



## Review Essay

# Creating a dementia-friendly environment through the use of outdoor natural landscape design intervention in long-term care facilities: A narrative review



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## ABSTRACT

There is an increasing volume of literature on the positive effects of outdoor natural landscapes on health and well-being. However, to date, there is a paucity of research on the effect of outdoor natural landscapes designed for people with dementia living in long-term care (LTC) facilities, in particular, those which have incorporated the characteristics of a dementia-friendly environment (DFE). This narrative literature review synthesizes current knowledge on the effect of outdoor natural landscape design, which is aligned with the characteristics of a DFE, to improve agitation, apathy and engagement of people with dementia living in LTC facilities. The reviewed studies predominantly support the positive effects of outdoor natural landscapes on agitation, apathy and engagement of people with dementia. However, there are concerns about the methodological approaches, principles incorporated in the applied outdoor natural landscapes' designs, and the environmental assessment. Further rigorous research is required to understand the impact of the outdoor natural landscapes, with the application of DFE characteristics in the design, on agitation, apathy and engagement of people with dementia living in LTC facilities.

## 1. Introduction

The concept of landscape has evolved from being just a scenery to a multifaceted one which represents an area or setting characterized by the interaction between nature and human beings (European Landscape Convention, 2000). From a health perspective, there is a long-held traditional belief originating from religion that landscape serves as a healer or therapy for its users (Gesler, 1992; Marcus and Sachs, 2014; Streep, 2003). A number of ancient cultures, including the Greeks, considered landscape as a holy element with curative power, utilizing it spiritually in both their cleansing rituals and constructions (Gesler, 1992). More recent studies on landscape have demonstrated the benefit of its various components including green and blue spaces for the physical (Mackay and Neill, 2010; Mytton et al., 2012), social (Alaimo et al., 2010; Finlay et al., 2015; Gorman, 2017; Kuo, 2010; Mokos, 2017; Nutsford et al., 2016) and psychological well-being (Barton and Pretty, 2010; Van Herzele and de Vries, 2011; White et al., 2010) of

individuals, especially for older adults (Astell-Burt et al., 2013; Finlay et al., 2015; Sulander et al., 2016). Today, some specific landscapes, such as outdoor natural spaces are considered essential to human well-being, having some therapeutic effects that address the physical, psychological and social needs of people to promote health and well-being (Abraham et al., 2010).

The term therapeutic landscape was first defined by Gesler (1993) as being all types of places, natural or built (human-made) environments or milieus associated with healing or treatment which have “attained an enduring reputation for achieving physical, mental, and spiritual healing” (Gesler, 1993: 171). His earliest studies investigated the potential healing processes found in traditional settings such as mineral springs (Gesler, 1993) and pilgrimage sites (Gesler, 1996) as popular belief attributed curative or restorative power to these places. Evolving from the health geography discipline, the overall definition shifted over time to other foci such as the dynamic relationship between health and place and the factors contributing to healing and its

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promotion. For instance, Williams (1998) demonstrated that meaning, value and experience were crucial elements to healing within the current philosophy of holistic medicine. Andrews (2002) indicated that the characteristics and quality of place could affect health care provisions and the health and well-being of individuals. Further studies show that the therapeutic landscapes effect is mainly dependent on the association or interaction between people and their social environments based on their attitude, identity and culture (Conradson, 2005; Finlay, 2018) and what is therapeutic for one individual, may have some adverse effect or even harm for someone else simultaneously (Finlay, 2018).

The emphasis on the significance of place (e.g. built environment) has driven researchers to evolve the concept to consider and examine therapeutic effects of a wide range of sites such as home environments (Nagib and Williams, 2018; Williams, 2002), hospitals (Curtis et al., 2007; Jencks, 2010b; Marcus and Sachs, 2014), green milieus (parks, gardens, etc.) (Barton and Pretty, 2010; Finlay et al., 2015; Sharma-brymer et al., 2015) and blue spaces (sea, rivers, lakes) (Dempsey et al., 2018; Finlay et al., 2015; Foley and Kistemann, 2015; Nutsford et al., 2016; Volker and Kistemann, 2011; White et al., 2010). For instance, there is an association between the higher level of exposure to sea views and a lower level of depression in older adults (Dempsey et al., 2018).

Bell et al. (2018) further investigated the changes in the therapeutic landscape concept and showed that the continuing evolution of the term creates ambiguities. Hence, they propose hierarchization within the concept to address this, while keeping the four original dimensions proposed by Gesler (1993); material, social, spiritual and symbolic. An outdoor natural landscape incorporating green and blue components is regarded as a specific subset of therapeutic landscapes that embodies the therapeutic potential to promote health and well-being. Hence, this categorization of an outdoor natural landscape is used for this review.

Although the positive effects of outdoor natural landscapes on health and well-being have been well documented, there remains a gap in the understanding of the effect of outdoor natural landscapes for people living with dementia in long-term care (LTC) facilities. A large number of older people with dementia living in LTC facilities manifest negative behavioral and psychological signs and symptoms of dementia (BPSD) such as agitation and apathy. Agitation encompasses physically aggressive and non-aggressive behavior, verbal agitation and repetitive behaviors (Rabinowitz et al., 2005). Apathy, another manifestation of BPSD, is identified as a lack of enthusiasm, motivation, and loss of interest (Marin, 1990) that leads to a reduction in positive emotions and social interaction (Robert et al., 2009). People with dementia living in LTC facilities can experience agitated behaviors and apathy as a reflection of their unmet needs.

The literature shows that these unmet needs are often due to the institutionalized environments of LTC facilities where there are either excessive or insufficient levels of stimulation, inappropriate environmental conditions, and lack of engagement (Cohen-Mansfield et al., 2015; Kales et al., 2015). In addition, due to the short-term memory problems in people with dementia, they often have difficulty in spatial perception as well as time and place identification, which makes the LTC facilities environment confusing and disorienting (McLean, 2007). This confusion and disorientation resulting from inappropriate environmental conditions, in turn, cause several BPSD and results in people with dementia becoming agitated (Waller and Masterson, 2015). To reduce these challenges necessitates a high quality and well-designed LTC environment for people with dementia (McLean, 2007).

In recent years, there is a trend towards improving the quality of LTC environments with the creation of dementia-friendly environments (DFEs) (Davis et al., 2009). According to Davis et al. (2009: 187), a DFE "is a cohesive system of support that recognizes the experiences of the person with dementia and best provide assistance for the person to remain engaged in everyday life in a meaningful way". It is a way to create a therapeutic environment that contributes to the comfort and

independence of residents aiming to take the environmental requirements of those with dementia into consideration (Alzheimer's Australia, 2004).

The creation of a DFE was first initiated in indoor spaces of hospitals and LTC facilities through several environmental modifications such as improving flooring, lighting, furniture and visual signage to increase comfort and inclusion of people with dementia in daily life (Handley et al., 2017; Waller, 2012). Similarly, along with these changes, there has been increasing attention to the whole environment, namely both indoor and outdoor spaces (Marcus and Sachs, 2014). In other words, creating a DFE is not limited to the indoor environment. The outdoor environment (e.g. outdoor natural landscape) is an equally important area that should accommodate the unmet needs of people with dementia (World Health Organization, 2007) so that residents have access to an outdoor natural landscape (Marcus and Sachs, 2014).

