sleep, behaviour, cognition or mood, documented no significant effect, while a review conducted by Gonzalez and Kirkevold (2013) reports that *sensory garden* might be beneficial on behavioural issues and well-being for persons with dementia.

Despite the above mentioned reviews highlighting selected perspectives of sensory stimulation among persons with dementia, no reviews seem to give an overview of available sensory stimulations used for persons with dementia and the methodological and theoretical characteristic of these interventions.

Aims and research questions

The overall aim of this study was to provide an up-to-date overview of available sensory stimulation interventions and its effect on persons with dementia and the characteristics of the studies that have been published between 2003–2014. The review presented here seeks to answer the following research questions:

1 At present, what kind of sensory stimulation interventions are used for persons with dementia?
2 What theoretical and methodological characteristics, e.g. specific study design and measures, do the available studies incorporate?
3 What is the effect of the different interventions?

Methods

The methodological approach to this paper is characterised as a 'systematic search and review' (Grant & Booth 2009) with evaluation of the included articles by means of Critical Appraisal Skills Programme (CASP, 2014). The CASP system is used as a description of quality, however, not for exclusion of articles.

Search strategy

A systematic search was conducted in August 2014 in four databases: CINAHL, PubMed (Medline), The Cochrane library and PsycINFO. We also did a hand search.

The databases were searched using the following strategy that was formulated in CINAHL and adapted to the other three databases:

'dement*' OR 'alzheim*', AND 'sensor* stimul*' OR 'multi-sensor* stimul*' OR 'multisensory* stimul*' OR 'multi-sensor* environ*' OR 'multisensory* environ*' OR 'psychosocial* method*' OR 'psychosocial* intervent*' OR 'non-pharmacological* intervent*' OR 'nonpharmacological* intervent*'OR 'non-pharmacological* therap*' OR 'nonpharmacologic* therap*'.OR 'music' OR 'massage' OR 'touch' OR 'aromatherap*' OR 'relexolog* OR 'Sonas' OR 'Snoezelen' OR 'sensory garden' OR 'acupressure' OR 'light therap* OR 'bright light therap*' OR 'doll therap*' OR 'toy therap*' OR 'pet therap*'.

Inclusion criteria

We included randomised controlled trials (RCT), controlled clinical trials (CCTs), studies with a cross-over design, as well as pre–post studies with control. Study participants having a diagnosis of dementia (including Alzheimer disease, frontotemporal dementia, vascular dementia and mixed Alzheimer's disease) were included. The main intervention was to be sensory based, delivered to individuals or in a group performed by staff members or researchers (not family caregivers) at a day hospital or long-term care home. Only studies using standardised instruments to measure the outcomes/effect were included. The articles were all in the English language and published in peer-reviewed journals.

Exclusion criteria

Dissertations were excluded as well as articles describing interventions aimed for the caregiver and studies carried out in persons' homes. Further exclusion criteria were articles not written in English, studies measuring the effect of pharmacological treatment or combination of pharmacological and sensory stimulations. Studies measuring the effect on staff or family were excluded.

Study selection and quality assessment

A first selection was performed by the first author according to the inclusion and exclusion criteria. A flow chart describes the selection process (Fig. 1). During the first step at the selection process, all abstracts were read, and if there was any doubt that the article met the inclusion criteria, the full text was obtained. After having excluded articles, which did not meet the criteria, the articles were read in full text and divided among the three investigators. All three authors

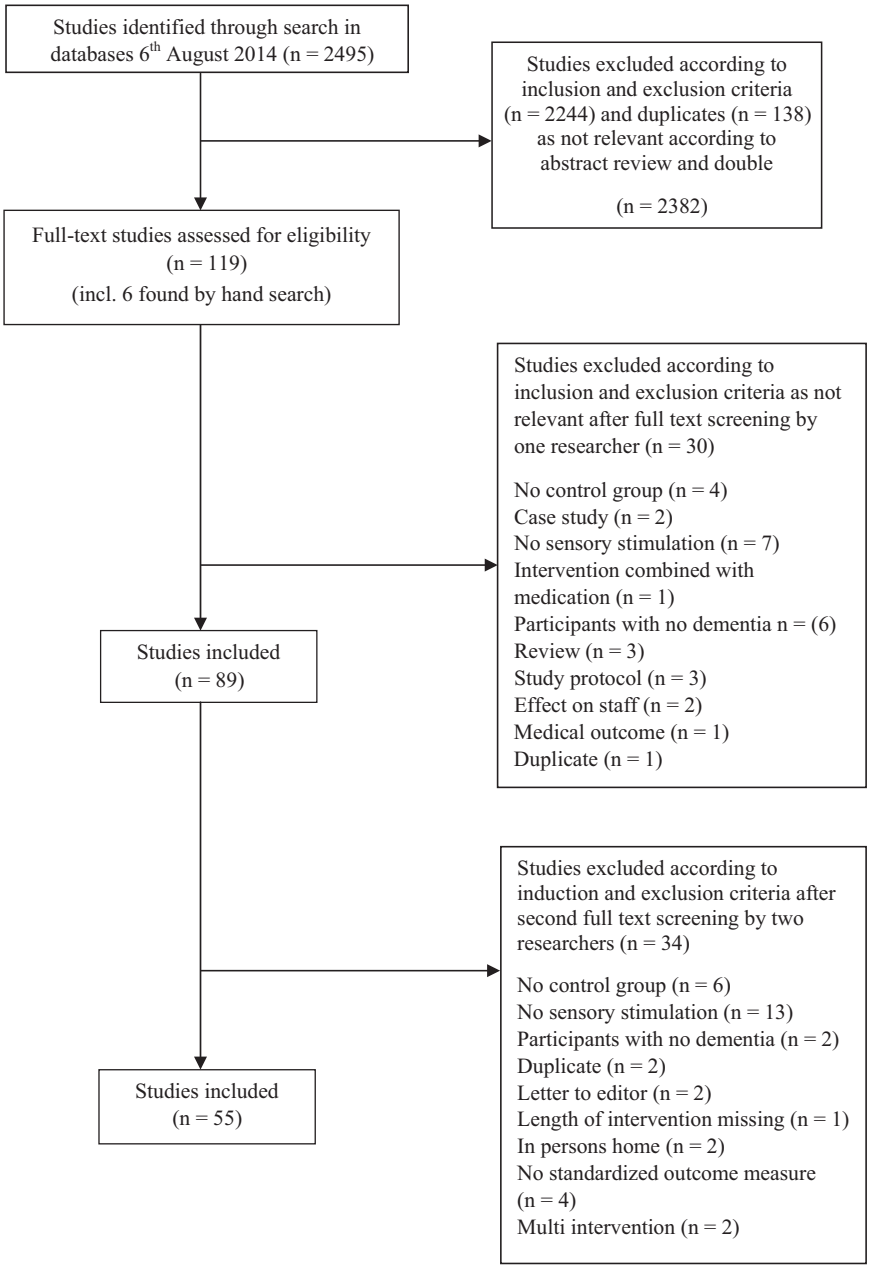

Figure 1 Flow chart for selection of articles in terms of inclusion and exclusion.

made a further deduction according to inclusion – and exclusion criteria, after having read all the articles.

To ensure accurate and transparent reporting of the review the first author assessed all studies evaluated for eligibility while the second and third author assessed half the number of articles each. Any discrepancies or difficulties were discussed and a consensus reached. A standardised form was used to extract relevant data, which are presented in Appendix 1.

The quality of the selected articles was evaluated by all three authors, using CASP (2014). This tool consists of 11 items, evaluating the following properties of studies: valid result of the review, what the findings are and if the result will have an impact clinically. Each item was rated potentially at low risk of bias ('Yes = 1'), high risk of bias ('No = 0'), or unclear ('Can't tell = 0'). In this study, we argue for a score with a cut-off ≥9 representing high quality. Those studies getting scores less than nine according to the number of Yes scores represent studies not reaching high quality. An overview of the quality of each article is presented in Appendix 1.

Interventions considered based on a theoretical foundation described the mechanism behind the intervention and its expected outcome.

A complete list of excluded articles is available for those contacting the corresponding author.

Results

Sample

The literature search included 2495 articles. Based on titles and abstracts, the first author selected 119 studies (including six hand-search) to be further assessed for eligibility. A total of 89 articles were first identified as meeting the above criteria. However, after a second assessment with all three authors included, this number was reduced to 55 (Fig. 1).

The studies were predominantly from Europe (n = 19) and North America (n = 16) and varied in design, methodology, number of participants and measures. The largest number of studies was found to cover music (n = 25), light therapy (n = 8) and massage/aromatherapy (n = 7). The majority (n = 48) of the studies were assessed to be of high quality based on CASP (Appendix 1).

Based on interventions, the studies were grouped into two main categories and seven sub categories:

1 *Single sensory stimulation* included music, light therapy, acupressure/reflexology, massage/aromatherapy and doll therapy/pet therapy/toy therapy.
2 *Multi-sensory stimulation* included Snoezelen and the Sonas programme.

Key findings by intervention

Music

Among the 25 studies examining the effect of music: 12 highlighted music therapy while the other 14 were music based (Table 1). In the following, we will present each approach.

Music therapy. Of the 12 studies examining the effect of music therapy, nine were theory based (Table 1) suggesting that BPSD are influenced by an interaction with the environment which can lower the person's stress thresholds. The target was relieving agitation, BPSD, enhancing QoL and cognition (Table 2). The sample size varied from 14–100, conducted twice to thrice weekly over a period of 6–16 weeks (Appendix 1). Only eight of the studies targeted a specific dementia stage. Ten studies used group sessions (Table 1).

Among the ten studies reporting significant effect, four studies (Svansdottir & Snaedal 2006, , Raglio *et al.* 2008, 2010a,b) emphasised a reduction in BPSD after group based music therapy. Sakamoto *et al.* (2013) who compared the effect of individualised passive and interactive music, found that those who participated in passive intervention were in significantly better mood after ten interventions than the interactive and control group. At the same time, the interactive interventions caused the greatest long-term improvement in the emotional state. Three studies were found to have a significant reduction on overall agitation (Tuet & Lam 2006, Choi *et al.* 2009, Lin *et al.* 2011) and one (Ridder *et al.* 2013) in agitation disruptiveness. Ledger and Baker (2007) reported a significant decrease in verbal aggressive behaviour for the music therapy group.

