

1 **Highlights**

- 2 • A narrative review of the effects of an outdoor natural landscape in long-term care on
3 symptoms of dementia.
- 4 • There was a limited use of dementia-friendly environments' characteristics in the
5 design of outdoor natural landscapes.
- 6 • Inconclusive evidence was found for the benefits of outdoor natural landscape on
7 dementia symptoms.
- 8 • Further rigorous research is required to examine the impact of outdoor natural
9 landscape on dementia in long-term care.

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

3 **Abstract**

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

18 **Keywords:** Outdoor natural landscapes; long-term care facilities; dementia-friendly
19 environment; narrative literature review.

1 1. INTRODUCTION

2 The concept of landscape has evolved from being just a scenery to a multifaceted one
3 which represents an area or setting characterized by the interaction between nature and
4 human beings (European Landscape Convention, 2000). From a health perspective, there is a
5 long-held traditional belief originating from religion that landscape serves as a healer or
6 therapy for its users (Gesler, 1992; Marcus and Sachs, 2014; Streep, 2003). A number of
7 ancient cultures, including the Greeks, considered landscape as a holy element with curative
8 power, utilizing it spiritually in both their cleansing rituals and constructions (Gesler, 1992).
9 More recent studies on landscape have demonstrated the benefit of its various components
10 including green and blue spaces for the physical (Mackay and Neill, 2010; Mytton et al.,
11 2012), social (Alaimo et al., 2010; Finlay et al., 2015; Gorman, 2017; Kuo, 2010; Mokos,
12 2017; Nutsford et al., 2016) and psychological well-being (Barton and Pretty, 2010; Van
13 Herzele and de Vries, 2011; White et al., 2010) of individuals, especially for older adults
14 (Astell-Burt et al., 2013; Finlay et al., 2015; Sulander et al., 2016). Today, some specific
15 landscapes, such as outdoor natural spaces are considered essential to human well-being,
16 having some therapeutic effects that address the physical, psychological and social needs of
17 people to promote health and well-being (Abraham et al., 2010).

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

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

11 The emphasis on the significance of place (e.g. built environment) has driven
12 researchers to evolve the concept to consider and examine therapeutic effects of a wide range
13 of sites such as home environments (Nagib and Williams, 2018; Williams, 2002), hospitals
14 (Curtis et al., 2007; Jencks, 2010b; Marcus and Sachs, 2014), green milieus (parks, gardens,
15 etc.) (Barton and Pretty, 2010; Finlay et al., 2015; Sharma-brymer et al., 2015) and blue
16 spaces (sea, rivers, lakes) (Dempsey et al., 2018; Finlay et al., 2015; Foley and Kistemann,
17 2015; Nutsford et al., 2016; Volker and Kistemann, 2011; White et al., 2010). For instance,
18 there is an association between the higher level of exposure to sea views and a lower level of
19 depression in older adults (Dempsey et al., 2018).

20 Bell et al. (2018) further investigated the changes in the therapeutic landscape concept
21 and showed that the continuing evolution of the term creates ambiguities. Hence, they
22 propose hierarchization within the concept to address this, while keeping the four original
23 dimensions proposed by Gesler (1993); material, social, spiritual and symbolic. An outdoor
24 natural landscape incorporating green and blue components is regarded as a specific subset of

1 therapeutic landscapes that embodies the therapeutic potential to promote health and well-
2 being. Hence, this categorization of an outdoor natural landscape is used for this review.

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

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

1 In recent years, there is a trend towards improving the quality of LTC environments
2 with the creation of dementia-friendly environments (DFEs) (Davis et al., 2009). According
3 to Davis et al. (2009: 187), a DFE “is a cohesive system of support that recognizes the
4 experiences of the person with dementia and best provide assistance for the person to remain
5 engaged in everyday life in a meaningful way”. It is a way to create a therapeutic
6 environment that contributes to the comfort and independence of residents aiming to take the
7 environmental requirements of those with dementia into consideration (Alzheimer’s
8 Australia, 2004).

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

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

1 various components of natural landscape while participating in horticulture activities
2 (Graham-Cochrane, 2010).

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

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

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
Orientation	<p>Utilizing appropriate pictorial signage and visual cues</p> <p>Utilizing appropriate structures including gazebos, arbors, water features, furnishings and vegetation as major or minor landmarks in the outdoor natural landscape</p> <p>Utilizing marked entrance and exit areas in the outdoor natural landscape</p> <p>Utilizing looped walkways that return to the starting point</p> <p>Locating the therapeutic landscape in a way that people with dementia can easily see and identify the outdoor natural landscape</p>
Accessibility	<p>Having visual access to the outdoor natural landscape</p> <p>Having unrestricted physical access to the outdoor natural landscape</p> <p>Taking advantage of wide walkways where people in wheelchairs can also pass easily</p> <p>Implementation of handrails and durable furniture at regular intervals</p> <p>Providing several garden beds of different heights for the ease of access</p> <p>Making the outdoor natural landscape accessible all year long by providing sunrooms or indoor gardening activities</p> <p>Supplying the outdoor natural landscape with specific tools requiring slight strength for the use of people with dementia</p> <p>Providing enough shade spaces for summer and warm places for winter in the outdoor natural landscape</p>
Socialization	<p>Providing meaningful activities or interactive elements in the outdoor natural landscape that bring people together, such as herb gardens, sheds, etc.</p> <p>Providing suitable furnishings for increasing social interaction</p> <p>Providing enough places as quiet refuges for residents' privacy as well as activity areas for groups</p>