Hence, in recent years, several new initiatives have evolved to allow people with dementia to take advantage of the potential therapeutic effects of an outdoor natural landscape. One of these is the creation of green care farms where people can spend time in an outdoor natural landscape, and they can take part in various farming and gardening activities (Bruin et al., 2009). Creation of gardens aiming at promoting general well-being in people with dementia named therapeutic gardens is another initiative, where people can sense various components of natural landscape while participating in horticulture activities (Graham-Cochrane, 2010).

An outdoor natural landscape for people with dementia, based on principles of DFE, is where individuals' well-being is promoted by relaxation in the environment and also enhanced by their active participation in garden-related activities (Graham-Cochrane, 2010). The design of outdoor natural landscapes based on the characteristics of DFE has been examined in a few LTC facilities such as the Living Garden at the Family Life Center in Michigan (Marcus, 2007; Marcus and Sachs, 2014). The positive effects of such outdoor natural landscapes on the well-being of residents have been documented; however, their specific impact on the adverse behavioral and psychological signs and symptoms of people with dementia are unclear.

Designing an outdoor natural landscape for people with dementia in LTC facilities must not only correspond to their needs but also incorporate DFE characteristics, such as orientation, accessibility, socialization, meaningful activities, reminiscence, sensory stimulation, safety and sustainability (Table 1), to respond to their needs appropriately. The ideal design process should incorporate two specific phases: site analysis (Hansen and Alvarez, 2016) and environmental assessment (Alzheimer's, 2018) to provide analysis of the environment which can maximize our understanding of the site and facilitate the drawing of the site.

Therefore, this narrative review aims to investigate recent studies that examine and use the characteristics of a DFE in the design of an outdoor natural landscape to reduce agitation and apathy and to encourage engagement of people with dementia in LTC facilities.

## 2. Methods

This study addresses a novel area of inquiry, built on previous studies. A narrative review is a comprehensive, realistic and critical analysis of the current knowledge on a specific topic in which the author narratively and critically summarizes the body of literature to identify the existing gaps (Baker, 2016; Charles Sturt University, 2019). It provides a broader perspective compared to the other types of reviews (Grant and Booth, 2009) and was chosen for this study to identify (a) the breadth and scope of available research on the effect of outdoor natural landscapes incorporating characteristics of a DFE on agitation, apathy and engagement, as well as (b) the outcomes of these studies, and (c) any gaps in the literature.

**Table 1**

DFE characteristics that should be followed when designing outdoor natural landscapes (based on the work by Brisbane City Council, 2014; Graham-Cochrane, 2010; Health Building Notes, 2015; Marcus and Sachs, 2014).

Characteristics	Descriptions
<b>Orientation</b>	Utilizing appropriate pictorial signage and visual cues Utilizing appropriate structures including gazebos, arbors, water features, furnishings and vegetation as major or minor landmarks in the outdoor natural landscape Utilizing marked entrance and exit areas in the outdoor natural landscape Utilizing looped walkways that return to the starting point Locating the therapeutic landscape in a way that people with dementia can easily see and identify the outdoor natural landscape
<b>Accessibility</b>	Having visual access to the outdoor natural landscape Having unrestricted physical access to the outdoor natural landscape Taking advantage of wide walkways where people in wheelchairs can also pass easily Implementation of handrails and durable furniture at regular intervals Providing several garden beds of different heights for the ease of access Making the outdoor natural landscape accessible all year long by providing sunrooms or indoor gardening activities Supplying the outdoor natural landscape with specific tools requiring slight strength for the use of people with dementia Providing enough shade spaces for summer and warm places for winter in the outdoor natural landscape
<b>Socialization</b>	Providing meaningful activities or interactive elements in the outdoor natural landscape that bring people together, such as herb gardens, sheds, etc. Providing suitable furnishings for increasing social interaction Providing enough places as quiet refuges for residents' privacy as well as activity areas for groups Providing a place for people with dementia to interact with others including a place for family visits and celebrations
<b>Meaningful activities (meaningful engagement)</b>	Providing some meaningful activities ranging from household chores to gardening for people with dementia Doing horticulture/gardening activity programs such as attending to herb garden tasks which also encourages food production activity Providing some elements that create social interaction in people with dementia such as a herb garden and a birdfeeder Designing safe walkways which encourage people with dementia to walk and take exercise as meaningful activities
<b>Reminiscence</b>	Utilizing various memory evoking elements of a therapeutic landscape including plants, gardening equipment, bird baths, old cars Utilizing familiar plants, materials or elements compatible with the culture of people with dementia
<b>Sensory Stimulations</b>	Providing an adequate amount of sensory stimulation by utilizing different sensory-provoking elements in a therapeutic landscape such as color, sound, texture and scent Designing the outdoor natural landscape in a way to stimulate the five senses Installing flower or plant beds of various heights for ease of touching, smelling and viewing Integrating nature-attracting plants in the outdoor natural landscape to attract singing birds and butterflies Integrating the outdoor natural landscape with appropriate lighting for the night use Locating the outdoor natural landscape and windows in a way that people with dementia can easily see and hear the sound of rain when it is cold outside
<b>Safety</b>	Creating a fenced outdoor natural landscape disguised with plants to make the fence less obvious Planting trees at a suitable distance from the outdoor natural landscape fence to prevent people with dementia from climbing Utilizing non-glare and gently sloped walkways with appropriate textures and contrasting colors on the edge of pathways Utilizing non-toxic plants in the outdoor natural landscape Disguising the entrances and exit areas which are not for the use of people with dementia Providing sufficient shade spaces for hot summer weather Providing durable elements or furniture in the outdoor natural landscape to prevent individuals from falling down Providing awnings over external doorways to help people's eyes adjust to light changes
<b>Sustainability</b>	Utilizing low maintenance plants Utilizing native plants compatible with the conditions of each region Removing weeds and composting plant beds Utilizing waste and debris of the outdoor natural landscape in compost bins Providing a self-sufficient outdoor natural landscape by providing a rainwater tank for watering Providing a gardening group for maintaining the outdoor natural landscape Locating the therapeutic landscape in a way that people with dementia are visible to staff in the outdoor natural landscape

## 2.1. Search strategy

A comprehensive literature search from 2007 to 2017 in peer-reviewed journals was carried out through the following databases: Scopus, ProQuest, Web of Science, Science Direct, Embase, CINAHL plus with full text, MEDLINE, PubMed, and Google Scholar. Additional studies were also found through manual reference checking. The search terms applied in the databases included four diverse groups of terms: 1: “landscape” OR “green space\*” OR “healing garden” OR “wander\* garden” OR “therapeutic garden” OR “therapeutic landscape\*” OR horticulture OR “green care” OR “dementia-friendly garden\*” OR “sensory garden\*” OR “Ecotherapy” OR “blue space\*” OR “therapeutic sound\*” OR “natural sound\*” OR “bird sound\*” OR “water sound\*” OR “natural stimulation” OR “Col?r” OR “smell\*”. AND 2. “Dementia” OR “Alzheimer” OR “cognitive impairment\*” AND 3. “Nursing home\*” OR “care facilit\*” OR “aged care facilit\*” OR “residential aged care facilit\*”. AND 4. Apath\* OR passivity OR Agitation OR “Agitated behavior?” OR “Engagement” OR “Social interaction”.