Music with movement. One study (Sung *et al.* 2006), not targeted to a specific dementia stage, examined the effect of group music with movement on agitation. The theoretical foundation was based on an understanding that music can change the reactions in the autonomic nervous system. A significant reduction in agitation following the intervention for the experiment group was reported.

Singing. A music based intervention pre-meal singing was used in one study, reported to enhance cardiovascular and pulmonary performance (McHugh *et al.* 2012). The intervention was not targeted to a specific stage of dementia and no significant effect on nutrition intake after attending the singing intervention, was documented.

Use of musical instruments. Two studies, conducted as group sessions, examined the effect of the use of musical instruments, targeting: well-being (Clément *et al.* 2012) and agitation and anxiety (Sung *et al.* 2012) (Table 2). None of the studies were based on a theoretical foundation. There was a difference between the studies regarding sample size, length and number of sessions as well as intervention period (Appendix 1). Clément *et al.* (2012) who examined the effect of the use of musical instruments vs. cooking, carried out the intervention twice a week for two hours over a period of four weeks. In Sung *et al.* (2012) study, the interventions were carried out twice weekly over a period of six weeks, each session lasted 30 minutes. Both music and cook interventions showed to have short-term benefits on emotions, but long-term benefits were only evident for the music group (Clément *et al.* 2012). Sung *et al.* (2012) documented reduced anxiety and agitation for the music group, however, the reduction in agitation between the music and the control group was not significantly different.

Listening to music. Of the nine studies identified, five based their intervention on a theoretical foundation described to activate the limbic system. The studies

Table 1 Theoretical and methodological characteristics, effect of interventions and study quality

	Total studies (n = 55)	Theoretical foundation	Sessions		Documented effect (n = 30)	Targeting level of dementia						Studies with quality score ≥ 9
			Group	Individual		Severe	Moderate to severe	Mild to severe	Mild to moderate	Mild to severe	No specific	
Music	25											
Music therapy	12	9	7	2	10	2	4	0	1	1	4	10
Music based												
Use of instruments	2	0	2	0	2	1	0	0	0	0	1	2
Singing	1	1	1	0	0	0	0	0	0	0	1	1
Movements	1	1	1	0	1	0	0	0	0	0	1	1
Listening	9	5	5	4	6	0	2	0	5	0	2	9
Light therapy	8											
Light in common area	4	4	4	0	0	1	0	0	0	0	3	3
Use of light box	4	4	0	4	1	1	0	0	0	0	3	4
Acupressure/reflexology	2											
Acupressure	1	0	0	1	1	0	0	0	0	0	1	1
Reflexology	1	1	0	1	1	0	0	0	1	0	0	1
Massage/aromatherapy	7											
Aromatherapy	4	3										
Spray unto patient's chest	1	1	0	1	0	0	0	0	0	0	1	1
Aroma diffuser on pillow	1	1	0	1	1	0	0	0	0	0	1	1
Lavender patch attached to patient's clothes	1	1	0	1	1	0	0	0	0	0	1	1
Massage of forearms with lavender oil	1	1	0	1	0	0	0	0	0	0	1	1
Massage	3	0	0	3	1	0	1	0	0	0	2	3
Doll therapy/animal assisted therapy/toy therapy	4											
Animal assisted therapy	3	0	1	2	1	0	0	0	1	0	0	2
Toy therapy	1	0	0	1	1	0	0	0	0	0	1	0
Snoezelen	7	7	0	7	3	0	3	1	0	0	3	5
The Sonas programme	2	1	2	0	0	0	1	0	0	0	0	2

Table 2 Targeted outcomes

Outcome	Music	Light therapy	Acupressure/ reflexology	Massage/ aromatherapy	Doll therapy/ animal assisted therapy/toy therapy	Snoezelen	The Sonas programme	Total
Agitation/aggression	11	4	1	4	3	1	1	25
BPSD	8	1	0	1	2	3	1	16
Depression/mood	4	2	0	1	2	2	2	13
Sleep	0	4	0	1	0	0	0	5
Anxiety	3	0	0	0	0	0	1	4
Quality of life/well-being	1	0	0	0	2	1	1	5
Affect	0	0	2	1	1	0	0	4
Psychological stress	2	0	1	1	0	0	0	3
Cognition	1	1	0	0	0	1	0	3
Nutrition and food intake	2	0	0	0	0	0	0	2
Fall and balance	0	0	0	1	0	1	0	2
Functioning performance	1	0	0	1	0	1	0	2
Pain	0	0	1	0	0	0	0	1
Communication	0	0	0	0	0	0	1	1

targeted; agitation (Hicks-Moore & Robinson 2008, Cooke *et al.* 2010b, Janata 2012, Narme *et al.* 2014), anxiety (Guetin *et al.* 2009, Sung *et al.* 2010, Janata 2012), depression (Guetin *et al.* 2009, Cooke *et al.* 2010b, Janata 2012) and QoL (Cooke *et al.* 2010b) (Table 2). Five of the interventions were group based whereas four were individual sessions. Two studies did not specify the dementia level. The sample size varied from 30–75, and the sessions varied between three sessions to 24 weeks, lasting from 10 minutes to four hours (Table 1).

Among the six studies reporting significant effect, five documented positive outcome. Garland *et al.* (2007) compared listening to music with simulated family presence and found that listening to music reduced verbal agitation while simulated presence reduced physical agitation as well. Lasting benefits were found to be present after 15 minutes. Short-time effect showing decreased agitation was reported by Narme *et al.* (2014) after two weeks, but did not last to the end of the intervention period. Significant improvement in emotional status was only short lasting and not documented after four weeks. Hicks-Moore and Robinson (2008) examined music and hand massage and found a significant decrease in verbal agitation, but there is nothing to support that a combination of the two interventions have a greater effect on reducing agitation than one of them alone. Both Guetin *et al.* (2009) and Sung *et al.* (2010) reported a significant decrease in anxiety and Guetin *et al.* (2009) reported a decrease in depression as well. In the Nair *et al.* (2011) study of the effect of listening to Baroque music, significantly more behavioural disturbances were observed during the weeks when the Baroque music was played compared to the control period with other music.

Light therapy

Eight studies examined the effect of light therapy, all built on a solid theoretical foundation referring to how light can change the circadian rhythm. Three targeted rest-activity disruption and sleep (Fontana Gasio *et al.* 2003, Dowling *et al.* 2005a,2005b, Burns *et al.* 2009), five agitation (Ancoli-Israel *et al.* 2003, Fontana Gasio *et al.* 2003, Dowling *et al.* 2007, Burns *et al.* 2009, Barrick *et al.* 2010), two depression (Fontana Gasio *et al.* 2003, Hickman *et al.* 2007) and one motor behaviour and appetite (Dowling *et al.* 2007) (Table 2). The light source and dementia level differed among the studies (Table 1).

The studies varied in relation to the number of participants, from 13–92, intervention period lasting from 18 days to 10 weeks, and sessions lasting from one to four hours (Appendix 1). Four of the interventions were carried out as individual sessions while the other four were in groups (Table 1).

Only one of the studies reported effect of bright light therapy, reporting that neuropsychiatric behaviours were significantly different between the experimental and control groups on agitation/aggression, depression/dysphoria, aberrant motor behaviour and appetite/eating disorders (Dowling *et al.* 2007).

Acupressure/reflexology

One study on reflexology was included, measuring the effect on distress (Hodgson & Andersen 2008), while the study on acupressure aimed to decrease agitation (Lin *et al.* 2009). Hodgson and Andersen (2008) measured the effect on residents with mild to moderate dementia while Lin *et al.* (2009) did not specify the stage of dementia. Both interventions were

carried out as individual sessions, over a period of 4–12 weeks. The interventions lasted from 15–30 minutes and were conducted, some only once and others up to six days/week (Appendix 1). Only reflexology referred to being built on a theoretical foundation where the intervention is meant to stimulate the blood flow and nerve impulses.

Acupressure. Lin *et al.* (2009) study divided the participants into three groups; one getting acupressure, another Montessori-based activities as well as a group who had family presence. Montessori-based activities consist of practical daily living activities such as rhythmic music, art and games. A significant reduction in agitated behaviour, aggressive behaviours, and physically nonaggressive behaviours in the acupressure and Montessori-based intervention were found. The Montessori group scored significantly better than the acupressure group on effect.

Reflexology. Hodgson and Andersen (2008) compared the effect of reflexology and weekly friendly visit. Residents receiving reflexology had significant reduction in pain and salivary alpha amylase concentration compared with the group who received friendly visits.

Massage/aromatherapy

Of the four studies using aromatherapy (Lin *et al.* 2007, Sakamoto *et al.* 2012, Fu *et al.* 2013, O'Connor *et al.* 2013) three were based on a theoretical foundation, which was not the case for studies using massage (Suzuki *et al.* 2010, Harris *et al.* 2012, Moyle *et al.* 2014). The assumption is that the essential oil enters the bloodstream and that the odour has a soothing effect. The studies targeted nighttime sleep (Harris *et al.* 2012), BPSD (Suzuki *et al.* 2010), agitation (Lin *et al.* 2007, Fu *et al.* 2013, O'Connor *et al.* 2013, Moyle *et al.* 2014), fall prevention, (Sakamoto *et al.* (2012), mood (Moyle *et al.* 2014) and stress, function and cognition (Suzuki *et al.* 2010) (Table 2). The four studies measuring the effect of aromatherapy used different types of application. All interventions were individual based and none, except one specified dementia level (Table 1). The sample size varied from 28–100 participants, sessions lasting from three minutes to 24 hours, each intervention period varying from 2–360 days (Appendix 1). Three of the studies documented effect on agitation and intellectual and emotional functioning (Lin *et al.* 2007, Suzuki *et al.* 2010, Sakamoto *et al.* 2012).

Massage. Tactile massage, which consisted of hand massage, showed a significant reduction in aggressiveness and stress level for the experimental group (Suzuki *et al.* 2010).