	<p>Providing a place for people with dementia to interact with others including a place for family visits and celebrations</p>
<p>Meaningful activities (meaningful engagement)</p>	<p>Providing some meaningful activities ranging from household chores to gardening for people with dementia</p> <p>Doing horticulture/gardening activity programs such as attending to herb garden tasks which also encourages food production activity</p> <p>Providing some elements that create social interaction in people with dementia such as a herb garden and a birdfeeder</p> <p>Designing safe walkways which encourage people with dementia to walk and take exercise as meaningful activities</p>
<p>Reminiscence</p>	<p>Utilizing various memory evoking elements of a therapeutic landscape including plants, gardening equipment, bird baths, old cars</p> <p>Utilizing familiar plants, materials or elements compatible with the culture of people with dementia</p>
<p>Sensory Stimulations</p>	<p>Providing an adequate amount of sensory stimulation by utilizing different sensory- provoking elements in a therapeutic landscape such as color, sound, texture and scent</p> <p>Designing the outdoor natural landscape in a way to stimulate the five senses</p> <p>Installing flower or plant beds of various heights for ease of touching, smelling and viewing</p> <p>Integrating nature- attracting plants in the outdoor natural landscape to attract singing birds and butterflies</p> <p>Integrating the outdoor natural landscape with appropriate lighting for the night use</p> <p>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</p>
<p>Safety</p>	<p>Creating a fenced outdoor natural landscape disguised with plants to make the fence less obvious</p> <p>Planting trees at a suitable distance from the outdoor natural landscape fence to prevent people with dementia from climbing</p> <p>Utilizing non-glare and gently sloped walkways with appropriate textures and contrasting colors on the edge of pathways</p>

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

Utilizing low maintenance plants

Utilizing native plants compatible with the conditions of each region

Removing weeds and composting plant beds

Sustainability

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

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

4 **2. METHODS**

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

13 **2.1 Search strategy**

14 A comprehensive literature search from 2007 to 2017 in peer-reviewed journals was
15 carried out through the following databases: Scopus, ProQuest, Web of Science, Science
16 Direct, Embase, CINAHL plus with full text, MEDLINE, PubMed, and Google Scholar.
17 Additional studies were also found through manual reference checking. The search terms
18 applied in the databases included four diverse groups of terms: 1: “landscape” OR “green
19 space*” OR “healing garden” OR “wander* garden” OR “therapeutic garden” OR
20 “therapeutic landscape*” OR horticulture OR “green care” OR “dementia-friendly garden*”
21 OR “sensory garden*” OR “Ecotherapy” OR “blue space*” OR “therapeutic sound*” OR
22 “natural sound*” OR “bird sound*” OR “water sound*” OR “natural stimulation” OR
23 “Col?r” OR “smell*”. AND 2. “Dementia” OR “Alzheimer” OR “cognitive impairment*”

1 AND 3. “Nursing home*” OR “care facilit*” OR “aged care facilit*” OR “residential aged
2 care facilit*”. AND 4. Apath* OR passivity OR Agitation OR “Agitated behavior*” OR
3 “Engagement” OR “Social interaction”.

4 **2.2 Eligibility**

5 This narrative review included studies that reviewed the effects of any type of outdoor
6 natural landscape interventions (e.g. therapeutic gardens, green care farming, ecotherapy and
7 therapeutic horticulture) on agitation, apathy and engagement of people with dementia (aged
8 65 years and over) in LTC facilities. Studies that reported a comparison between the effects
9 of outdoor natural interventions and indoor spaces that included either a multisensory room
10 (MSR) or an indoor activity program for older people with dementia were included. Peer-
11 reviewed studies reporting qualitative, quantitative or mixed-method studies written in
12 English and published from 2007 to 2017 were included.

13 **2.3 Included studies**

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

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

- 1 1. Involved populations without dementia including healthy older adults or older adults with
2 other disorders.
 - 3 2. Reported the effect of other environment-based interventions including multisensory
4 rooms (MSRs) and special care units (SCUs) with a focus on interior design rather than
5 an outdoor environment.
 - 6 3. Involved settings other than LTC facilities such as a daily horticultural activities program
7 in the park.
 - 8 4. Examined other outcomes: 1. medications, 2. falls, and 3. cognitive functioning, 4. stress
9 and 5. staff satisfaction.
 - 10 5. Reported the effects of indoor gardening on agitation, apathy or engagement for older
11 people with dementia rather than the review focus on outdoor natural landscapes in LTC
12 facilities.
 - 13 6. Involved multiple interventions in combination with an outdoor natural landscape
14 intervention and therefore it was difficult to distinguish between the effects of each
15 intervention.
 - 16 7. Provided insufficient research information (e.g. editorial and opinions).
 - 17 8. Non-English studies were excluded.
- 18 A further four studies identified through manual reference checking were included, resulting
19 in a total of 15 studies being included in this narrative review (Fig. 1)