## 2.2. Eligibility

This narrative review included studies that reviewed the effects of any type of outdoor natural landscape interventions (e.g. therapeutic gardens, green care farming, ecotherapy and therapeutic horticulture) on agitation, apathy and engagement of people with dementia (aged 65 years and over) in LTC facilities. Studies that reported a comparison between the effects of outdoor natural interventions and indoor spaces that included either a multisensory room (MSR) or an indoor activity program for older people with dementia were included. Peer-reviewed studies reporting qualitative, quantitative or mixed-method studies written in English and published from 2007 to 2017 were included.

## 2.3. Included studies

As shown in Fig. 1, a total of 1256 studies were identified in the selected eight databases. After removing 513 duplicates, 743 studies were screened based on their title and abstract. This resulted in the deletion of 613 studies considered irrelevant. Reasons for these exclusions were that they were not related to the topic, or they did not examine the effects of an outdoor natural landscape designed for older people with dementia on the outcomes of agitation, apathy and engagement.

A total of 130 studies were retained for full-text review; 119 of these were excluded as they did not meet the inclusion criteria leaving eleven eligible studies. These 119 studies were excluded because of the following reasons:

1. Involved populations without dementia including healthy older adults or older adults with other disorders.
2. Reported the effect of other environment-based interventions including multisensory rooms (MSRs) and special care units (SCUs) with a focus on interior design rather than an outdoor environment.
3. Involved settings other than LTC facilities such as a daily horticultural activities program in the park.
4. Examined other outcomes: 1. medications, 2. falls, and 3. cognitive functioning, 4. stress and 5. staff satisfaction.
5. Reported the effects of indoor gardening on agitation, apathy or engagement for older people with dementia rather than the review focus on outdoor natural landscapes in LTC facilities.
6. Involved multiple interventions in combination with an outdoor natural landscape intervention and therefore it was difficult to distinguish between the effects of each intervention.
7. Provided insufficient research information (e.g. editorial and opinions).
8. Non-English studies were excluded.

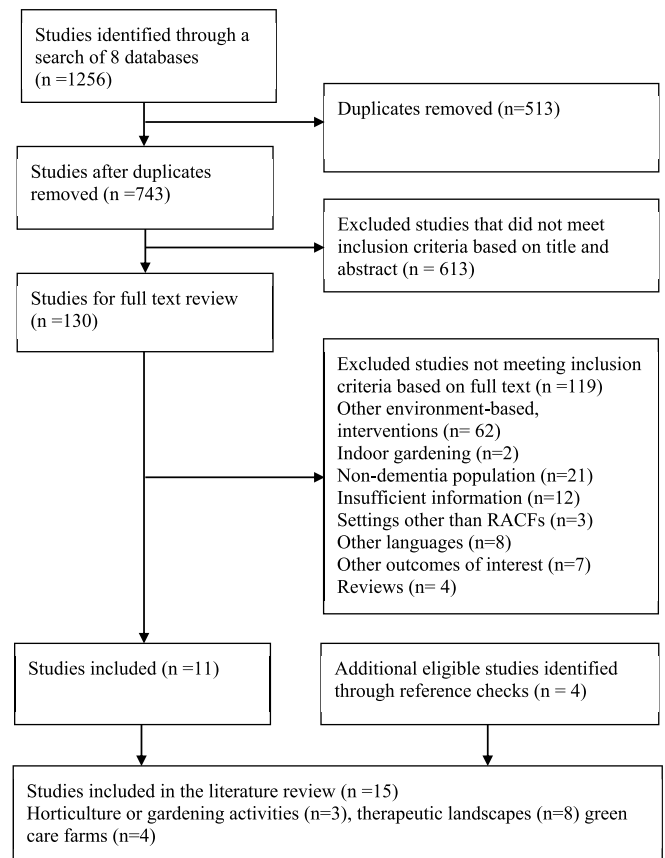


Fig. 1. The Literature review flow diagram.

A further four studies identified through manual reference checking were included, resulting in a total of 15 studies being included in this narrative review (Fig. 1).

## 2.4. Quality assessment

The quality assessment of included articles was guided by the [Pluye et al. \(2011\)](#) Mixed Methods Appraisal Tool (MMAT) and was carried out by three members of the research team (PM, WM & CJ) independently. Disagreement among assessors was solved through discussion. Each article was examined for its methodological quality according to the type of study, including qualitative, quantitative (RCT), quantitative (non-RCT), quantitative (descriptive) and mixed-method studies, by answering two general screening questions. These questions aimed to evaluate the clarity and appropriateness of the study design and data collection procedures to address the research questions. In addition, several questions exclusive to individual types of study were posed.

The possible responses were Yes, No or Cannot tell. Having answered the question, the scores were presented by using four different symbols: \*, \*\*, \*\*\* and \*\*\*\*. To score both the qualitative and quantitative studies, the number of (Yes) responses indicating meeting of the criteria are counted. That is, when one response was yes (i.e. one criterion was met) the study was given \* (25%) score. Two, three and four (Yes) response were given \*\* (50%), \*\*\* (75%) and \*\*\*\* (100%) respectively. For mixed-method studies, both qualitative and quantitative components of the study were assessed. The overall quality score of these mixed-method studies equals the lowest score of the study component (i.e. qualitative or quantitative). For example, if just one criterion was met by the qualitative component of the study (i.e. one (Yes) response) and two criteria were met by the quantitative component of

**Table 2**  
Quality assessment of studies.

Methods	Articles	Screening Questions		Questions															Score <sup>1</sup>					
				1				2				3				4				5				
				1	2	3	4	1	2	3	4	1	2	3	4	1	2	3		4	1	2	3	
Qualitative	Raske (2010)	Y	Y	Y	Y	Y	Ct																%75 (***)	
	Hernandez (2007)	Y	N	Y	Y	Y	N																%75 (***)	
	de Bruin et al. (2015)	Y	Y	Y	Y	Y	Y																%100 (****)	
Quantitative (RCT)	Connell et al. (2007)	Y	Y				N	N	Ct	Ct													%25 (*)	
	Jarrott and Gigliotti (2010)	Y	Y				N	N	Ct	Ct													%25 (*)	
	Luk et al. (2011)	N	Ct				N	Y	Ct	Ct													%25 (*)	
Quantitative (Non-RCT)	Calkins et al. (2007)	Y	Y							Ct	Y	Ct	Ct										%25 (*)	
Quantitative (Descriptive)	Detweiler et al. (2008)	Y	Y											Y	N	Y	Ct						%50 (**)	
	Bruin et al. (2009)	Y	Y											N	Ct	N	Ct						%25 (*)	
	de Boer et al. (2017a)	Y	Y											Y	Ct	Y	Ct						%50 (**)	
	de Boer et al. (2017b)	Y	Y											Y	Ct	Y	Ct						%50 (**)	
	Gonzalez and Kirkevold (2015)	N	Ct											Y	Ct	Ct	N						%25 (*)	
Mixed-method	Rappe and Topo (2007)	Y	Y	Y	Ct	Y	Ct							Ct	Y	Y	Ct	Y	N	N			%50 (**)	
	Anderson et al. (2011)	Y	Y	Y	Y	Ct	Ct							Ct	Y	Ct	Ct				Y	Y	Ct	%25 (*)
	Edwards et al. (2013)	Y	Y	Y	Ct	Ct	Ct							Ct	Y	Y	Y				Y	Y	Y	%100 (****)