Aromatherapy. The use of aroma diffusers documented significant reduction in agitation, irritability, aberrant motor behaviour and dysphoria Lin *et al.* (2007). Sakamoto *et al.* (2012) documented a significant reduction in agitation after aromatherapy using patch with Lavender.

Animal-assisted therapy/doll therapy/toy therapy

Three studies, none based on a theoretical foundation, examined the effect of animal-assisted therapies, using dogs as the intervention (Majić *et al.* 2013, Travers *et al.* 2013, Nordgren & Engström 2014), while another examined the effect of therapeutic robot cat (Libin & Cohen-Mansfield 2004). The studies targeted agitation/aggression (Libin & Cohen-Mansfield 2004, Majić *et al.* 2013, Nordgren & Engström 2014), depression/mood (Majić *et al.* 2013, Travers *et al.* 2013), QoL (Travers *et al.* 2013), affect and engagement (Libin & Cohen-Mansfield 2004), as well as psychological functioning (Travers *et al.* 2013) (Table 2). Two of the studies used a one-to-one session, lasting 45–60 minutes, over a period of 10–12 weeks (Majić *et al.* 2013, Nordgren & Engström 2014) while Travers *et al.* (2013) used group intervention for 40–50 minutes for one week. The sample size varied from 33–55 participants (Appendix 1).

Animal-assisted therapy. One of the four studies examining the effect of animal assisted therapy reported a significant improvement in overall QoL (Travers *et al.* 2013).

Toy therapy. Libin and Cohen-Mansfield (2004) who exposed nine residents to a robot cat and plush toy cat showed a significant decrease in agitation in residents who used the plush cat, whereas the group exposed to the robot cat showed a significant increase in pleasure and interest.

Snoezelen

Seven studies were identified, using Snoezelen as an intervention, all with a theoretical foundation emphasising that BPSD may result from periods of sensory deprivation. The target was behaviour (Baker *et al.* 2003, van Weert *et al.* 2005a, Milev *et al.* 2008), agitation (Baillon *et al.* 2004), functional performance (Collier *et al.* 2010), well-being (Cox *et al.* 2004), balance (Klages *et al.* 2011), cognition (Baker *et al.* 2003) and mood (Baker *et al.* 2003, van Weert *et al.* 2005b) (Table 2). Four studies identified the dementia stage and all sessions were individual, sample size varying from 18–136 participants. The length of the intervention period varied from nine sessions to 18 months, each session lasting from 16–40 minutes (Table 1).

Three of the studies reported a significant effect for those who attended Snoezelen. van Weert *et al.* (2005a) who used a 24-hour individual Snoezelen approach, documented a significant effect in the intervention group regarding loss of decorum and apathetic, rebellious, aggressive and depressive behaviour. The experimental group showed significant changes in well-being, as well as adapted behaviour. Significant short-time effect was documented in Milev *et al.* (2008) study on improved behaviour for the Snoezelen group. Collier *et al.* (2010) who compared Snoezelen and indoor gardening found a significant improvement in motor and process scores in the Snoezelen group.

The Sonas programme

Two studies have examined the effects of the Sonas programme (Jackson *et al.* 2003, Hutson *et al.* 2014), one stating that the principles of the Sonas programme is to facilitate interactions by stimulating all five senses (Hutson *et al.* 2014). The Sonas sessions were provided in groups, both studies targeting depression, aggression and agitation. Jackson *et al.* (2003) measured the effect of the Sonas programme on cognitive performance as well, while Hutson *et al.* (2014) on QoL and communication (Table 2). Jackson *et al.* (2003), which ran the intervention over a period of eight weeks, included 75 participants who attended a 45 minutes session once a week. Hutson *et al.* (2014) included 39 persons with moderate to severe dementia in their study. The intervention was carried out twice a week for 45 minutes, over a period of seven weeks (Appendix 1). No significant changes were found in either of the studies.

Discussion

Fifty-five studies were included in this review, covering seven different categories of sensory stimulation interventions: music, light therapy, acupressure/reflexology, massage/aromatherapy, doll therapy/pet therapy/toy therapy, Snoezelen and the Sonas programme. Sensory stimulation might be an appropriate approach enhancing QoL primarily for persons with severe dementia. (Vozzella 2007). To our knowledge no other review, except Sherratt *et al.* (2004) has investigated the theoretical foundation for these interventions. Thirty-seven studies in our review did report building their intervention on a theoretical foundation. Although we have not provided a comprehensive account of the conceptual framework on which the theoretical foundation is based: nevertheless, describing how the mechanism behind the interventions works is essential for recommending these approaches as part of daily care for persons with dementia.

Several studies did not report the level of severity of dementia, which makes it difficult to draw any conclusion about the suitability of the interventions according to dementia level. This is in accordance with Gruneir *et al.* (2008) who found that only 1·9% of the studies identified, examined interventions specific to severe dementia. Limited description of the interventions makes it also challenging to draw conclusions of their approaches.

Most of the studies included were from USA/Canada (16), Europe (19) and Australia (9). Only ten were conducted in Asia, this despite Asia being the continent where dementia is increasing most (World Health Organization, 2011, pp. 166–167).

Outcome

The majority (76%) of the studies on music reported effect, mostly reduced BPSD, agitation and aggressiveness. One exception is Nair *et al.* (2011) study who reported increased behavioural disturbances for patients listening to Baroque music. This emphasises the importance of targeting the interventions to individual needs and preferences since such has been found to be more effective (Cabrera *et al.* 2015). In addition, adjusting the type of stimuli is essential since both under- and over-stimulation can cause for example agitation (Bakker 2003).

Group sessions seem to have a better effect than individual sessions which is consistent with Choi *et al.* (2009) who found that music carried out in groups was more effective than individual sessions.

About half of the studies on massage/aromatherapy, doll/animal assisted therapy/toy therapy and Snoezelen reported effect, mainly reduced agitation, as well. However, only one study reported improvement in QoL.

Outcome measures

Several different outcome measures, mostly some forms of BPSD, were used in the studies. Such focus on negative outcome is contradicted with the recent shift in treatment goal for persons with dementia from prolonging life to improving QoL (Volicer & Hurley 2003, Rabins *et al.* 2006, Heggestad *et al.* 2013) and might make us forget to take the persons resources into account. Another outcome measure which was used in only one intervention (reflexology) was pain, This despite literature stating that experiencing pain can be a reason for decrease in QoL (van Kooten *et al.* 2015).

Variation

The studies showed a wide variety in sample size, length of sessions as well as relatively short intervention periods in many studies, which makes it difficult to draw any conclusions about the short and long-term effect. Different treatment approaches, i.e. the use of light box and bright light in a common area or spray with lavender oil directly on the person's chest or an aroma diffuser in the person's room, makes comparison between the studies difficult, as well. These findings are supported in the review by Forbes *et al.* (2009) who found a wide variety of treatment approaches. Another bias is the fact that the person implementing the interventions often is the person who measures the outcomes.

Of the 30 studies which reported effect, 22 based their intervention on a theoretical foundation. However, the other eight reported effect without such a foundation. This might be connected to the inconsistency between outcome and the aim of the intervention, which was found in several studies. Light therapy is a good example. This intervention has become a standard therapy for seasonal affective disorder (Martensson *et al.* 2015). However, half of the studies on light therapy in this study measured BPSD as outcome and found little effect of the intervention. Such inconsistency between the aim of the intervention and the outcome, as well as use of different outcome measures, can easily lead to an incorrect conclusion about the appropriateness of the intervention used for persons with dementia, and make it difficult to compare effect. When not knowing or not being aware of the substantial mechanisms underlying the components in the interventions, it might be a risk to apply it uncritically. Furthermore, putting random interventions with limited theoretical foundation into new areas, for example using light therapy for persons with dementia having behaviour problems when the evidence-based effect is related to season based depression treatment.

Strength and limitations

There are some limitations in this review. Only studies published in English within a limited time were included. Studies with small sample size and assessed to have lower quality measure than nine based on CASP criteria, were included also. Including studies evaluated to low quality provided an overview of the field. Actually, presenting such overview was one of the aims of the study. However, this literature review gives an overview of a large number of available sensory stimulation interventions, their effect as well as the theoretical and methodological characteristics of these interventions. This information is crucial when selecting appropriate interventions for persons with dementia in different stages.

Conclusion

This literature review reveals the difficulty of making an overall conclusion in relation to the effect of sensory stimulation. Most of the interventions report some effect on BPSD. It remains to clarify whether or not the benefits of the different interventions are specific to the intervention domain or to sensory stimulation in general. Except for music, this review shows a limited number of studies of other sensory stimulation interventions. Therefore, we find it difficult to draw any clear conclusion on the effect since the outcome varies in the studies included.

More high quality research is recommended, especially regarding studies measuring the effect on QoL and communication, and if the effect depends on the stage of dementia. This knowledge will be helpful for nurses in the process of assessing for appropriate sensory stimulation interventions. We therefore recommend that further studies present a detailed outline of the conceptual framework on which the theoretical foundation is based.

Relevance to clinical practice

It is important that nurses become more aware of the use of sensory stimulation approaches as an integrated part of nursing care since the different sensory stimulation interventions can make a huge difference in a person's life. However, it is important that research on sensory stimulation interventions are of high quality to be able to deliver evidence-based practice within this field.

Acknowledgement

The authors would like to thank Sister Morag Collins SJC for her detailed proof reading.

Contributions

Study design: BSS; Data collection and analysis: BSS, SY, EKG; Manuscript preparation: BSS, SY, EKG.

Conflict of interest

None.

References

Algase DL, Beck C, Kolanowski A, Whall A, Berent S, Richards K & Beattie E (1996) Need-driven dementia-compromised behavior: an alternative view of disruptive behavior. *American Journal of Alzheimer's Disease* **11**, 10.

Alves J, Petrosyan A & Magalhaes R (2014) Olfactory dysfunction in dementia. *World Journal of Clinical Cases* **2**, 661–667.

Ancoli-Israel S, Martin JL, Gehrman P, Shochat T, Corey-Bloom J, Marler M, Nolan S, Levi L (2003) Effect of light on agitation in institutionalized patients with severe Alzheimer disease. *The American Journal of Geriatric Psychiatry*, **11**, 194–203.