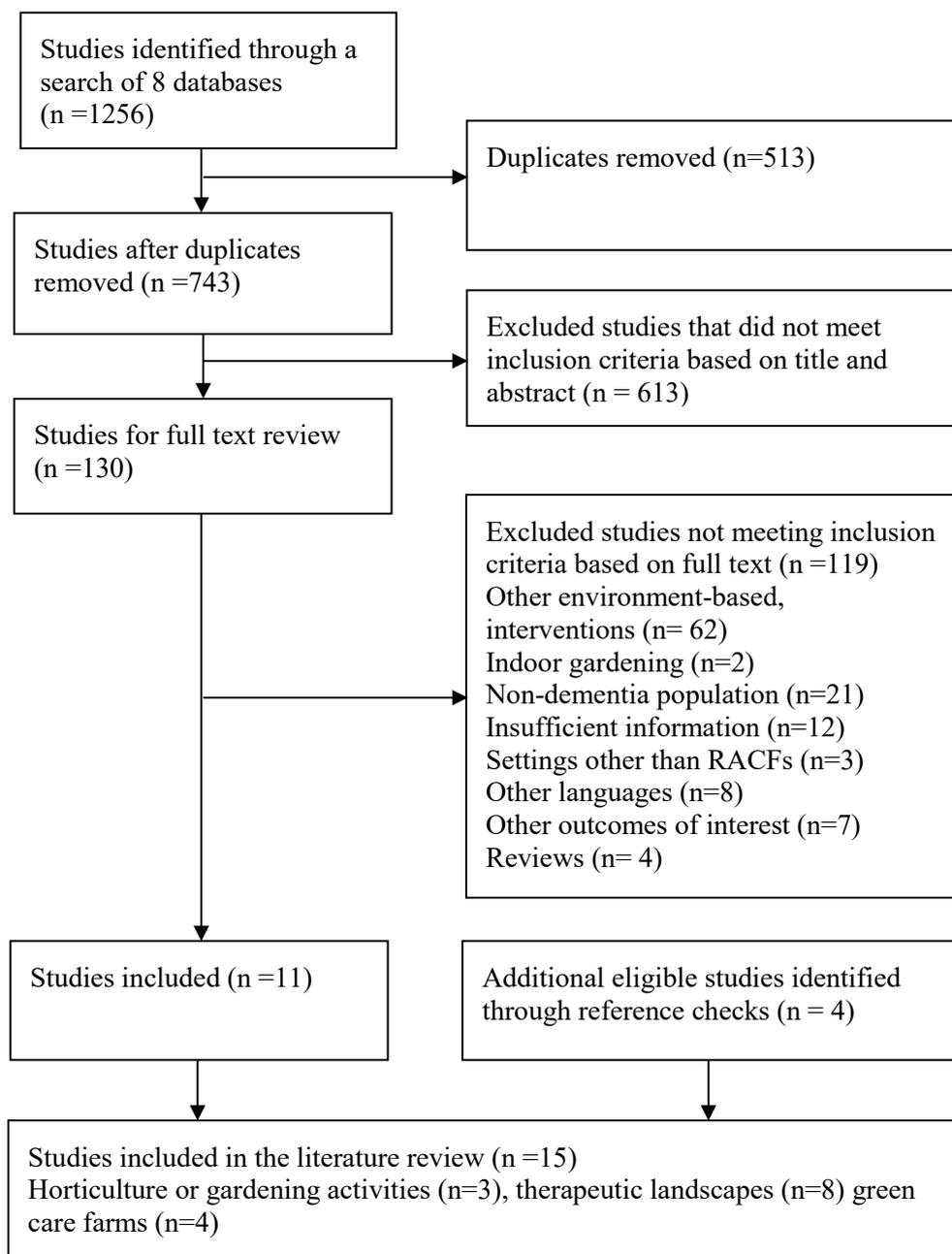


Fig.1. The Literature review flow diagram

1 2.4 Quality assessment

2 The quality assessment of included articles was guided by the Pluye et al. (2011)

3 Mixed Methods Appraisal Tool (MMAT) and was carried out by three members of the

1 research team (PM, WM & CJ) independently. Disagreement among assessors was solved
2 through discussion. Each article was examined for its methodological quality according to the
3 type of study, including qualitative, quantitative (RCT), quantitative (non-RCT), quantitative
4 (descriptive) and mixed-method studies, by answering two general screening questions.
5 These questions aimed to evaluate the clarity and appropriateness of the study design and
6 data collection procedures to address the research questions. In addition, several questions
7 exclusive to individual types of study were posed.

8 The possible responses were Yes, No or Cannot tell. Having answered the question,
9 the scores were presented by using four different symbols: *, **, *** and ****. To score both
10 the qualitative and quantitative studies, the number of (Yes) responses indicating meeting of
11 the criteria are counted. That is, when one response was yes (i.e. one criterion was met) the
12 study was given * (25%) score. Two, three and four (Yes) response were given ** (50%),
13 *** (75%) and **** (100%) respectively. For mixed-method studies, both qualitative and
14 quantitative components of the study were assessed. The overall quality score of these mixed-
15 method studies equals the lowest score of the study component (i.e. qualitative or
16 quantitative). For example, if just one criterion was met by the qualitative component of the
17 study (i.e. one (Yes) response) and two criteria were met by the quantitative component of
18 the study, the overall quality score of the mixed method study was *(25%) (Pluye et al.,
19 2011) (Table2).

Table 2. Quality Assessment of Studies

Methods	Articles	Screening Questions		Questions																Score ¹			
				1				2				3				4					5		
		1	2	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 (*)

	(Detweiler et al., 2008)	Y	Y							Y	N	Y	Ct				%50 (**)	
	(Bruin et al., 2009)	Y	Y							N	Ct	N	Ct				%25 (*)	
Quantitative (Descriptive)	(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 (*)	
	(Rappe and Topo, 2007)	Y	Y	Y	Ct	Y	Ct			Ct	Y	Y	Ct	Y	N	N	%50 (**)	
Mixed- method	(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).