1. Scoring metrics: Qualitative and quantitative studies: (scores varying from 25% (\*) -one criterion met-to 100% (\*\*\*\*) -all criteria met-). Mixed methods research studies: the overall quality score is the lowest score of the study components Pluye, P., Robert, E., Cargo, M., Bartlett, G., O’Cathain, A., Griffiths, F., Boardman, F., Gagnon, M.P., Rousseau, M.C., 2011. Proposal: A mixed methods appraisal tool for systematic mixed studies reviews., <http://mixedmethodsappraisaltoolpublic.pbworks.com>, (Accessed: 20 September 2017).

the study, the overall quality score of the mixed method study was \*(25%) (Pluye et al., 2011) (Table 2).

### 3. Findings

A data extraction form was created in an Excel file for data management of included studies. Data extracted from each of the included articles was tabulated in terms of methodological approach, study region, study participants (i.e. demographic characteristics of participants), intervention studies (i.e. intervention dose and assessment tools) and types of landscape design (i.e. site analysis, environmental assessment phase), DFE characteristics and the landscape plan (Table 3). Each category is presented in this findings section.

#### 3.1. Methodological approach

Of the 15 studies included in this narrative review, several methods were used to assess the influence of outdoor natural landscape on people with dementia. Three studies adopted a mixed-method approach, while the remaining 12 studies exclusively utilized either a qualitative or quantitative approach. Five studies used a descriptive study design (de Bruin et al., 2015; Gonzalez and Kirkevold, 2015; Hernandez, 2007; Rappe and Topo, 2007; Raske, 2010), four were observational studies (Bruin et al., 2009; de Boer et al., 2017a, 2017b; Detweiler et al., 2008) and six studies were intervention studies (Anderson et al., 2011; Calkins et al., 2007; Connell et al., 2007; Edwards et al., 2013; Jarrott and Gigliotti, 2010; Luk et al., 2011) of which three were randomized control trials (Connell et al., 2007;

Jarrott and Gigliotti, 2010; Luk et al., 2011) and three were quasi-experimental studies (Anderson et al., 2011; Calkins et al., 2007; Edwards et al., 2013).

#### 3.2. Study region

The majority of studies were conducted in Europe (n = 6) (Bruin et al., 2009; de Boer et al., 2017a, 2017b; de Bruin et al., 2015; Gonzalez and Kirkevold, 2015; Rappe and Topo, 2007); and the USA (n = 6); (Calkins et al., 2007; Connell et al., 2007; Detweiler et al., 2008; Hernandez, 2007; Jarrott and Gigliotti, 2010; Raske, 2010). Two studies (Anderson et al., 2011; Edwards et al., 2013) were conducted in Australia and one in Asia (Luk et al., 2011).

#### 3.3. Study participants

The reviewed studies included a total number of 1179 participants (people with dementia, staff and family members) of which their sample size varied between 10 (Edwards et al., 2013) to 423 (Gonzalez and Kirkevold, 2015). The mean age of people with dementia who participated in the studies ranged from 71 (de Bruin et al., 2015) to 89 years (Anderson et al., 2011).

The number of female participants with dementia was higher than males, except in three studies where the number of male participants was higher than females (Bruin et al., 2009; de Bruin et al., 2015; Detweiler et al., 2008). In addition, the mean level of cognitive impairment in participants varied in the studies between mild to a severe level of dementia. The average Mini-Mental State Examination (MMSE)

**Table 3**  
Outdoor natural landscape literature.

Study/Region	Purpose	Study design	Study participants	Intervention dose	Assessment tools	Findings	DFE characteristics	Site analysis/ Architectural plan
(Galkins et al., 2007)/USA	To examine the effects of increased time spent outdoors on agitation and sleep	Quasi-experimental design with pre-test/post-test design	Residents from three nursing homes (n = 17) 15 females and 2 males Mean MMSE score = 10.5	Outdoor activities. 2 weeks with activity. 1 week without activity (a) 30mins per day * 7 days per week * 2 weeks = 7hrs (b) 30 min per day*7 days per week*one week = 3.5 h.	1. Sleep (a) Actlume-L (b) Pittsburgh Sleep Quality Index (PSQI) 2. Agitation (a) Cohen– Mansfield Agitation Inventory Short Form (b) Actiwatch	Increased time spent outdoors caused a modest improvement in sleep; however, no measurable changes in agitation	Not enough information on the characteristics of the therapeutic landscape	No
(Connell et al., 2007)/USA	To evaluate the influence of an outdoor horticultural activity program compared with an indoor horticultural activity program on sleep and behavior	Randomized controlled trial	Residents in nursing homes (n = 20), 1 female, 19 males Mean MMSE score = 15.3 ± (8.4) Mean age = 79.7 ± (8.3)	Horticultural activities 60 min per day*5 days per week* 10 days = 10 h.	1. Cognitive status: Minimal Mental Status Exam (MMSE) 2. Agitation: CMAI 3. Sleep: wrist actigraphs with photocells	There was an improvement in maximum sleep duration in the outdoor activity group. The total sleep minutes in both outdoor and indoor groups improved significantly. There was also a significant improvement in verbal agitation in the outdoor activity group	Provision of meaningful activities including horticulture/gardening activities	No
(Rappe and Topo, 2007)/Europe	To examine the influence of plants on the well-being of older people with dementia	Study 1: Survey with both scaled and open-ended questions with staff Study 2: Observation of residents	Study 1: Staff (n = 65), 10 residential care homes Study 2: Residents with dementia (n = 123), from two daycare units, (Mean MMSE = 20), mean age 77 years and six residential care units, (mean MMSE score = 12) mean age = 84 years. More females than males	Green environments	Study 1: Survey Study 2: Dementia Care Mapping (DCM)	Study 1: Plants improved the psychological well-being and social relationships of people with dementia by offering topics for conversation. Study 2: Green environments supported the identity of people with dementia and created an active atmosphere in the units.	Provision of sensory stimulations by using plants; however, the garden was incompatible with the criteria of safety and accessibility	
(Detweiler et al., 2008)/USA	To evaluate the effects of participation in a wander garden on agitated behaviors	Pre-test/post-test design Observation of residents 12 months before and after opening the garden	Participants in a dementia Unit (n = 34 males). Mean age = 80.71 years	A wander garden with free and direct access from the dementia unit	1. Agitation (a) Cohen–Mansfield Agitation Inventory (CMAI) (b) Incidents reports from staff (c) Inappropriate behavior reported from relatives (d) needed medications	The use of medications was reduced after the wander garden was opened; however, verbal agitation did not change considerably. Staff and the relatives believed that the garden resulted in less agitation and improvements in mood and quality of life.	The therapeutic landscape is incompatible with criteria of safety and accessibility. Not much information was provided on the characteristics of the therapeutic landscape.	
(Hernandez, 2007)/USA	To evaluate the effects of garden design on the quality of life of residents	Multi-method qualitative research techniques Interviews with staff, family members and architects.	Staff (n = 28) Family members (n = 12), Architects (n = 5) in two dementia units in Midwest USA	A garden space Behavior mapping was conducted during a minimum of five randomly assigned one-half hour periods from 7:00 a.m.–11:00 p.m. every day of the week, including weekends	1. Residents, staff and family members were interviewed to ascertain garden use 2. Observation of how the garden was used by people with dementia (behavioral mapping) 3. Emotional reactions: Apparent Affect Rating Scale (AARS)	The garden improved residents' quality of life. Gardens created a better quality of life, through passive use (sitting outside), mild activities (reduction in stress and agitation), active use (physical activities, social activities, cultural activities) and direct garden use.	The therapeutic landscape is incompatible with the criteria of safety and accessibility. There is not enough information about the characteristics of the therapeutic landscape.	No/briefly