Baillon S, Van Diepen E, Prettyman R, Redman J, Rooke N & Campbell R (2004) A comparison of the effects of Snoezelen and reminiscence therapy on the agitated behaviour of patients with dementia. *International Journal of Geriatric Psychiatry* **19**, 1047–1052.

Baker R, Holloway J, Holtkamp CC, Larsson A, Hartman LC, Pearce R, Scherman B, Johansson S, Thomas PW, Wareing LA, Owens M (2003) Effects of multi-sensory stimulation for people with dementia. *Journal of Advanced Nursing* **43**, 465–477.

Bakker R (2003) Sensory loss, dementia, and environment. *Generations* **27**, 46–51.

Barrick AL, Sloane PD, Williams CS, Mitchell CM, Connell BR, Wood W, Hickman SE, Preisser JS, Zimmerman S (2010) Impact of ambient bright light on agitation in dementia. *International Journal of Geriatric Psychiatry* **25**, 1013–1021.

Bergh S, Engedal K, Røen I & Selbæk G (2011) The course of neuropsychiatric symptoms in patients with dementia in Norwegian nursing homes. *International Psychogeriatrics* **23**, 1231–1239.

Bernabei V, De Ronchi D, La Ferla T, Moretti F, Tonelli L, Ferrari B, Forlani M, Atti AR (2013) Animal-assisted interventions for elderly patients affected by dementia or psychiatric disorders: a review. *Journal of Psychiatric Research* **47**, 762–773.

Burns A, Allen H, Tomenson B, Duignan D & Byrne J (2009) Bright light therapy for agitation in dementia: a randomized controlled trial. *International Psychogeriatrics* **21**, 711–721.

Cabrera E, Sutcliffe C, Verbeek H, Saks K, Soto-Martin M, Meyer G, Leino-Kilpi H, Zabalegui A (2015) Non-pharmacological interventions as a best practice strategy in people with dementia living in nursing homes. A systematic review. *European Geriatric Medicine* **6**, 134–150.

Carrion C, Aymerich M, Bailles E & Lopez-Bermejo A (2013) Cognitive psychosocial intervention in dementia: a systematic review. *Dementia and Geriatric Cognitive Disorders* **36**, 363–375.

CASP (2014) 11 questions to help you make sense of a trial. Available at: http://media.wix.com/ugd/dded87_40b9f-f0bf53840478331915a8ed8b2fb.pdf

Cerejeira J, Lagarto L & Mukaetova-Ladinska EB (2012) Behavioral and psychological symptoms of dementia. *Frontiers in Neurology* **3**, 73.

Choi AN, Lee MS, Cheong KJ & Lee JS (2009) Effects of group music intervention on behavioral and psychological symptoms in patients with dementia: a pilot-controlled trial. *International Journal of Neuroscience* **119**, 471–481.

Chung JC & Lai CK (2002) Snoezelen for dementia. *Cochrane Database of Systematic Reviews*, Issue 4, Art. No.: p. 1–43.

Clément S, Tonini A, Khatir F, Schiaratura L & Samson S (2012) Short and longer term effects of musical intervention in severe Alzheimer's disease. *Music Perception* **29**, 533–541.

Cohen-Mansfield J (2001) Nonpharmacologic interventions for inappropriate behaviors in dementia: a review, summary, and critique. *American Journal of Geriatric Psychiatry* **9**, 361–381.

Collier L, McPherson K, Ellis-Hill C, Staal J & Bucks R (2010) Multisensory stimulation to improve functional performance in moderate to severe dementia – interim results. *American Journal of Alzheimer's Disease & Other Dementias* **25**, 698–703.

Cooke ML, Moyle W, Shum DH, Harrison SD & Murfield JE (2010a) A randomized controlled trial exploring the effect of music on agitated behaviours and anxiety in older people with dementia. *Aging & Mental Health* **14**, 905–916.

Cooke ML, Moyle W, Shum DH, Harrison SD & Murfield JE (2010b) A randomized controlled trial exploring the effect of music on quality of life and depression in older people with dementia. *Journal of Health Psychology* **15**, 765–776.

Cox H, Burns I & Savage S (2004) Multisensory environments for leisure: promoting well-being in nursing home residents with dementia. *Journal of Gerontological Nursing* **30**, 37–45.

Dewing J (2010) Responding to agitation in people with dementia. *Nursing Older People* **22**, 18–25.

Douglas S, James I & Ballard C (2004) Non-pharmacological interventions in dementia. *Advances in Psychiatric Treatment* **10**, 171–179.

Dowling GA, Hubbard EM, Mastick J, Luxenberg JS, Burr RL & Van Someren EJ (2005a) Effect of morning bright light treatment for rest-activity disruption in institutionalized patients with severe Alzheimer's disease. *International Psychogeriatrics* **17**, 221–236.

Dowling GA, Mastick J, Hubbard EM, Luxenberg JS & Burr RL (2005b) Effect of timed bright light treatment for rest-activity disruption in institutionalized patients with Alzheimer's disease. *International Journal of Geriatric Psychiatry* **20**, 738–743.

Dowling GA, Graf CL, Hubbard EM & Luxenberg JS (2007) Light treatment for neuropsychiatric behaviors in Alzheimer's disease. *Western Journal of Nursing Research* **29**, 961–975.

Finkel SI (1997) Managing the behavioral and psychological signs and symptoms of dementia. *International Clinical Psychopharmacology* **12**(Suppl 4), S25–S28.

Finkel SI (2001) Behavioral and psychological symptoms of dementia: a current focus for clinicians, researchers, and caregivers. *Journal of Clinical Psychiatry* **62**(Suppl 21), 3–6.

Fontana Gasio P, Krauchi K, Cajochen C, Someren E, Amrhein I, Pache M, Egemen Savaskan E, Wirz-Justice A

(2003) Dawn-dusk simulation light therapy of disturbed circadian rest-activity cycles in demented elderly. *Experimental Gerontology* **38**, 207–216.

Forbes D, Culum I, Lischka AR, Morgan DG, Peacock S, Forbes J & Forbes S (2009) Light therapy for managing cognitive, sleep, functional, behavioural, or psychiatric disturbances in dementia. *Cochrane Database of Systematic Reviews*, Issue 4, Art. No.: p. 1–25. doi: 10.1002/14651858.CD003946.pub2.

Forrester LT, Maayan N, Orrell M, Spector AE, Buchan LD & Soares-Weiser K (2014) Aromatherapy for dementia. *Cochrane Database of Systematic Reviews*, Issue 2, Art. No.: CD003150.

Fossey J, Ballard C, Juszczak E, James I, Alder N, Jacoby R & Howard R (2006) Effect of enhanced psychosocial care on antipsychotic use in nursing home residents with severe dementia: cluster randomised trial. *British Medical Journal* **332**, 756–761.

Fu CY, Moyle W & Cooke M (2013) A randomised controlled trial of the use of aromatherapy and hand massage to reduce disruptive behaviour in people with dementia. *BioMed Central Complementary and Alternative Medicine* **13**, 165.

Garland K, Beer E, Eppingstall B & O'Connor DW (2007) A comparison of two treatments of agitated behavior in nursing home residents with dementia: simulated family presence and preferred music. *American Journal of Geriatric Psychiatry* **15**, 514–521.

Gonzalez MT & Kirkevold M (2013) Benefits of sensory garden and horticultural activities in dementia care: a modified scoping review. *Journal of Clinical Nursing* **23**, 19–20.

Grant MJ & Booth A (2009) A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Information and Libraries Journal* **26**, 91–108.

Gruneir A, Lapane KL, Miller SC & Mor V (2008) Is dementia special care really special? A new look at an old question. *Journal of the American Geriatrics Society* **56**, 199–205.

Guetin S, Portet F, Picot MC, Pommie C, Messaoudi M, Djabelkir L, Olsen AL, Cano MM, Lecourt E, Touchon J (2009) Effect of music therapy on anxiety and depression in patients with Alzheimer's type dementia: randomised, controlled study. *Dementia and Geriatric Cognitive Disorders* **28**, 36–46.

Hansen NV, Jørgensen T & Ørtenblad L (2006) Massage and touch for dementia. *Cochrane Database of Systematic Reviews*, Issue 4, Art. No.: p. 1–20.

Harris M, Richards KC & Grando VT (2012) The effects of slow-stroke back massage on minutes of nighttime sleep in persons with dementia and sleep disturbances in the nursing home: a pilot study. *Journal of Holistic Nursing* **30**, 255–263.

Heggestad AK, Nortvedt P & Slettebo A (2013) 'Like a prison without bars': dementia and experiences of dignity. *Nursing Ethics* **20**, 881–892.

Hickman SE, Barrick AL, Williams CS, Zimmerman S, Connell BR, Preisser JS, Mitchell M, Sloane PD (2007) The effect of ambient bright light therapy on depressive symptoms in persons with dementia. *Journal of the American Geriatrics Society* **55**, 1817–1824.

Hicks-Moore SL & Robinson BA (2008) Favorite music and hand massage: two interventions to decrease agitation in residents with dementia. *Dementia*, **7**, 95–108.

Hodgson NA & Andersen S (2008) The clinical efficacy of reflexology in nursing home residents with dementia. *Journal of Alternative and Complementary Medicine* **14**, 269–275.

Hutson C, Orrell M, Spector A & Dugmore O (2014) Sonas: a pilot study investigating the effectiveness of an intervention for people with moderate to severe dementia. *American Journal of Alzheimer's Disease and Other Dementias*, 1–8.

Jackson GA, Sterling R, Russell K & Templeton G (2003) A multisensory programme: evaluating effects on agitation. *Nursing & Residential Care* **5**, 126–129.

Janata P (2012) Effects of widespread and frequent personalized music programming on agitation and depression in assisted living facility residents with Alzheimer-type dementia. *Music and Medicine* **4**, 8–15.

Klages K, Zecevic A, Orange JB & Hobson S (2011) Potential of Snoezelen room multisensory stimulation to improve balance in individuals with dementia: a feasibility randomized controlled trial. *Clinical Rehabilitation* **25**, 607–616.