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

Table 3. Outdoor natural landscape literature

Study/Region	Purpose	Study design	Study participants	Intervention dose	Assessment tools	Findings	DFE characteristics	Site analysis/ Architectural plan
(Calkins 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 mins per day*7 days per week*one week=3.5 hrs.	1. Sleep (a) Actilume-L (b) Pittsburg 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	Randomized controlled trial	Residents in nursing homes (n = 20), 1 female, 19 males Mean MMSE score = 15.3 ± (8.4)	Horticultural activities 60 mins per day*5 days per week* 10 days=10 hrs.	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	Provision of meaningful activities including horticulture/gardening activities	No

	program on sleep and behavior		Mean age= 79.7 ± (8.3)				in verbal agitation in the outdoor activity group
(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	Pre-test/post-test design Observation of residents 12 months before and	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)	The use of medications was reduced after the wander garden was opened; however, verbal agitation did not change considerably. Staff and	The therapeutic landscape is incompatible with criteria of safety and accessibility.

	agitated behaviors	after opening the garden			(b) Incidents reports from staff (c) Inappropriate behavior reported from relatives (d) needed medications	the relatives believed that the garden resulted in less agitation and improvements in mood and quality of life.	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 re-search 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 AM–11:00 PM 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
(Bruin et al., 2009)/Europe	A comparison between activities undertaken in green care	A cross sectional study	Study 1: Green care farms: groups of an average of 10	Green care farms & regular daycare facility In study 1, the observations	1. Cognitive status: Mini-mental Status Exam (MMSE) 2. Observation through libitum	Activities of older people at green care farms were more frequent, occurred outdoors more often,	Provision of meaningful activities horticulture/gar	No

farms and regular daycare facilities	<p>older people per day</p> <p>Regular daycare facilities: groups of on average 9 older people per day</p> <p>Study 2: 30 individual older people at a green care farm</p> <p>25 individual older people with dementia attending daycare at a regular daycare facility with dementia</p> <p>Mean MMSE in study 1: G:19.4, R:20.0 Mean MMSE in study 2: G:19.0, R:18.2</p> <p>Total number of males in study 2: 32</p>	<p>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.</p> <p>In study 2, observations were performed on either 1 or 2 weekdays per person</p>	<p>sampling to gain insight into the main activity (the activity with the longest duration) over every 15minutes</p> <p>3. An inventory was made for the location of activities</p>	<p>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</p>	dening activities
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		Total number of females in study							
		2: 23							
(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 hrs.	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)	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	

6 were men and
10 were women.

(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 hrs.	1. Cognitive impairment: Minimal Mental Status Exam (MMSE) 2. Coding of observed months post-intervention 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
(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	1. Cognitive impairment: Minimal 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

				week* 6 weeks= 6 hrs.				
(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	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	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	Provision of meaningful activities horticulture/gardening activities	No

	for people with dementia		<p>services at a GCF group (n = 12), or attended day services in a regular daycare facility RDCF (n = 17)</p> <p>People with dementia in the GCF and WL group were primarily males, with an average age of 71 and 76 years, respectively.</p> <p>People with dementia in the RDCF group were mostly females with an average age of 85 years.</p>		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.		
(Gonzalez and Kirkevold, 2015)/Europe	To ascertain the opinions of the leaders and staff regarding the benefits of sensory gardens (SGs)	A Cross-Sectional E-mail Survey	<p>121 leaders of nursing homes and 302 staff</p> <p>Leaders: 87 females, 13 males, staff: 95</p>	Sensory gardens (a kind of therapeutic landscape)	SGs facilitated taking residents outdoors, offered topics for communication and improved contact and	Provision of sensory stimulations by using different plants	No

	for the residents with dementia		females, 5 males			social privacy for relatives.		
(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 hrs. per session *7 sessions in 2-week period= 63 hrs. observation at baseline phase. 4.5hrs session* 6 times in 2 weeks = 54 hrs. 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	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
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Depression
(CSDD)

1 **3.1 Methodological approach**

2 Of the 15 studies included in this narrative review, several methods were used to
3 assess the influence of outdoor natural landscape on people with dementia. Three studies
4 adopted a mixed-method approach, while the remaining 12 studies exclusively utilized either
5 a qualitative or quantitative approach. Five studies used a descriptive study design (de Bruin
6 et al., 2015; Gonzalez and Kirkevold, 2015; Hernandez, 2007; Rappe and Topo, 2007; Raske,
7 2010), four were observational studies (Bruin et al., 2009; de Boer et al., 2017a; de Boer et
8 al., 2017b; Detweiler et al., 2008) and six studies were intervention studies (Anderson et al.,
9 2011; Calkins et al., 2007; Connell et al., 2007; Edwards et al., 2013; Jarrott and Gigliotti,
10 2010; Luk et al., 2011) of which three were randomized control trials (Connell et al., 2007;
11 Jarrott and Gigliotti, 2010; Luk et al., 2011) and three were quasi-experimental studies
12 (Anderson et al., 2011; Calkins et al., 2007; Edwards et al., 2013).

13 **3.2 Study region**

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

20 **3.3 Study participants**

21 The reviewed studies included a total number of 1179 participants (people with
22 dementia, staff and family members) of which their sample size varied between 10 (Edwards
23 et al., 2013) to 423 (Gonzalez and Kirkevold, 2015). The mean age of people with dementia

1 who participated in the studies ranged from 71 (de Bruin et al., 2015) to 89 years (Anderson
2 et al., 2011).