(continued on next page)

Table 3 (continued)

Study/Region	Purpose	Study design	Study participants	Intervention dose	Assessment tools	Findings	DFE characteristics	Site analysis/ Architectural plan
(Bruin et al., 2009)/ Europe	A comparison between activities undertaken in green care farms and regular daycare facilities	A cross sectional study	Study 1: Green care farms: people per day Regular daycare facilities: groups of on average 9 older people per day Study 2: 30 individual older people at a green care farm 25 individual older people with dementia attending daycare at a regular daycare facility with dementia Mean MMSE in study 1: G:19.4, R:20.0 Mean MMSE in study 2: G:19.0, R:18.2 Total number of males in study 2: 32 Total number of females in study 2: 23	Green care farms & regular daycare facility In study 1, the observations were performed on consecutive weekdays, except at 1 green care farm where the observations were performed on 3 consecutive weekdays and, due to practical reasons, 1 weekday 6 weeks later. In study 2, observations were performed on either 1 or 2 weekdays per person	1. Cognitive status: Minimal Status Exam (MMSE) 2. Observation through libitum sampling to gain insight into the main activity (the activity with the longest duration) over every 15 min 3. An inventory was made for the location of activities	Activities of older people at green care farms were more frequent, occurred outdoors more often, were of higher physical intensity, and aimed at individuals than were activities at regular daycare facilities. The green care farms' environment may be more beneficial for older people with dementia than the regular daycare facility environment	Provision of meaningful activities horticulture/ gardening activities	No
(Jarrott and Gigliotti, 2010)/USA	To compare the benefits between traditional activities (TA) and horticultural-based (HT) activities on engagement and affect	RCT, Comparative study	129 participants diagnosed with dementia from eight care programs Percentage of females in the entire group:53.1% Mean age of the entire group: 80.09	Horticultural or traditional activities 50mins per session*2 times per week*6 weeks = 10 h.	1. Cognitive impairment: Minimal Mental Status Exam (MMSE) 2. Affect: Apparent Affect Rating Scale (AARS) 3. Engagement: Menorah Park Engagement Scale (MPES)	There were no significant differences in affect between the two groups. The HT group showed a higher level of active, passive and other engagement, while the TA group was self-engaged.	Provision of meaningful activities horticulture/ gardening activities	No
(Raske, 2010)/ USA	To evaluate the impact of the construction and use of an enabling garden on resident quality of life	Descriptive study Qualitative interviews with Staff, family members and residents	43 participants included 16 residents, 6 family members, 15 staff members, and six gardens club volunteers. Mean age of residents interviewed = (81.4) 6 were men and 10 were women.	An enabling garden (a kind of therapeutic garden)	1. Cognitive impairment: Minimal Mental Status Exam (MMSE) 2. Coding of type and location of activities	Results revealed the garden had positive effects on residents' quality of life, particularly regarding meaningful daily activities, resident relationships, and functional competency.	There is not much information on the exact characteristics of the therapeutic landscape	No
(Anderson et al., 2011)/ Australia	To know whether a multisensory room is more effective than Sensory Stimulation provided by a therapeutic garden space	One group pre-post test study design and a focus group with staff	12 permanent residents of a care facility. Mean age = 89 years, Mean MMSE scores = 5.7	Snoezelen room and garden space 20 min per session* Once a week*6 weeks = 2 h.	1. Cognitive impairment: Minimal Mental Status Exam (MMSE) 2. Coding of observed behaviors into 4 Categories (disturbed/disengaged, neutral, engaged, very engaged)	Reduction in disengaged/ disturbed behaviors was noted after both Snoezelen and garden. However, the sample size for the garden group was too small to evaluate statistically. No significant differences in behavior were observed across groups over time. No significant differences were observed between Snoezelen and garden.	Provision of sensory stimulations by using plants, trees and fish pond	No

(continued on next page)

Table 3 (continued)

Study/Region	Purpose	Study design	Study participants	Intervention dose	Assessment tools	Findings	DFE characteristics	Site analysis/ Architectural plan
(Luk et al., 2011)/Asia	To investigate the effect of horticulture and gardening activities on agitation of residents with dementia	A single-blind with pre-post-test design	14 subjects with dementia, C-MMSE score = 13.4, mean age = 84.9 (.8.3), Percentage of female in the entire group: 92.9%	Gardening activities for the intervention group and tabletop activities for the control group 30mins per session* 2 times per week* 6 weeks = 6 h.	1. Cognitive impairment: Mini-mental Status Exam (MMSE) 2. Agitation: CMAI	There was a decreasing trend in physically non-aggressive behaviors in the experimental group. However, no significant reduction in agitation resulted from the intervention.	Provision of meaningful activities horticulture/ gardening activities	No
(Edwards et al., 2013)/Australia	To examine the impact of a garden on the quality of life of residents with dementia	one group pre-test post-test	10 participants Age Range: 79-90 years old Mild to moderate dementia, 9 females, one male	Voluntary access to an interactive, sensory garden for residents and staff. Baseline phase = 10 days, residents assessed 3 months after the construction of the garden.	1. Quality of Life: Dementia Quality of Life Instrument (DEMQOL and DEMQOL Proxy) 2. Cognitive impairment: Mini-mental Status Exam (MMSE) 3. Depression: Cornell Scale for Depression in Dementia (SCDD) 4. Agitation: Cohen-Mansfield Agitation: Inventory (CMAI)	The garden improved the mean quality of life scores in participants by over 10%. Mean agitation and depression scores decreased by half. The garden improved the quality of life for residents. The garden offered new topics for conversation.	Provision of sensory stimulations by using trees and plants	No/briefly
(de Bruin et al., 2015)/Europe	To examine the benefits of day services at green care farms (GCFs) regarding social participation for people with dementia	A qualitative study with semi-structured interviews	People with dementia who attended day services at a GCF (n = 21), or they were on a waiting list (WL) for day services at a GCF group (n = 12), or attended day services in a regular daycare facility RDCF (n = 17) People with dementia in the GCF and WL group were primarily males, with an average age of 71 and 76 years, respectively. RDCF group were mostly females with an average age of 85 years.	Green care farms & Regular daycare facility		For both the GCF and RDCF groups, it was indicated that day services made people with dementia feel part of society. The most important domains of social participation addressed by RDCFs were social interactions and recreational activities. GCFs additionally addressed the domains of "paid employment" and "volunteer work." GCFs are valuable concerning social participation for a particular group of people with dementia.	Provision of meaningful activities horticulture/ gardening activities	No
(Gonzalez and Kirkevold, 2015)/Europe	To ascertain the opinions of the leaders and staff regarding the benefits of sensory gardens (SGs) for the residents with dementia	A Cross-Sectional E-mail Survey	121 leaders of nursing homes and 302 staff Leaders: 87 females, 13 males, staff: 95 females, 5 males	Sensory gardens (a kind of therapeutic landscape)		Provision of sensory stimulations by using different plants	No	(continued on next page)