Kolanowski A, Fick D, Frazer C & Penrod J (2010) It's about time: use of non-pharmacological interventions in the nursing home. *Journal of Nursing Scholarship* **42**, 214–222.

Kong EH, Evans LK & Guevara JP (2009) Nonpharmacological intervention for agitation in dementia: a systematic review and meta-analysis. *Aging & Mental Health* **13**, 512–520.

van Kooten J, Delwel S, Binnekade TT, Smalbrugge M, van der Wouden JC, Perez RS & Scherder EJ (2015) Pain in dementia: prevalence and associated factors: protocol of a multidisciplinary study. *BioMed Central Geriatrics* **15**, 29.

Kovach CR, Noonan PE, Schlidt AM & Wells T (2005) A model of consequences of need-driven, dementia-compromised behavior. *Journal of Nursing Scholarship*, **37**, 134–140; discussion 140.

Kverno KS, Black BS, Nolan MT & Rabins PV (2009) Research on treating neuropsychiatric symptoms of advanced dementia with non-pharmacological strategies, 1998–2008: a systematic literature review. *International Psychogeriatrics* **21**, 825–843.

Lawlor B & Bhriain SN (2001) Psychosis and behavioural symptoms of dementia: defining the role of neuroleptic interventions. *International Journal of Geriatric Psychiatry* **16**(Suppl 1), S2–S6.

Ledger AJ & Baker FA (2007) An investigation of long-term effects of group music therapy on agitation levels of people with Alzheimer's disease. *Aging & Mental Health* **11**, 330–338.

Libin A & Cohen-Mansfield J (2004) Therapeutic robocat for nursing home residents with dementia: preliminary inquiry. *American Journal of Alzheimer's Disease and Other Dementias* **19**, 111–116.

Lin PW, Chan W, Ng BF, Lam LC (2007) Efficacy of aromatherapy (*Lavandula angustifolia*) as an intervention for agitated behaviours in Chinese older

persons with dementia: a cross-over randomized trial. *International Journal of Geriatric Psychiatry* **22**, 405–410.

Lin L, Yang M, Kao C, Wu S, Tang S & Lin J (2009) Using acupressure and Montessori-based activities to decrease agitation for residents with dementia: a cross-over trial. *Journal of the American Geriatrics Society* **57**, 1022–1029.

Lin Y, Chu H, Yang CY, Chen CH, Chen SG, Chang HJ & Chou KR (2011) Effectiveness of group music intervention against agitated behavior in elderly persons with dementia. *International Journal of Geriatric Psychiatry* **26**, 670–678.

Lyketsos CG, Steinberg M, Tschanz JT, Norton MC, Steffens DC & Breitner JC (2000) Mental and behavioral disturbances in dementia: findings from the Cache County Study on Memory in Aging. *American Journal of Psychiatry* **157**, 708–714.

Lykkeslet E, Gjengedal E, Skrondal T & Storjord M-B (2014) Sensory stimulation – a way of creating mutual relations in dementia care. *International Journal of Qualitative Studies on Health and Well-being* **9**, 23888.

Majić T, Gutzmann H, Heinz A, Lang UE & Rapp MA (2013) Animal-assisted therapy and agitation and depression in nursing home residents with dementia: a matched case-control trial. *The American Journal of Geriatric Psychiatry* **21**, 1052–1059.

Martensson B, Pettersson A, Berglund L & Ekselius L (2015) Bright white light therapy in depression: a critical review of the evidence. *Journal of Affective Disorders* **182**, 1–7.

McHugh L, Gardstrom S, Hiller J, Brewer M & Diestelkamp WS (2012) The effect of pre-meal, vocal re-creative music therapy on nutritional intake of residents with Alzheimer's disease and related dementias: a pilot study. *Music Therapy Perspectives* **30**, 32–42.

Milev RV, Kellar T, McLean M, Mileva V, Luthra V, Thompson S & Peever L (2008) Multisensory stimulation for elderly with dementia: a 24-week single-blind randomized controlled pilot study. *American Journal of Alzheimer's Disease and Other Dementias* **23**, 372–376.

Moyle W, Cooke ML, Beattie E, Shum DHK, O'Dwyer ST & Barrett S (2014) Foot massage versus quiet presence on agitation and mood in people with dementia: a randomised controlled trial. *International Journal of Nursing Studies* **51**, 856–864.

Nair BK, Heim C, Krishnan C, D'Este C, Marley J & Attia J (2011) The effect of Baroque music on behavioural disturbances in patients with dementia. *Australasian Journal on Ageing* **30**, 11–15.

Narme P, Clement S, Ehrle N, Schiaratura L, Vachez S, Courtaigne B, Munsch F, Samson S (2014) Efficacy of musical interventions in dementia: evidence from a randomized controlled trial. *Journal of Alzheimer's Disease* **38**, 359–369.

National Institutes of Health (2002). *Home Safety for People with Alzheimer's Disease*. National Institute on Aging Alzheimer's Disease Education and Referral (ADEAR) Center. NIH Publication No. 02-5179, US.

Nordgren L & Engström G (2014) Effects of dog-assisted intervention on behavioural and psychological symptoms of dementia. *Nursing Older People* **26**, 31–38.

O'Connor DW, Eppingstall B, Taffe J & van der Ploeg ES (2013) A randomized, controlled cross-over trial of dermally-applied lavender (*Lavandula angustifolia*) oil as a treatment of agitated behaviour in dementia. *BioMed Central Complementary and Alternative Medicine* **13**, 315.

O'Neil ME, Freeman M, Christensen V, Telerant R, Addleman A & Kansagara D (2011) *A Systematic Evidence Review of Non-pharmacological Interventions for Behavioral Symptoms of Dementia*. US Department of Veterans Affairs, Washington, DC.

van der Ploeg ES, Mbakile T, Genovesi S & O'Connor DW (2012) The potential of volunteers to implement non-pharmacological interventions to reduce agitation associated with dementia in nursing home residents. *International Psychogeriatrics* **24**, 1790–1797.

Prince M, Wimo A, Guerchet M, Ali G-C, Wu Y-T & Prina M (2015). *The Global Impaact of Dementia; An Analysis of Prevalence, Incidence, Cost and Trends*, World Alzheimer Report 2015. Alzheimer's Disease International, London, 2015.

Rabins PV, Lyketsos CG & Steele C (2006) *Practical Dementia Care*. Oxford University Press, Oxford.

Raglio A, Bellelli G, Traficante D, Gianotti M, Ubezio MC, Villani D, Trabucchi M (2008) Efficacy of music therapy in the treatment of behavioral and psychiatric symptoms of dementia. *Alzheimer Disease and Associated Disorders* **22**, 158–162.

Raglio A, Bellelli G, Traficante D, Gianotti M, Ubezio MC, Gentile S, Villani D, Trabucchi M (2010a) Efficacy of music therapy treatment based on cycles of sessions: a randomised controlled trial. *Aging & Mental Health* **14**, 900–904.

Raglio A, Oasi O, Gianotti M, Manzoni V, Bolis S, Ubezio MC, Villani D, Stramba-Badiale M (2010b) Effects of music therapy on psychological symptoms and heart rate variability in patients with dementia. A pilot study. *Current Aging Science* **3**, 242–246.

Ridder HM, Stige B, Qvale LG & Gold C (2013) Individual music therapy for agitation in dementia: an exploratory randomized controlled trial. *Aging & Mental Health* **17**, 667–678.

Sakamoto Y, Ebihara S, Ebihara T, Tomita N, Toba K, Freeman S, Arai H, Kohzuki M (2012) Fall prevention using olfactory stimulation with lavender odor in elderly nursing home residents: a randomized controlled trial. [corrected] [published erratum appears in J AM GERIATR SOC 2012 Nov; 60(11): 2193]. *Journal of the American Geriatrics Society* **60**, 1005–1011.

Sakamoto M, Ando H & Tsutou A (2013) Comparing the effects of different individualized music interventions for elderly individuals with severe dementia. *International Psychogeriatrics* **25**, 775–784.

Seignourel PJ, Kunik ME, Snow L, Wilson N & Stanley M (2008) Anxiety in dementia: a critical review. *Clinical Psychology Review* **28**, 1071–1082.

Selbaek G, Kirkevold O & Engedal K (2007) The prevalence of psychiatric symptoms and behavioural disturbances and the use of psychotropic drugs in Norwegian nursing homes. *International Journal of Geriatric Psychiatry* **22**, 843–849.

Sherratt K, Thornton A & Hatton C (2004) Music interventions for people

with dementia: a review of the literature. *Aging & Mental Health* **8**, 3–12.

Sonas aPc (2011) *Sonas Workshop Booklet*. Sonas aPc, Dublin, Ireland.

Sung HC, Chang S, Lee W & Lee M (2006) The effects of group music with movement intervention on agitated behaviours of institutionalized elders with dementia in Taiwan. *Complementary Therapies in Medicine* **14**, 113–119.

Sung HC, Chang AM & Lee WL (2010) A preferred music listening intervention to reduce anxiety in older adults with dementia in nursing homes. *Journal of Clinical Nursing* **19**, 1056–1064.

Sung HC, Lee WL, Li TL & Watson R (2012) A group music intervention using percussion instruments with familiar music to reduce anxiety and agitation of institutionalized older adults with dementia. *International Journal of Geriatric Psychiatry* **27**, 621–627.

Suzuki M, Tatsumi A, Otsuka T, Kikuchi K, Mizuta A, Makino K, Kimoto A, Fujiwara K, Abe T, Nakagomi T, Hayashi T, Saruhara T (2010) Physical and psychological effects of 6-week tactile massage on elderly patients with severe dementia. *American Journal of Alzheimer's Disease and Other Dementias* **25**, 680–686.

Svansdottir HB & Snaedal J (2006) Music therapy in moderate and severe dementia of Alzheimer's type: a case-control study. *International Psychogeriatrics* **18**, 613–621.

Takahashi T & Matsushita H (2006) Long-term effects of music therapy on elderly with moderate/severe dementia. *Journal of Music Therapy* **43**, 317–333.