3 The number of female participants with dementia was higher than males, except in
4 three studies where the number of male participants was higher than females (Bruin et al.,
5 2009; de Bruin et al., 2015; Detweiler et al., 2008). In addition, the mean level of cognitive
6 impairment in participants varied in the studies between mild to a severe level of dementia.
7 The average Mini-Mental State Examination (MMSE) was between 5.7 (Anderson et al.,
8 2011) and 20 (de Bruin et al., 2015; Rappe and Topo, 2007). However, some studies did not
9 describe the precise level of cognitive impairment of participants (Detweiler et al., 2008;
10 Hernandez, 2007; Raske, 2010).

11 **3.4 Intervention studies**

12 Three types of outdoor natural landscape interventions were identified within the 15
13 reviewed studies. They were horticultural activities (Connell et al., 2007; Jarrott and Gigliotti,
14 2010; Luk et al., 2011), therapeutic gardens (Anderson et al., 2011; Calkins et al., 2007;
15 Detweiler et al., 2008; Edwards et al., 2013; Gonzalez and Kirkevold, 2015; Hernandez,
16 2007; Rappe and Topo, 2007; Raske, 2010) and green care farms (Bruin et al., 2009; de Boer
17 et al., 2017a; de Boer et al., 2017b; de Bruin et al., 2015). The efficacy of outdoor natural
18 landscape interventions on agitation, apathy and engagement of people with dementia was
19 generally reported in the studies mentioned above. However, sometimes detailed information
20 about the applied intervention protocol was missing, which could have been useful for
21 replication of the protocol in future studies. Jarrott and Gigliotti (2010) outlined a clear and
22 detailed intervention protocol, while most of the other studies briefly described the
23 intervention procedure.

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

11 **3.4.1 Horticulture activities**

12 The effectiveness of horticultural activities on the signs and symptoms of dementia
13 have been addressed in three studies using quantitative approaches (Connell et al., 2007;
14 Jarrott and Gigliotti, 2010; Luk et al., 2011). Two studies (Connell et al., 2007; Luk et al.,
15 2011) applied horticultural activities as a way to reduce agitation, while one study (Jarrott
16 and Gigliotti, 2010) used these activities to increase the level of engagement in people with
17 dementia. Luk et al. (2011) did not report any significant effect of horticultural activities on
18 reducing agitation, but the two others revealed that horticultural activities reduce verbal
19 agitation (Connell et al., 2007) and increase engagement of people with dementia (Jarrott and
20 Gigliotti, 2010). This increase in the level of engagement occurred either actively (i.e.
21 physically or verbally responding to the presented activity) or passively (i.e. observing and
22 listening to the presented activity). However, both studies did not include a follow-up phase
23 to determine the sustainability of the intervention's effect.

1 **3.4.2 Therapeutic gardens**

2 Therapeutic gardens as one type of an outdoor natural landscape consisting of green
3 and blue components have been examined in eight studies for the influence of therapeutic
4 gardens on the signs and symptoms of dementia (Anderson et al., 2011; Calkins et al., 2007;
5 Detweiler et al., 2008; Edwards et al., 2013; Gonzalez and Kirkevold, 2015; Hernandez,
6 2007; Rappe and Topo, 2007; Raske, 2010). Three of these studies reported positive effects
7 of therapeutic gardens on engagement and socialization of people with dementia (Hernandez,
8 2007; Rappe and Topo, 2007; Raske, 2010). These studies showed that therapeutic gardens
9 increase the level of participation in activities such as watering, planting and watching
10 flowers (Hernandez, 2007; Raske, 2010), or increased communication among people with
11 dementia (Rappe and Topo, 2007).

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

18 The next three studies (Calkins et al., 2007; Detweiler et al., 2008; Gonzalez and
19 Kirkevold, 2015) employed a quantitative approach to investigate the impact of therapeutic
20 gardens on people with dementia. Of these, two assessed the efficacy of therapeutic gardens
21 on the level of agitation and reported no significant impact (Calkins et al., 2007; Detweiler et
22 al., 2008). The third study showed that the therapeutic garden improves socialization and
23 communication of people with dementia (Gonzalez and Kirkevold, 2015). However, none of

1 these studies addresses objective outcome measures (i.e. results were based on web-based
2 surveys of nursing home leaders). Also, none of these studies undertook qualitative
3 interviews with people with dementia to seek their views on the effect of the therapeutic
4 garden.

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

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

17 **3.4.3 Green care farms**

18 The therapeutic impacts of green care farms as another type of designed outdoor
19 natural landscape on people with dementia have been evaluated in four studies, focusing on
20 either engagement (Bruin et al., 2009; de Boer et al., 2017a; de Bruin et al., 2015) or
21 neuropsychiatric symptoms such as agitation and apathy (de Boer et al., 2017b). Green care
22 farms were shown to have a positive influence on the level of socialization and engagement
23 of people with dementia, and no significant effect on the level of neuropsychiatric symptoms,

1 including agitation. However, the use of an observational study design could hinder the
2 determination of the cause and effect relationship to accurately show whether green care
3 farms leads to an improvement in behavioral signs and symptoms of dementia (Bruin et al.,
4 2009; de Boer et al., 2017a; de Boer et al., 2017b). Semi-structured interviews can also be
5 potentially biased when the selection of participants is undertaken by care professionals (de
6 Bruin et al., 2015).

7 **3.4.4 Intervention dose**

8 The average total intervention duration and frequency varied among the studies which
9 took place over weeks to months. That is, a total intervention dose in the studies was between
10 3.5 hours (Calkins et al., 2007) and 63 hours (de Boer et al., 2017a). The average total
11 intervention duration and frequency in the studies was approximately 20 hours.