Table 3 (continued)

Study/Region	Purpose	Study design	Study participants	Intervention dose	Assessment tools	Findings	DFE characteristics	Site analysis/ Architectural plan
(de Boer et al., 2017a)/ Europe	To evaluate whether residents of green care farms participate more in (physical) activities and social interaction compared with residents of traditional and regular small-scale nursing homes?	Longitudinal observation study	A total of 115 nursing home residents at baseline, 100 at follow-up. S-MMSE, mean (SD) = 8 Baseline phase: 75% of participants were female Follow up phase: 76% of participants were female. Mean age of participants in entire groups: 84 (7.8)	Green care farm (a period of 2 weeks) 4.5 h per session * 7 sessions in 2-week period = 63 h observation at baseline phase. 4.5hrs session* 6 times in 2 weeks = 54 h at follow-up phase	1. Cognitive impairment: Standardized Mini-Mental State Exam (S- MMSE) 2. Activities of daily living (ADLs): the Barthel index. 3. Activities: Maastricht Electronic Daily Life Observation Tool	Residents of green care farm significantly more often participated in domestic activities and in nature-related activities and significantly less often engaged in passive activities compared with residents of traditional nursing homes. Residents of green care farm had significantly more active engagement and had more social interaction. Besides, they came outside significantly more than residents of traditional nursing homes. Residents of green care farms were significantly more physically active than were residents of regular small-scale living facilities.	Provision of meaningful activities horticulture/ gardening activities	No
(de Boer et al., 2017b)/ Europe	To compare the quality of care, quality of life and related outcomes in green care farms, regular small-scale living facilities and traditional nursing homes for people with dementia.	A cross-sectional design	115 residents of 18 nursing homes. Five green care farms, nine regular small-scale living facilities, and four traditional nursing homes, Mean MMSE = 9.7 75% of participants are females. Mean age = 83.8 7.8	A farm environment (includes animals, vegetable gardens and other features of a farm environment)	1. Cognitive impairment: Standardized Mini-Mental State Exam (S- MMSE) 2. Social engagement: The Revised Index for Social Engagement (RISE) 3. Neuropsychiatric Symptoms: (NPI-NH) 4. Quality of life: QUA-LIDEM and QoL AD 5. Quality of care: Assessed by outcomes, structure and process indicators (falling incidents) during Last 30 days. 6. Agitation: Agitation Inventory (CMAI) 7. Depression: Cornell Scale for Depression (CSDD)	Higher quality of life scores were reported for residents of green care farms, in comparison with residents of traditional nursing homes. Residents of green care farms scored higher on three quality of life domains of the Qualidem: positive affect, social relations and having something to do. No differences with regular small-scale living facilities were found.	Provision of meaningful activities horticulture/ gardening activities	No

was between 5.7 (Anderson et al., 2011) and 20 (de Bruin et al., 2015; Rappe and Topo, 2007). However, some studies did not describe the precise level of cognitive impairment of participants (Detweiler et al., 2008; Hernandez, 2007; Raske, 2010).

### 3.4. Intervention studies

Three types of outdoor natural landscape interventions were identified within the 15 reviewed studies. They were horticultural activities (Connell et al., 2007; Jarrott and Gigliotti, 2010; Luk et al., 2011), therapeutic gardens (Anderson et al., 2011; Calkins et al., 2007; Detweiler et al., 2008; Edwards et al., 2013; Gonzalez and Kirkevold, 2015; Hernandez, 2007; Rappe and Topo, 2007; Raske, 2010) and green care farms (Bruin et al., 2009; de Boer et al., 2017a, 2017b; de Bruin et al., 2015). The efficacy of outdoor natural landscape interventions on agitation, apathy and engagement of people with dementia was generally reported in the studies mentioned above. However, sometimes detailed information about the applied intervention protocol was missing, which could have been useful for replication of the protocol in future studies. Jarrott and Gigliotti (2010) outlined a clear and detailed intervention protocol, while most of the other studies briefly described the intervention procedure.

Additionally, none of the randomized control trials (RCTs) provided an adequate description of the process of randomization or blinding (Connell et al., 2007; Jarrott and Gigliotti, 2010; Luk et al., 2011) for eliminating selection bias in treatment assignment (Connell et al., 2007; Jarrott and Gigliotti, 2010). Two of the RCTs had small sample sizes. In the study conducted by Connell et al. (2007) ten participants took part in each group of the study (i.e. outdoor activity group and indoor activity group). In the investigation conducted by Luk et al. (2011), just seven participants in the intervention group and six in the control group participated. These small sample sizes decreased the reliability of both the Connell et al. (2007) and Luk et al. (2011), study results. The following subsections will present more in-depth information regarding each type of intervention.

#### 3.4.1. Horticulture activities

The effectiveness of horticultural activities on the signs and symptoms of dementia have been addressed in three studies using quantitative approaches (Connell et al., 2007; Jarrott and Gigliotti, 2010; Luk et al., 2011). Two studies (Connell et al., 2007; Luk et al., 2011) applied horticultural activities as a way to reduce agitation, while one study (Jarrott and Gigliotti, 2010) used these activities to increase the level of engagement in people with dementia. Luk et al. (2011) did not report any significant effect of horticultural activities on reducing agitation, but the two others revealed that horticultural activities reduce verbal agitation (Connell et al., 2007) and increase engagement of people with dementia (Jarrott and Gigliotti, 2010). This increase in the level of engagement occurred either actively (i.e. physically or verbally responding to the presented activity) or passively (i.e. observing and listening to the presented activity). However, both studies did not include a follow-up phase to determine the sustainability of the intervention's effect.

#### 3.4.2. Therapeutic gardens

Therapeutic gardens as one type of an outdoor natural landscape consisting of green and blue components have been examined in eight studies for the influence of therapeutic gardens on the signs and symptoms of dementia (Anderson et al., 2011; Calkins et al., 2007; Detweiler et al., 2008; Edwards et al., 2013; Gonzalez and Kirkevold, 2015; Hernandez, 2007; Rappe and Topo, 2007; Raske, 2010). Three of these studies reported positive effects of therapeutic gardens on engagement and socialization of people with dementia (Hernandez, 2007; Rappe and Topo, 2007; Raske, 2010). These studies showed that therapeutic gardens increase the level of participation in activities such as watering, planting and watching flowers (Hernandez, 2007; Raske,

2010), or increased communication among people with dementia (Rappe and Topo, 2007).