Thorgrimsen L, Spector A, Wiles A & Orrell M (2003) Aroma therapy for dementia. *Cochrane Database of Systematic Reviews*, Issue 3, Art. No.: CD003150.

Travers C, Perkins J, Rand J, Bartlett H & Morton J (2013) An evaluation of dog-assisted therapy for residents of aged care facilities with dementia. *Anthrozoos: A Multidisciplinary Journal of the Interactions of People & Animals*, **26**, 213–225.

Tuet RWK & Lam LCW (2006) A preliminary study of the effects of music therapy on agitation in Chinese patients with dementia. *Hong Kong Journal of Psychiatry* **16**, 87–91.

Vasionyte I & Madison G (2013) Musical intervention for patients with dementia: a meta-analysis. *Journal of Clinical Nursing* **22**, 1203–1216.

Verkaik R, van Weert JC & Francke AL (2005) The effects of psychosocial methods on depressed, aggressive and apathetic behaviors of people with dementia: a systematic review. *International Journal of Geriatric Psychiatry* **20**, 301–314.

Vink AC, Bruinsma MS & Scholten RJ (2003) Music therapy for people with dementia. *Cochrane Database of Systematic Reviews*, Issue 4, Art. No.: p. 1–50.

Vink AC, Zuidersma M, Boersma F, de Jonge P, Zuidema SU & Slaets JP (2013) The effect of music therapy compared with general recreational activities in reducing agitation in people with dementia: a randomised controlled trial. *International Journal of Geriatric Psychiatry* **28**, 1031–1038.

Volicer L & Hurley AC (2003) Management of behavioral symptoms in progressive degenerative dementias. *Journals of Gerontology Series A: Biological Sciences & Medical Sciences* **58A**, 837–845.

Vozzella S (2007) Sensory stimulation in dementia care: why it is important and how to implement it. *Topics in Geriatric Rehabilitation* **23**, 102–113.

van Weert JC, van Dulmen AM, Spreeuwenberg PM, Ribbe MW & Bensing JM (2005a) Behavioral and mood effects of Snoezelen integrated into 24-hour dementia care. *Journal of the American Geriatrics Society* **53**, 24–33.

van Weert JC, van Dulmen AM, Spreeuwenberg PM, Ribbe MW & Bensing JM (2005b) Effects of Snoezelen, integrated in 24 h dementia care, on nurse-patient communication during morning care. *Patient Education and Counseling* **58**, 312–326.

Wilson SL, Powell GE, Brock D & Thwaites H (1996) Vegetative state and responses to sensory stimulation: an analysis of 24 cases. *Brain Injury* **10**, 807–818.

Wittmann-Price RA (2012) The olfactory sense: a developmental and lifespan perspective. *Journal of Clinical Nursing* **21**, 2545–2554.

World Health Organization (2011) *Bulletin of the World Health Organization*. World Health Organization, Geneva.

World Health Organization (2012) *Dementia: A Public Health Priority*. (9789240689848). World Health Organization, Geneva.

Appendix 1

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Snoezelen											
Baker *et al.* (2003) Day centre UK	Effect of Snoezelen on changing behaviour, mood and cognition	RCT	Moderate to severe dementia (n = 136)	*Snoezelen* Snoezelen (n = 65) and activities (n = 71) twice a week, each lasting 30 minutes	Behaviour Mood Cognition	Interact during Interact short BRS REHAB GIP BMD MMSE	Multi-Sensory	Yes	No overall significant differences between groups in change in behaviour, mood or cognition Behaviour was stable for both groups, but apathy decreased in both groups Participants in both groups related better to others and were less inactive/bored after sessions	4 weeks	8
Baillon *et al.* (2004) Nursing Home UK	Effect of Snoezelen on mood and behaviour	Cross-over RCT	Mild to severe dementia (n = 20)	*Snoezelen* Experimental phase: Snoezelen sessions. Control phase: reminiscence sessions. Both phases involved three individual sessions, lasting 40 minutes	Agitation	ABMI Interact Short	Multi-Sensory	Yes	No significant difference between the two interventions	2 weeks	10
Collier *et al.* (2010) Nursing Home UK	Effect of Snoezelen and gardening on functional performance	RCT single-blind	Moderate to severe dementia (n = 30)	*Snoezelen* Snoezelen (n = 17) and gardening (n = 13) trice a week	Functional performance	GBS AMPS PAL SMMSE	Multi-Sensory	Yes	No significant difference between the two groups. Both improved in motor skills A significant improvement in motor and process scores for the Snoezelen group only	4 weeks	11

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Cox *et al.* (2004) Nursing Home Australia	Effect of Snoezelen and landscaped gardening in improving well-being	Cross-over design	Dementia (n = 24)	Snoezelen All participants attended each activity as well as normal living room activities three times – total of nine individual sessions of 16 minutes each	Well-being	ARS	Multi-Sensory	Yes	No consistent differences across the four ratings made in each environment Significant more reported sadness in the living room than Snoezelen or landscape garden	3 sessions	7
Klages *et al.* (2011) Nursing Home Canada	Effect of Snoezelen on the balance	RCT	Dementia (n = 24)	Snoezelen Snoezelen (n = 9) visit with activities (n = 10), both 30 minutes twice a week	Balance	The functional Reach Test Sharpened Romberg Timed Up and Go Test	Multi-Sensory	Yes	No significant effects of unstructured Snoezelen room session	6 weeks	9
Milev *et al.* (2008) Nursing Home Canada	Effect of Snoezelen on behaviour	Single-blind RCT	Dementia (n = 18)	Snoezelen Gr. 1 (n = 7) attended Snoezelen trice a week, Gr. 2 (n = 5) once a week, each 30 minutes and care as usual (n = 6)	Behaviour	MMSE DOS CGI-I	Multi-Sensory	Yes	Significance was documented at weeks 8 and 24 between treatment groups and control groups on DOS There was no significant difference between groups at week 4 and 8, but at week 12 and 24	24 weeks	11
van Weert *et al.* (2005a) Nursing Home the Netherlands	Effect of Snoezelen on behaviour and mood	Quasi-experimental pre- and post-test design	Moderate to severe dementia (n = 129)	Snoezelen 24 hours Snoezelen (n = 62) and care as usual (n = 63)	Behaviour and mood	BIP Interact CMAI-D CSDD-D FACE	Multi-sensory	Yes	Significant effect for apathetic behaviour, rebellious behaviour, aggressive behaviour and depressive behaviour for patients receiving Snoezelen They also showed significant changes in well-being as well as adaptive behaviour	18 months	10

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Sonas											
Hutson *et al.* (2014) Nursing Home UK	The feasibility and effect of the Sonas programme	RCT	Moderate to severe dementia (n = 39)	Sonas Tw Sonas sessions per week, lasting 45 minutes (n = 20) attended two and care as usual (n = 16)	BPSD QoL Depression Anxiety Communication	QoL-AD The Holden Communication Scale CSDD RAID NPI-Q	Multi-sensory	Yes	No significant effect on improvements in QoL BPSD, depression, anxiety or communication after the Sonas sessions	7 weeks	10
Jackson *et al.* (2003) Nursing Home UK	Evaluate the impact of the Sonas programme	RCT	Dementia (n = 75)	Sonas Sonas once a week for 45 minutes (n = 42) and usual care (n = 33)	Agitation Aggression Depression Cognition	CMAI RAGE Cognitive Performance Scale Depressive SignsScale	Multi-sensory	No	No significant effect on agitation or aggression for either group	8 weeks	10
Music (therapy)											
Choi *et al.* (2009) Day centre S. Korea	Effect of music on BPSD	NRCT	Dementia (n = 20)	Music Music for 50 minutes three times a week (n = 10) and usual care (n = 10)	BPSD QoL	GDS GQoL NPI-Q	Single sensory	Yes	The music intervention groups showed significant improvement in agitation No significant changes in depression or quality of life	5 weeks	9
Ledger and Baker (2007) Nursing Home Australia	Long-term effects of group music therapy on agitation	NRCT	Mild to Moderate dementia (n = 45)	*Music* Weekly group music therapy sessions each lasting 30–45 minutes for at least 42 weeks (n = 26) and care as usual (n = 19)	Agitation	CMAI	Single sensory	Yes	No significant differences between music and control group in the range, frequency, and severity of agitated behaviours manifested over time Significant reduction in verbal aggressive behaviour in the music group	1 year	8

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Lin *et al.* (2011) Nursing Home Taiwan	Effect of group music intervention on agitated behaviour	RCT	Mild to severe dementia (n = 100)	*Music* Two music therapy group sessions per week (n = 49), each lasting 30 minutes Control group (n = 51) care as usual	Agitation	C-CMAI	Single sensory	No	Significantly greater reductions in agitation for experimental group than control group	6 weeks	10
Raglio *et al.* (2008) Nursing Home Italy	Effect of music therapy in reducing BPSD	RCT	Mild to severe dementia (n = 59)	*Music* Three cycles of 10, using musical instruments (n = 30), each lasting 30 minutes. Control group (n = 29) care as usual	BPSD	NPI Barthel	Single sensory	Yes	The experiment group showed improvement in delusions, agitation, anxiety, apathy, irritability, aberrant motor activity, and night-time behaviour disturbances	16 weeks	11
Raglio *et al.* (2010a) Nursing Homes Italy	Effect of group music intervention on cycles sessions	RCT	Severe dementia (n = 53)	*Music* Three cycles of 12 music therapy, three times a week, lasting 30 minutes (n = 27). The control group (n = 26) received usual care	BPSD	NPI	Single sensory	No	Significant decrease in BPSD for both groups and a significant difference between groups Delusions, agitation and apathy significantly improved in the experimental group, but not in the control group	6 months	10
Raglio *et al.* (2010b) Nursing Home Italy	Effects of music therapy on psychological symptoms and heart rate variability	RCT	Dementia (n = 20)	*Music* Two 30 minutes sessions a week (n = 10) and the control group (n = 10) received usual care	BPSD Heart rate	MMSE ADAS-cogn test ADL IADL NPI ECG	Single sensory	Yes	No sign change in cognition or ADL for either groups A slight, but significant decrease in overall BPSD for the music therapy group and slight increase for the control group. The music group showed a significant effect on depression symptoms No significant change in heart rate	15 weeks	11