12 **3.4.5 Assessment tools**

13 Among the assessment tools applied for measurement of agitation, five studies used
14 the Cohen-Mansfield Agitation Inventory (CMAI) (Calkins et al., 2007; Connell et al., 2007;
15 Detweiler et al., 2008; Edwards et al., 2013; Luk et al., 2011), while other studies used either
16 the Neuropsychiatric Inventory-Nursing Home Version (NPI-NH) (de Boer et al., 2017b) or
17 coded different behaviors through observation of participants (Anderson et al., 2011). The
18 single study that assessed apathy (de Boer et al., 2017b) used the Neuropsychiatric Inventory-
19 Nursing Home Version (NPI-NH).

20 Assessment tools used for the measurement of social engagement in people with
21 dementia varied in different studies. Two studies (Hernandez, 2007; Rappe and Topo, 2007)
22 observed participants' social engagement and activities through Dementia Care Mapping 7th
23 (DCM); one study (Jarrott and Gigliotti, 2010) through the Menorah Park Engagement Scale

1 and one (de Boer et al., 2017a) via The Maastricht Electronic Daily Life Observation tool
2 (MEDLO-tool). In two other studies, observers recorded participants' type and location of
3 activities including indoor and outdoor activities (Bruin et al., 2009), or coded different
4 activities undertaken by participants into the four levels of very engaged, engaged, neutral
5 and disengaged (Anderson et al., 2011). Other studies examined social engagement through a
6 survey (Gonzalez and Kirkevold, 2015), interviews (Raske, 2010), or focus groups (de Bruin
7 et al., 2015).

8 Additionally, the review shows that different studies have different ways of defining
9 engagement, thus making comparisons across studies difficult. Engagement was assessed via
10 the level of stimulation, for example, active or passive stimulation (Hernandez, 2007; Jarrott
11 and Gigliotti, 2010), the level of social interaction, for example, communication and
12 interaction between residents (Anderson et al., 2011; Raske, 2010; Gonzalez and Kirkevold,
13 2015), the level of financial incentive such as volunteer or paid work (de Bruin et al., 2015),
14 temporal commitment such as when residents visited or talked about the garden (Rappe and
15 Toppo, 2007), or type of activities ranging from drinking to outdoor related activities) (de
16 Boer et al. 2017a; Bruin et al. 2009).

17 **3.4.6 Outdoor natural landscape design**

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

1 ***a- Site analysis***

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

11 ***b- Environmental assessment phase***

12 Utilizing audit tools that are aligned with the characteristics of a DFE is another
13 complementary step in analyzing the site before the design of the environment, which creates
14 a useful framework for the assessment of the environment (Alzheimer's WA, 2018). Among
15 the 15 studies retrieved, almost half (n=8) specifically discussed the design of outdoor natural
16 landscapes for people with dementia (Anderson et al., 2011; Calkins et al., 2007; Detweiler et
17 al., 2008; Edwards et al., 2013; Gonzalez and Kirkevold, 2015; Hernandez, 2007; Rappe and
18 Topo, 2007; Raske, 2010), yet none of these studies included an environmental assessment
19 before the design. Such assessment is an essential phase in the outdoor natural landscape
20 design process, which helps designers understand the strengths and weakness of the
21 environment and users' needs before any design takes place (Chapman, 2015; Hansen and
22 Alvarez, 2016; Reardon, 2013).

1 ***c- Dementia-Friendly Environment Characteristics***

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

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

17 ***d- Outdoor natural landscape plan***

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

22 None of the 15 studies investigated included a detailed architectural plan of the
23 outdoor natural landscape as a guideline for future studies. Two out of 15 studies briefly

1 showed some layouts or architectural plans of the outdoor natural landscape in unspecified
2 scales (Edwards et al., 2013; Hernandez, 2007)

3 **4. DISCUSSION**

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

8 From a statistical point of view, when looking at the dates of publication, articles from
9 the USA form one early group while the most recent articles are from either Europe or
10 Australia. Most of the articles are from western countries including those in Europe. This
11 could be explained by the language criterion being restricted to English during the review
12 process, thus automatically eliminating articles in any other languages, but these results could
13 also be associated with the evidence that Europe has a long tradition in the history of
14 therapeutic landscape design (Gesler, 2003; Jencks, 2010a). For example, Epidaurus in
15 Greece (Gesler, 1993), Lourdes in France (Gesler, 1996) and Bath in England (Kearns and
16 Gesler, 1998) were among the first traditional sites with a reputation for healing using
17 therapeutic landscapes. St Thomas's hospital in London, the Lariboisiere hospital in Paris and
18 the Royal Navy Hospital at Plymouth, England, were among the first contemporary examples
19 of the incorporation of landscape within indoor spaces for therapeutic purposes. For example,
20 an outdoor natural landscape was incorporated within the hospital environment as a central
21 courtyard, and patients were able to see the landscape through the windows (Marcus and
22 Sachs, 2014). This also raises the question of whether culture is an influencing factor when
23 exploring this topic, a concept first mentioned by Gesler (1992). For example, has the

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

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

19 From the perspective of outdoor natural landscape design, research on the outdoor
20 natural landscape has provided insufficient layouts and architectural plans. This could be
21 further developed not only to validate the entirety of the methodology but also to create a
22 body of best-practices. Although several studies have attempted to address some
23 characteristics of a DFE in an outdoor natural landscape design such as the inclusion of
24 meaningful activities (i.e. gardening), or sensory stimulation, other aspects of a DFE such as

1 safety and accessibility seem not to have been considered in the design. This limits the
2 efficacy of the landscape for people with dementia in LTC facilities. Therefore, further
3 research is needed for which the eight mentioned characteristics of DFE could be
4 systematically applied, and their effectiveness evaluated. The Living Garden at the Family
5 Life Center in Michigan is one case example of a successfully designed outdoor natural
6 landscape for people with dementia (Marcus and Sachs, 2014), where specific measures have
7 been taken for providing each of these characteristics. The approach used in designing the
8 outdoor natural landscape in the Life Center could be used as a guideline for future
9 researchers.