These studies are mainly based on descriptive or qualitative approaches with a duration of data collection varying between two consecutive days (Rappe and Topo, 2007) and four weeks (Hernandez, 2007). Unfortunately, a detailed interpretation or description of both the data collection and results were not provided in these studies. Additionally, only proxies such as staff or family members were interviewed rather than people with dementia (Hernandez, 2007; Rappe and Topo, 2007).

The next three studies (Calkins et al., 2007; Detweiler et al., 2008; Gonzalez and Kirkevold, 2015) employed a quantitative approach to investigate the impact of therapeutic gardens on people with dementia. Of these, two assessed the efficacy of therapeutic gardens on the level of agitation and reported no significant impact (Calkins et al., 2007; Detweiler et al., 2008). The third study showed that the therapeutic garden improves socialization and communication of people with dementia (Gonzalez and Kirkevold, 2015). However, none of these studies addresses objective outcome measures (i.e. results were based on web-based surveys of nursing home leaders). Also, none of these studies undertook qualitative interviews with people with dementia to seek their views on the effect of the therapeutic garden.

The two remaining studies used mixed-method approaches to evaluate the effects of therapeutic gardens on the agitation of people with dementia (Anderson et al., 2011; Edwards et al., 2013). One study showed a decrease in agitated behaviors of people with dementia (Edwards et al., 2013). There were no follow-up measurements to assess whether the intervention effects were sustained over time. In addition, qualitative interviews were only conducted with staff and not with people with dementia who were the primary users of the therapeutic garden.

The last study by Anderson et al. (2011) compared the level of engagement and agitation of people with dementia when using a multi-sensory room and a therapeutic garden. They demonstrated a high level of engagement in people with dementia in both environments. They concluded that their small sample size ( $n = 5$ ) limited an understanding of pre and post-changes in the agitation of people with dementia.

#### 3.4.3. Green care farms

The therapeutic impacts of green care farms as another type of designed outdoor natural landscape on people with dementia have been evaluated in four studies, focusing on either engagement (Bruin et al., 2009; de Boer et al., 2017a; de Bruin et al., 2015) or neuropsychiatric symptoms such as agitation and apathy (de Boer et al., 2017b). Green care farms were shown to have a positive influence on the level of socialization and engagement of people with dementia, and no significant effect on the level of neuropsychiatric symptoms, including agitation. However, the use of an observational study design could hinder the determination of the cause and effect relationship to accurately show whether green care farms leads to an improvement in behavioral signs and symptoms of dementia (Bruin et al., 2009; de Boer et al., 2017a, 2017b). Semi-structured interviews can also be potentially biased when the selection of participants is undertaken by care professionals (de Bruin et al., 2015).

#### 3.4.4. Intervention dose

The average total intervention duration and frequency varied among the studies which took place over weeks to months. That is, a total intervention dose in the studies was between 3.5 h (Calkins et al., 2007) and 63 h (de Boer et al., 2017a). The average total intervention duration and frequency in the studies was approximately 20 h.

#### 3.4.5. Assessment tools

Among the assessment tools applied for measurement of agitation, five studies used the Cohen-Mansfield Agitation Inventory (CMAI) (Calkins et al., 2007; Connell et al., 2007; Detweiler et al., 2008;

Edwards et al., 2013; Luk et al., 2011), while other studies used either the Neuropsychiatric Inventory-Nursing Home Version (NPI-NH) (de Boer et al., 2017b) or coded different behaviors through observation of participants (Anderson et al., 2011). The single study that assessed apathy (de Boer et al., 2017b) used the Neuropsychiatric Inventory-Nursing Home Version (NPI-NH).

Assessment tools used for the measurement of social engagement in people with dementia varied in different studies. Two studies (Hernandez, 2007; Rappe and Topo, 2007) observed participants' social engagement and activities through Dementia Care Mapping 7th (DCM); one study (Jarrott and Gigliotti, 2010) through the Menorah Park Engagement Scale and one (de Boer et al., 2017a) via The Maastricht Electronic Daily Life Observation tool (MEDLO-tool). In two other studies, observers recorded participants' type and location of activities including indoor and outdoor activities (Bruin et al., 2009), or coded different activities undertaken by participants into the four levels of very engaged, engaged, neutral and disengaged (Anderson et al., 2011). Other studies examined social engagement through a survey (Gonzalez and Kirkevold, 2015), interviews (Raske, 2010), or focus groups (de Bruin et al., 2015).

Additionally, the review shows that different studies have different ways of defining engagement, thus making comparisons across studies difficult. Engagement was assessed via the level of stimulation, for example, active or passive stimulation (Hernandez, 2007; Jarrott and Gigliotti, 2010), the level of social interaction, for example, communication and interaction between residents (Anderson et al., 2011; Raske, 2010; Gonzalez and Kirkevold, 2015), the level of financial incentive such as volunteer or paid work (de Bruin et al., 2015), temporal commitment such as when residents visited or talked about the garden (Rappe and Topo, 2007), or type of activities ranging from drinking to outdoor related activities (de Boer et al., 2017a; Bruin et al., 2009).

#### 3.4.6. Outdoor natural landscape design

The design of each outdoor natural landscape consists of the different phases of site analysis (Hansen and Alvarez, 2016), environmental assessments (Alzheimer's, 2018) to check whether DFE characteristics (Graham-Cochrane, 2010) are followed, and of providing conceptual diagrams and plans of the outdoor natural landscape (Chapman, 2015). These phases in the design of an outdoor natural landscape were investigated in the included studies as outlined below.

**3.4.6.1. Site analysis.** The primary step for designing each outdoor natural landscape is an analysis or audit of the site or environment to recognize various conditions of the site including soil, water, drainage and sunlight/shade requirements, which affect the type and location of plants (Hansen and Alvarez, 2016). Among the 15 studies investigated, none described the site analysis, site characteristics and the process of how the outdoor natural landscape was designed or how the plants were selected. There was no information on the plants, trees or any other architectural elements in the outdoor natural landscape. In one study (Rappe and Topo, 2007) the designers planted the plant called *Nérיום oleánder*, which is toxic if eaten and may have placed people with dementia at risk of being poisoned.

**3.4.6.2. Environmental assessment phase.** Utilizing audit tools that are aligned with the characteristics of a DFE is another complementary step in analyzing the site before the design of the environment, which creates a useful framework for the assessment of the environment (Alzheimer's, 2018). Among the 15 studies retrieved, almost half ( $n = 8$ ) specifically discussed the design of outdoor natural landscapes for people with dementia (Anderson et al., 2011; Calkins et al., 2007; Detweiler et al., 2008; Edwards et al., 2013; Gonzalez and Kirkevold, 2015; Hernandez, 2007; Rappe and Topo, 2007; Raske, 2010), yet none of these studies included an environmental assessment before the design. Such assessment is an essential phase in the outdoor

natural landscape design process, which helps designers understand the strengths and weakness of the environment and users' needs before any design takes place (Chapman, 2015; Hansen and Alvarez, 2016; Reardon, 2013).

**3.4.6.3. Dementia-friendly environment characteristics.** As mentioned previously, DFE characteristics that should be applied in designing outdoor natural landscape are orientation, accessibility, socialization, meaningful activities, reminiscence, sensory stimulation, safety and sustainability (Graham-Cochrane, 2010).