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Ridder *et al.* (2013) Nursing Home Norway Denmark	Effect of individual music therapy on agitation and to explore its effect on psychotropic medication and QoL	A two-armed, cross-over, exploratory, RCT	Moderate to severe dementia (n = 42)	*Music* Biweekly music sessions (n = 21) and usual care (n = 21)	Agitation QoL Psychotropic medication	CMAI ADRQL	Single sensory	Yes	Agitation disruptiveness increased during standard care and decreased during music therapy The prescription of psychotropic medication increased significantly more often during standard care than during music therapy	6 weeks	10
Sakamoto *et al.* (2013) Nursing Home Japan	Effect of individualised music intervention	RCT	Severe dementia (n = 39)	*Music* Gr. 1 (n = 13) attended passive music and Gr. 2 active music (n = 13) both 30 minutes once a week. The control group (n = 13) received usual care	BPSD	BEHAVE-AD Autonomic nerve index Faces Scale	Single sensory	Yes	Both passive and interactive music interventions reduced stress and increased relaxation for short-time Music documented to have long-time effect on BPSD on the interactive group compared with passive music intervention and no-music condition	10 weeks	11
Svansdottir and Snaedal (2006) Nursing Home Iceland	Effect of music therapy on BPSD	RCT	Moderate to severe dementia (n = 38)	*Music* Thrice weekly group music therapy, sessions lasted 30 minutes (n = 20) and usual care (n = 18)	BPSD	BEHAVE-AD	Single sensory	No	Significant change in 'activity disturbances' category for experimental group but not control group Significant treatment effects not maintained 4 weeks post intervention	6 weeks	11
Takahashi and Matsushita (2006) Nursing Home Japan	Long-term effect of music therapy	NRCT	Moderate to severe dementia (n = 43)	*Music* Music therapy once a week for 1 hour (n = 24) and the control group (n = 19) usual care	Cognition BP Cortisol level	BP Salvia HDS-R	Single sensory	Yes	No significant difference in cortisol level, BP or cognition between groups	2 years	9

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Tuet and Lam (2006) Nursing Home and Day centre China	Effect of music on agitation	Cross-over study	Dementia (n = 14)	*Music* 45 minutes group music three times a week for 3 weeks (n = 7) and usual care (n = 7) The groups were crossed over further 3 weeks	Agitation	CMAI NPI	Single sensory	Yes	Significant reduction in agitation at the end of music intervention period	6 weeks	8
Vink *et al.* (2013) Nursing Home the Netherlands	Effect of music therapy vs. recreational activities on agitation	RCT	Dementia (n = 77)	*Music* Music therapy for 40 minutes twice a week (n = 43) and recreational activities (n = 34)	Agitation	CMAI	Single sensory	Yes	No significant change	16 weeks	10
Music (movement)											
Sung *et al.* (2006) Nursing Home Taiwan	Effect of group music with movement intervention on agitated behaviours	RCT	Dementia (n = 36)	*Music* Music with movement twice a week for 30 minutes (n = 18) and usual care (n = 18)	Agitation	Modified-CMAI	Single sensory	Yes	Agitated behaviours was significantly reduced in the experimental group compared with the control group	4 weeks	10
Music (Singing)											
McHugh *et al.* (2012) Day centre USA	Effect of pre-meal singing on malnutrition	RCT	Dementia (n = 15)	*Music* Vocal re-creative music therapy prior to lunch for 4 days a week for 30 minutes (n = 8) and usual care group (n = 7)	Nutrition intake	Care Tracker	Single sensory	Yes	Slightly higher nutrition intake for the music group, but no significance	4 weeks	10

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Music (use of instruments)											
Clément *et al.* (2012) Nursing Home France	The short- and long-term effect of musical and cooking interventions on emotional well-being	RCT	Severe AD (n = 14)	*Music* Played or used musical instruments twice a week for 2 hours (n = 5) and prepared or tasted cakes (n = 6)	Well-being	I-MED I-END STAI-A	Single sensory and multi-sensory	No	Short-term benefits of both music and cooking on emotions No significance in facial mimic emotional index for either music or cooking group. However, long term effect on mood for the music group and significant higher mood for the cooking group after the 4th session, but not after the 8th	4 weeks	10
Sung *et al.* (2012) Nursing Home Taiwan	Effect of group music intervention on anxiety and agitation	RCT	Dementia (n = 55)	*Music* Music twice weekly for 30 minutes (n = 27) and care as usual (n = 28)	Anxiety Agitation	CMAI RAID	Single sensory	No	Significant reduction in agitation for the music group, but the reduction did not reach significant difference compared with control group	6 weeks	10
Music (listen)											
Cooke *et al.* (2010b) Nursing Home Australia	Effect of live group music programme on QoL	A randomised cross-over design	Mild to moderate dementia (n = 47)	*Music (live group)* Gr. 1 (n = 24) and Gr. 2 (n = 23) listened to music for 30 minutes three times a week for eight weeks, and then they 'crossed-over' after eight weeks	QoL Depression	DQOL GDS	Single sensory	Yes	No significant affect levels of depression and Qol No evidence to indicate the use of music was more effective than participating in a reading group	16 weeks	11

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Cooke *et al.* (2010a) Nursing Home Australia	Effect of music on agitation and anxiety	A randomised cross-over design	Mild to moderate dementia (n = 47)	*Music* Music (n = 24) and reading group (n = 23) listened to 40 minutes with music three times a week for 8 weeks and then they 'crossed-over'	Agitation Anxiety	CMAI-SF RAID	Single sensory	No	No significant effect on agitation and anxiety	16 weeks	9
Garland *et al.* (2007) Nursing Home USA	Effect of music and simulated family presence in reducing agitation	Randomised cross-over design	Dementia (n = 30)	*Music* All groups attended simulated presence, music or placebo, once a day for 3 days during weeks 2, 3 and 4. The tape was played for 15 minutes each time	Agitation	CMAI	Single sensory	No	Simulated presence resulted in significantly reduced verbally agitated behaviours after simulated presence, but not after listening to music	4 weeks	11
Guetin *et al.* (2009) Nursing Home France	Effect of music on anxiety and depression	Comparative, controlled, randomised study	Mild to moderate dementia (n = 30)	*Music* Gr. 1 (n = 15) listened to music and placebo group (n = 15) listed to reading for 20 minutes once a week	Anxiety Depression	Hamilton Scale GDS MMSE	Single sensory	Yes	Significant improvement in anxiety and depression in the group who received music from the fourth week of intervention Effect lasted 2 months after last intervention	24 weeks	11

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Hicks-Moore and Robinson (2008) Nursing Home Canada	Effect of favourite music (FM) and hand massage (HM) on agitation	Randomised Cross-over design	Mild to moderate dementia (n = 41)	*Music* All participants in the treatment group (n = 32) received 3 interventions: HM, FM, HMFM. Each intervention delivered once, lasting 10 minutes. Control group (n = 9) usual care	Agitation	CMAI	Multi-sensory	Yes	For all three interventions there was a significant difference between pre- and post treatment and pre and follow-up for verbal agitation and physical non-aggression No significance in physical aggressive behaviour, but in verbal aggression	3 treatments	9
Janata (2012) Nursing Home USA	Effect of customised music on agitation and depression	RCT	Moderate to severe (n = 38)	*Music* Listened to music several times each day (n = 19) and usual care (n = 19)	Agitation Depression Anxiety	CMAI CSDD NPI	Single sensory	No	No significant effect in agitation anxiety or depression	12 weeks	11
Narme *et al.* (2014) Nursing Home France	The effects of music vs. cooking intervention	RCT	Moderate to severe dementia (n = 37)	*Music* Listened to music and used instruments (n = 18) while the control group (n = 19) did cooking, for 1 hour twice a week	Emotional status Cognition Behavioural functioning	Emotional facial expression SIB CMAI NPI NPI	Single sensory	Yes	Significant improvement in music group with regard to emotional status after the 4th session, but not after last session Agitated behaviour significantly decreased for the music group after 4th session, but not after the last No significant effect of either intervention on cognition	4 weeks	11

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Nair *et al.* (2011) Nursing Home Australia	Effect of Baroque music	RCT cross-over design	Dementia (n = 75)	*Music* Listened to music for 4 hours daily for 4 weeks (n = 38). Control group (n = 37) received usual care. Crossed over after 6 weeks	Behavioural disturbances	PROC GENMOD	Single sensory	No	Significantly more behavioural disturbances during the weeks when Baroque music was played compared to control periods	12 weeks	10
Sung *et al.* (2010) Nursing Home Taiwan	Effect of a preferred music listening intervention on anxiety	Quasi-experimental pre- and post-test design	Mild to moderate dementia (n = 52)	*Music* Individual music twice a week each lasting 30 minutes (n = 29) and usual care (n = 23)	Anxiety	RAID	Single sensory	Yes	Those who listened to music had significantly lower anxiety scores after intervention compared to those in the control group	6 weeks	9
Light therapy											
Ancoli-Israel *et al.* (2003) Nursing Home USA	Effect of morning bright light on agitated behaviour	RCT	Severe dementia (n = 92)	*Bright light therapy (BLT)* Gr. 1 (n = 30), morning bright light, Gr. 2 (n = 31), morning dim red light and the control group (n = 31) evening bright light for 2 hours, 10 consecutive days	Agitation	CMAI ABRS	Single sensory	Yes	No significant effect on agitation	18 days	10
Barrick *et al.* (2010) Nursing Home USA	Effect of ambient bright light therapy on agitation	Cluster-unit cross-over trial	Dementia (n = 66)	*Ambient bright light therapy* Each group received four light conditions; am bright light (3 hours), evening bright light (2 hours), all day bright light and stand light. Each presented during multiple three weeks	Agitation	MMSE MDS-COGS CMAI	Single sensory	Yes	No effect in reducing agitation Agitation increased for all participants	3 weeks	10