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

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

1 English, and as a result, some relevant articles published in other languages may have been
2 eliminated from the search.

3 **5. CONCLUSION**

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

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

19 However, due to the complexity of the outdoor natural landscape concept and its
20 value in the health care system, especially for those with dementia living in LTC facilities,
21 more interdisciplinary studies are needed to address the existing studies' limitations. Studies
22 to date appear to have overlooked the role of architectural design which creates places or
23 outdoor natural landscapes. An in-depth understanding of the characteristics of DFEs in the

1 design of outdoor natural landscapes can help researchers and designers to design more
2 effectively for users such as people with dementia.

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1 **References**

- 2 Abraham, A., Sommerhalder, K., Abel, T., 2010. Landscape and well-being: a scoping study
3 on the health-promoting impact of outdoor environments. *Int J Public Health* 55, 59-69
4 doi:10.1007/s00038-009-0069-z.
- 5 Agency for Healthcare Research and Quality, 2013. Mixed Methods: Integrating Quantitative
6 and Qualitative Data Collection and Analysis While Studying Patient-Centered Medical
7 Home Models. PCMH Research Methods,
8 https://pcmh.ahrq.gov/sites/default/files/attachments/MixedMethods_032513comp.pdf, 1-8,
9 (Accessed: 27 November 2017).
- 10 Alaimo, K., Reischl, T.M., Allen, J.O., 2010. Community Gardening, Neighborhood
11 Meetings, and Social Capital. *Journal of community psychology* 38, 497-514
12 doi:10.1002/jcop.20378.
- 13 Alzheimer's WA, 2018. Dementia enabling environments. Dementia Care Environment Audit
14 Tools & Services, <https://www.enablingenvironments.com.au/audit-tools--services.html>,
15 (Accessed: 9 April 2018).
- 16 Alzheimer's Australia, 2004. Dementia Care and the Built Environment.
17 https://www.fightdementia.org.au/files/20040600_Nat_NP_3DemCareBuiltEnv.pdf, 1-16,
18 (Accessed: 5 August 2017).
- 19 Anderson, K., Bird, M., Macpherson, S., McDonough, V., Davis, T., 2011. Findings from a
20 pilot investigation of the effectiveness of a snoezelen room in residential care: should we be
21 engaging with our residents more? *Geriatr Nurs* 32, 166-177
22 doi:10.1016/j.gerinurse.2010.12.011.

1 Andrews, G.J., 2002. Towards a more place-sensitive nursing research: an invitation to
2 medical and health geography. *Nursing Inquiry* 9, 221-238 doi:10.1046/j.1440-
3 1800.2002.00157.x.

4 Astell-Burt, T., Feng, X., Kolt, G.S., 2013. Mental health benefits of neighbourhood green
5 space are stronger among physically active adults in middle-to-older age: Evidence from
6 260,061 Australians. *Preventive Medicine* 57, 601-606
7 doi:<https://doi.org/10.1016/j.ypmed.2013.08.017>.

8 Baker, J.D., 2016. The Purpose, Process, and Methods of Writing a Literature Review.
9 *AORN Journal* 103, 265-269 doi:10.1016/j.aorn.2016.01.016.

10 Barton, J., Pretty, J., 2010. What is the Best Dose of Nature and Green Exercise for
11 Improving Mental Health? A Multi-Study Analysis. *Environmental Science & Technology*
12 44, 3947-3955 doi:10.1021/es903183r.

13 Bell, S.L., Foley, R., Houghton, F., Maddrell, A., Williams, A.M., 2018. From therapeutic
14 landscapes to healthy spaces, places and practices: A scoping review. *Social Science &
15 Medicine* 196, 123-130 doi:<https://doi.org/10.1016/j.socscimed.2017.11.035>.

16 Brisbane City Council, 2014. Green gardening guide.
17 https://www.brisbane.qld.gov.au/sites/default/files/20141111_-_green_gardening_guide.pdf,
18 1-68, (Accessed: 3 March 2018).

19 Bruin, S.R.D., Oosting, S.J., Kuin, Y., Hoefnagels, E.C.M., Blauw, Y.H., Groot,
20 L.C.P.G.M.D., Schols, J.M.G.A., 2009. Green Care Farms Promote Activity Among Elderly
21 People With Dementia. *Journal of Housing for the Elderly* 23, 368-389
22 doi:10.1080/02763890903327275.

1 Calkins, M., Szmerekovsky, J.G., Biddle, S., 2007. Effect of Increased Time Spent Outdoors
2 on Individuals with Dementia Residing in Nursing Homes. *Journal of Housing for the Elderly*
3 21, 211-228 doi:10.1300/J081v21n03_11.

4 Chapman, G.H.d., 2015. Landscape Design: Ten Important Things to Consider. ENH1112,
5 http://edis.ifas.ufl.edu/ep375#FOOTNOTE_2, (Accessed: 16 August 2018).

6 Charles Sturt University, 2019. Literature Review: Traditional or narrative literature reviews.
7 <https://libguides.csu.edu.au/c.php?g=476545&p=3997199>, (Accessed: 13 March 2019).