Of the 15 studies, the design of three outdoor natural landscapes did not comply with the characteristics of a DFE. These studies (Detweiler et al., 2008; Hernandez, 2007; Rappe and Topo, 2007) did not take into consideration the criteria of safety and accessibility of the outdoor natural landscape in the design. Seven studies focused on just one characteristic of a DFE in the outdoor natural landscape such as the provision of meaningful activities including gardening programs (Bruin et al., 2009; Connell et al., 2007; de Boer et al., 2017a, 2017b; de Bruin et al., 2015; Jarrott and Gigliotti, 2010; Luk et al., 2011). Three studies considered several sensory stimulations in outdoor natural landscapes, but other DFE characteristics were ignored (Anderson et al., 2011; Edwards et al., 2013; Gonzalez and Kirkevold, 2015). The two remaining studies (Calkins et al., 2007; Raske, 2010) did not provide adequate evidence concerning the characteristics of the outdoor natural landscapes to determine whether they are suitably compatible with DFE principles.

**3.4.6.4. Outdoor natural landscape plan.** The last step in the design of an outdoor natural landscape is providing conceptual diagrams and plans involving the essential architectural elements and details for implementation in the outdoor natural landscape following site analysis and individuals' need (Chapman, 2015).

None of the 15 studies investigated included a detailed architectural plan of the outdoor natural landscape as a guideline for future studies. Two out of 15 studies briefly showed some layouts or architectural plans of the outdoor natural landscape in unspecified scales (Edwards et al., 2013; Hernandez, 2007).

## 4. Discussion

This narrative review investigated qualitative, quantitative and mixed-method studies to assess the effectiveness of outdoor natural landscapes concerning the behavioral and psychological signs and symptoms of dementia including agitation and apathy, and engagement. Several major topics for discussion emerged from this review.

From a statistical point of view, when looking at the dates of publication, articles from the USA form one early group while the most recent articles are from either Europe or Australia. Most of the articles are from western countries including those in Europe. This could be explained by the language criterion being restricted to English during the review process, thus automatically eliminating articles in any other languages, but these results could also be associated with the evidence that Europe has a long tradition in the history of therapeutic landscape design (Gesler, 2003; Jencks, 2010a). For example, Epidaurus in Greece (Gesler, 1993), Lourdes in France (Gesler, 1996) and Bath in England (Kearns and Gesler, 1998) were among the first traditional sites with a reputation for healing using therapeutic landscapes. St Thomas's hospital in London, the Lariboisiere hospital in Paris and the Royal Navy Hospital at Plymouth, England, were among the first contemporary examples of the incorporation of landscape within indoor spaces for therapeutic purposes. For example, an outdoor natural landscape was incorporated within the hospital environment as a central courtyard, and patients were able to see the landscape through the windows (Marcus and Sachs, 2014). This also raises the question of whether culture is an influencing factor when exploring this topic, a concept first

mentioned by Gesler (1992). For example, has the investigation of the therapeutic landscape effect been something that has interested western countries due to their long tradition in designing therapeutic landscape, or, on the contrary, has there been a lack of interest or understanding in this area by other cultures? At a time of high international mobility across the globe, further studies on this aspect could provide a significant contribution to inform how cultural values contribute to well-being and healing for people living with dementia.

The outcomes of preliminary studies in the study of outdoor natural landscape design and health to date suggest that outdoor natural interventions can lead to improved outcomes in people with dementia, specifically some BPSD including agitation and apathy and also engagement in people with dementia. However, with a limited body of literature, it is difficult to reach a definite conclusion. More rigorous studies with precise outdoor natural landscape designs are needed to investigate the impact of an outdoor natural landscape that is aligned with the characteristics of a DFE on agitation, apathy and engagement of people with dementia in LTC. Importantly, the voice of people with dementia could be a factor to consider during the design of outdoor natural landscapes. To date, this is a factor that has been widely disregarded in the literature. The needs and expectations of people with dementia living in LTC facilities could be sought in future research in order to have a better understanding of their preferences for outdoor natural landscape design.

From the perspective of outdoor natural landscape design, research on the outdoor natural landscape has provided insufficient layouts and architectural plans. This could be further developed not only to validate the entirety of the methodology but also to create a body of best-practices. Although several studies have attempted to address some characteristics of a DFE in an outdoor natural landscape design such as the inclusion of meaningful activities (i.e. gardening), or sensory stimulation, other aspects of a DFE such as safety and accessibility seem not to have been considered in the design. This limits the efficacy of the landscape for people with dementia in LTC facilities. Therefore, further research is needed for which the eight mentioned characteristics of DFE could be systematically applied, and their effectiveness evaluated. The Living Garden at the Family Life Center in Michigan is one case example of a successfully designed outdoor natural landscape for people with dementia (Marcus and Sachs, 2014), where specific measures have been taken for providing each of these characteristics. The approach used in designing the outdoor natural landscape in the Life Center could be used as a guideline for future researchers.

Additionally, this review highlights the need for the development of a comprehensive protocol of outdoor natural landscape interventions that include detailed information of the applied methodology, including follow-up and environmental assessment phases as well as the architectural design. Furthermore, if future studies would integrate both qualitative and quantitative approaches, this would address the limitations of a single method and gain more credibility for the approach (Agency for Healthcare Research and Quality, 2013).

Finally, several limitations should be considered when examining the outcomes of this review. First, indoor natural landscapes were excluded in the review since several studies have focused on this area previously (Lee and Kim, 2008; Tse, 2010). Future reviews could consider examining indoor horticultural activities (i.e. indoor gardening), which would lead to an in-depth understanding of the effects of indoor natural interventions. Secondly, the methodological diversity of the included studies, as well as the descriptive approaches of some studies, prohibited the use of a systematic or meta-analytic approach to undertaking quantitative evaluations of the effectiveness of outdoor natural landscapes during the review process. Last but not least, as indicated earlier, the search was limited to studies written in English, and as a result, some relevant articles published in other languages may have been eliminated from the search.

## 5. Conclusion

This narrative review investigated the effect of outdoor natural landscape aligned with the characteristics of a DFE on agitation, apathy and engagement of people with dementia in LTC facilities. Although social scientists and health geographers have increasingly studied the relationship between the outdoor natural landscape, health and the healing process currently there is inadequate evidence to support the use of the outdoor natural landscape for people with dementia living in LTC.

However, a significant body of research showed the therapeutic potential of outdoor natural landscapes on the health and wellbeing of individuals. Along with these studies, the poor environmental and institutional-like conditions of LTC facilities, which cannot fulfill the needs of people with dementia, have focused attention on transforming environments to more livable places. These transformations could be facilitated by the creation of DFEs encompassing both indoor and outdoor spaces. DFE characteristics could be applied in the design of outdoor natural landscapes in order to not only make a more livable and comfortable environment for people with dementia but also to utilize the therapeutic potential of the outdoor natural landscapes.

However, due to the complexity of the outdoor natural landscape concept and its value in the health care system, especially for those with dementia living in LTC facilities, more interdisciplinary studies are needed to address the existing studies' limitations. Studies to date appear to have overlooked the role of architectural design which creates places or outdoor natural landscapes. An in-depth understanding of the characteristics of DFEs in the design of outdoor natural landscapes can help researchers and designers to design more effectively for users such as people with dementia.

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None.

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