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Burns *et al.* (2009) Nursing Home UK	Effect of bright light therapy on agitation and sleep	RCT	Dementia (n = 48)	*Bright light therapy (BLT)* Exposed to BLT (n = 22) and standard light (n = 26) during the second and third week for 2 hours	Agitation Sleep	MMSE CSDD CRBRS CMAI MOUSEPAD Actigraphs Sleep chart	Single sensory	Yes	No significant effect	8 weeks	11
Dowling *et al.* (2005b) Nursing Home USA	Effect of timed bright light therapy in reducing rest-activity (circadian) disruption	RCT	AD (n = 70)	*Timed bright light therapy* Gr. 1 (n = 29) received BLT for 1 hour, 5 days a week in the morning and the Gr. 2. (n = 24) in the afternoon, in the common area The control group (n = 17) received usual indoor light	Rest-activity disruption	Actiwatch activity monitor	Single sensory	Yes	No significant effect	10 weeks	9
Dowling *et al.* (2005a) Nursing Home USA	Effect of morning bright light exposure on night-time sleep, daytime wake time, and the rest–activity rhythm	Randomised Placebo, Control Trial (RCT)	Severe AD (n = 46)	*Morning bright light* Experimental group (n = 29) received 1 hour of bright light exposure 5 days a week in common area. The control group (n = 17) received usual indoor light	Night-time sleep, daytime wake time, and the rest–activity rhythm	Actigraphy	Single sensory	Yes	No significant effect	10 weeks	9
Dowling *et al.* (2007) Nursing Home USA	Effect of morning or afternoon bright light exposure compared with usual indoor light on BPSD	RCT	Dementia (n = 70)	*Bright light therapy* Gr. 1 (n = 29) received 1 hour BLT 5 days a week in the morning and Gr. 2 (n = 24) in the afternoon, in common area The control group (n = 17) received usual indoor light	Presence, frequency, severity, and occupational disruptiveness of BPSD	NPI-NH	Single sensory	Yes	Statistically significant differences between groups on agitation/ aggression, depression/dysphoria, aberrant motor behaviour, and appetite/eating disorders	10 weeks	9

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Hickman *et al.* (2007) Nursing Home USA	Effect of ambient bright light therapy on depression	Cluster-unit cross-over intervention	Dementia (n = 60)	*Ambient light therapy* Four lighting conditions – each four hours	Depression	CSDD	Single sensory	Yes	No significant change in depression	3 weeks	8
Fontana Gasio *et al.* (2003) Nursing Home Switzerland	Effect of low intensity dawn-dusk simulation to improve the disturbed circadian rest-activity cycle, nocturne sleep and cognitive functioning	Randomly	Dementia (n = 13)	*Dawn-dusk simulation (DDS) light therapy* Experimental group (n = 9) were exposed to DDS and control group (n = 4) to dim red light for 60–78 minutes	Disturbed circadian rest-activity cycle, nocturne sleep and cognitive functioning	NPI-NH GDS Sleep log Actiwatch MMSE CERAD	Single sensory	Yes	No change significant change in agitation, depression or sleep	3 weeks	10
Massage/aromatherapy											
Fu *et al.* (2013) Nursing Home Australia	Effect of aromatherapy with and without hand massage on disruptive behaviour	RCT	Dementia (n = 67)	*Aromatherapy* Gr. 1 aromatherapy (spray on chest) (n = 23), Gr. 2 aromatherapy and hand massage for 5 minutes (n = 22) and control group (n = 22) care as usual. All intervention were given twice daily, seven days a week	Disruptive behaviour (aggression and agitation)	CMAI-SF	Single sensory	Yes	No significant improvements in aggressive behaviours after receiving aromatherapy or for those who received a combination of aromatherapy and hand massage	6 weeks	11
Harris *et al.* (2012) Nursing Home USA	Effect of slow-stroke massage on total minutes of night-time sleep	Pilot RCT	Dementia (n = 40)	*Slow-stroke back massage* Three minutes slow-stroke back massage (SSBM) for two nights (n = 20) and usual care (n = 20)	Sleep	Actigraphy	Single sensory	No	No significant improvement in night-time sleep	2 days	10

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Lin *et al.* (2007) Nursing Home China	Effect of lavender on agitation	RCT Single-blind Cross-over	Dementia (n = 70)	*Aromatherapy* Experimental group (n = 35) inhaled lavender for at least 1 hour during sleep and control (n = 35) sunflower three weeks and then they switched for another three weeks	Agitation	CCMAI CNPI	Single sensory	No	Significant reduction of agitation after inhalation of lavender, but not sunflower inhalation	8 weeks	10
Moyle *et al.* (2014) Nursing Home Australia	Effect of foot massage and quiet presence on agitation and mood	RCT	Moderate to severe dementia (n = 53)	*Foot massage* Foot massage (n = 25) and presence (n = 28) for 10 minutes, five times a week	Agitation and mood	CMAI OERS	Single sensory	Yes	Strong evidence that the mean total CMAI increased in both groups – mainly due to the verbal aggression subscale No significant difference between the groups in the other CMAI subscales or in OERS	3 weeks	11
O'Connor *et al.* (2013) Nursing Home Australia	Effect of dermally applied lavender on agitated behaviour	Single blindedRCT Cross-over trial	Dementia (n = 64)	*Dermally applied lavender* Massage with lavender oil six times for one minute (n = 37) and control oil (n = 27)	Agitation	MMSE CMAI Affect rating scale	Multi-sensory	Yes	No significant difference between the groups	6 days	10
Sakamoto *et al.* (2012) Nursing Home Japan	Effect of lavender olfactory stimulation on fall incidence	RCT	Dementia (n = 100)	*Olfactory stimulation* Lavender patch attached to the inside of the clothes near the neck 24/7 (n = 51) and an unscented patch (n = 49)	Falls Agitation	MMSE CMAI	Single sensory	Yes	Significant decrease in agitation Lower incidence rate of falls in the lavender group	360 days	11

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Suzuki *et al.* (2010) Day centre Japan	Effect of tactile massage on changes in physical and mental function and BPSD	Controlled trials	Dementia (n = 28)	*Tactile massage* Tactile massage five times a week for 30 minutes, (n = 20) and usual care (n = 20)	BPSD Cognition ADL Stress	MMSE GBS BEHAVE-AD Salivary CgA	Single sensory	No	Significant reduction in intellectual and emotional functioning in the control group, while the experiment group maintained functioning The experiment group showed a significant reduction in stress	6 weeks	9
Toy therapy/animal therapy/doll therapy											
Libin and Cohen-Mansfield (2004) Nursing Home USA	Effect of a robotic cat and a plush toy	Comparison condition experimental design	Dementia (n = 9)	*Robotcat* Each of the nine residents received two interactive sessions – one with the robot cat and one with the plush cat. One session per day for 10 minutes each	Agitation Affect Engagement	ABMI Lawton's Modified Behaviour stream	Multi-sensory	No	Significant decrease in overall agitation and physical agitation when interacting with the plush cat. No significant increase in pleasure and interest although it did increase. Robot cat – significant increase in pleasure and interest No significant differences regarding engagement	Two sessions	8
Majić *et al.* (2013) Nursing Home Germany	Effect of animal-assisted therapy (AT) on symptoms of agitation/ aggression and depression	Matched case–control design repeated measure	Dementia (n = 54)	*Animal-assisted therapy* AAT group (n = 30) received a 45 minutes session once a week and usual care (n = 35)	Agitation Aggression Depression	CMAI DMAS	Multi-sensory	No	No significant effect	10 weeks	9

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Nordgren and Engström (2014) Nursing Home Sweden	Effect of a dog-assisted intervention on BPSD	Quasi-experimental, pre–post test	Dementia (n = 33)	*Dog-assisted* Ten sessions dog-assisted intervention, once or twice a week for 45–60 minutes (n = 20 and usual care (n = 13)	BPSD	CMAI MDDAS	Multi-sensory	No	No significant changes in agitation after 12 weeks, but significant increase in verbal agitation after 6 months follow-up	12 weeks	8
Travers *et al.* (2013) Nursing Home Australia	Effect of dog-assisted therapy on mood, QoL, and psychological functioning	RCT	Mild to moderate dementia (n = 55)	*Dog-assisted* Three groups sessions of 40–50 minutes each, per week with a dog (n = 27) and human-therapist-only intervention (n = 28)	Depression QoL Psychological functioning	QOL-AD SF-36 GDS-SF MOSES	Multi-sensory	No	The intervention group showed significant improvement in QoL in one facility Dog-assisted therapy may be beneficial for some residents	1 week	9
Acupressure/reflexology											
Hodgson and Andersen (2008) Nursing Home USA	Effect of reflexology on physiological distress, pain and affect	Experimental, repeated-measures, cross-over design study	Mild to moderate dementia (n = 21)	*Reflexology* Gr. 1 (n = 10) four weeks of weekly reflexology followed by four weeks of a friendly visits. Gr. 2 (n = 11) four weeks of friendly visits followed by four weeks of weekly reflexology. Each session lasted 30 minutes	Physiological distress Pain Affect	Salivary amylase CNPL AARS	Single sensory	Yes	Residents receiving reflexology had clinically and statistically significant reduction in pain and salivary alpha amylase concentration. No improvement in the control group	12 weeks	10

Appendix 1 (continued)

Study Setting Country	Purpose	Study design	Sample	Intervention, duration and frequencies	Target	Outcome measure	Type of intervention	Theoretical foundation	Main findings	Length of intervention	Strength/ quality
Lin *et al.* (2009) Nursing Home USA	Effect of acupressure and Montessori-based activities in decreasing agitated behaviours	A double-blinded randomised cross-over design	Dementia (n = 133)	*Acupressure* Three sequence groups: 1 (n = 42), 2 (n = 39) and 3 (n = 52). Montessori-based activities were done in 45-minute sessions once every day, six days/week. Acupressure or presence was done in 15 minutes sessions once every day, six days/week	Agitation	CMAI Ease-of-care AARS	Single sensory	No	Significant decrease in agitated behaviour, aggressive behaviours, and physically nonaggressive behaviours in the acupressure and Montessori-based groups. Ease-of-care ratings significantly better for the acupressure and Montessori-based groups. Montessori-based group significantly better in terms of apparent affect	4 weeks	11