8 Cohen-Mansfield, J., Dakheel-Ali, M., Marx, M.S., Thein, K., Regier, N.G., 2015. Which
9 unmet needs contribute to behavior problems in persons with advanced dementia? *Psychiatry*
10 Res 228, 59-64 doi:10.1016/j.psychres.2015.03.043.

11 Collins, J.A., Fauser, B.C., 2005. Balancing the strengths of systematic and narrative reviews.
12 *Hum Reprod Update* 11, 103-104 doi:10.1093/humupd/dmh058.

13 Connell, B.R., Sanford, J.A., Lewis, D., 2007. Therapeutic Effects of an Outdoor Activity
14 Program on Nursing Home Residents with Dementia. *Journal of Housing for the Elderly* 21,
15 194-209 doi:10.1300/J081v21n03_10.

16 Conradson, D., 2005. Landscape, care and the relational self: Therapeutic encounters in rural
17 England. *Health & Place* 11, 337-348 doi:<https://doi.org/10.1016/j.healthplace.2005.02.004>.

18 Curtis, S., Gesler, W., Fabian, K., Francis, S., Priebe, S., 2007. Therapeutic Landscapes in
19 Hospital Design: A Qualitative Assessment by Staff and Service Users of the Design of a
20 New Mental Health Inpatient Unit. *Environment and Planning C: Government and Policy* 25,
21 591-610 doi:10.1068/c1312r.

1 Davis, S., Byers, S., Nay, R., Koch, S., 2009. Guiding design of dementia friendly
2 environments in residential care settings: Considering the living experiences. *Dementia* 8,
3 185-203 doi:10.1177/1471301209103250.

4 de Boer, B., Hamers, J.P., Zwakhalen, S.M., Tan, F.E., Beerens, H.C., Verbeek, H., 2017a.
5 Green Care Farms as Innovative Nursing Homes, Promoting Activities and Social Interaction
6 for People With Dementia. *J Am Med Dir Assoc* 18, 40-46 doi:10.1016/j.jamda.2016.10.013.

7 de Boer, B., Hamers, J.P.H., Zwakhalen, S.M.G., Tan, F.E.S., Verbeek, H., 2017b. Quality of
8 care and quality of life of people with dementia living at green care farms: a cross-sectional
9 study. *BMC Geriatr* 17, 155 doi:10.1186/s12877-017-0550-0.

10 de Bruin, S.R., Stoop, A., Molema, C.C., Vaandrager, L., Hop, P.J., Baan, C.A., 2015. Green
11 Care Farms: An Innovative Type of Adult Day Service to Stimulate Social Participation of
12 People With Dementia. *Gerontol Geriatr Med* 1, 2333721415607833
13 doi:10.1177/2333721415607833.

14 Dempsey, S., Devine, M.T., Gillespie, T., Lyons, S., Nolan, A., 2018. Coastal blue space and
15 depression in older adults. *Health & Place* 54, 110-117
16 doi:<https://doi.org/10.1016/j.healthplace.2018.09.002>.

17 Detweiler, M.B., Murphy, P.F., Myers, L.C., Kim, K.Y., 2008. Does a wander garden
18 influence inappropriate behaviors in dementia residents? *Am J Alzheimers Dis Other Demen*
19 23, 31-45 doi:10.1177/1533317507309799.

20 Edwards, C.A., McDonnell, C., Merl, H., 2013. An evaluation of a therapeutic garden's
21 influence on the quality of life of aged care residents with dementia. *Dementia (London)* 12,
22 494-510 doi:10.1177/1471301211435188.

1 European Landscape Convention, 2000. European Landscape Convention *. European Treaty
2 Series, Florence, p. 2.

3 Finlay, J., Franke, T., McKay, H., Sims-Gould, J., 2015. Therapeutic landscapes and
4 wellbeing in later life: Impacts of blue and green spaces for older adults. *Health Place* 34, 97-
5 106 doi:10.1016/j.healthplace.2015.05.001.

6 Finlay, J.M., 2018. 'Walk like a penguin': Older Minnesotans' experiences of (non)therapeutic
7 white space. *Soc Sci Med* 198, 77-84 doi:10.1016/j.socscimed.2017.12.024.

8 Foley, R., Kistemann, T., 2015. Blue space geographies: Enabling health in place. *Health &*
9 *Place* 35, 157-165 doi:<https://doi.org/10.1016/j.healthplace.2015.07.003>.

10 Gesler, W., 1996. Lourdes: healing in a place of pilgrimage. *Health & Place* 2, 95-105
11 doi:[https://doi.org/10.1016/1353-8292\(96\)00004-4](https://doi.org/10.1016/1353-8292(96)00004-4).

12 Gesler, W.M., 1992. Therapeutic landscapes: medical issues in light of the new cultural
13 geography. *Soc Sci Med* 34, 735-746 doi:[https://doi.org/10.1016/0277-9536\(92\)90360-3](https://doi.org/10.1016/0277-9536(92)90360-3).

14 Gesler, W.M., 1993. Therapeutic Landscapes: Theory and a Case Study of Epidauros,
15 Greece. *Environment and Planning D: Society and Space* 11, 171-189 doi:10.1068/d110171.

16 Gesler, W.M., 2003. *Healing places*. Rowman & Littlefield Publishers.

17 Gonzalez, M.T., Kirkevold, M., 2015. Clinical use of sensory gardens and outdoor
18 environments in norwegian nursing homes: a cross-sectional e-mail survey. *Issues Ment*
19 *Health Nurs* 36, 35-43 doi:10.3109/01612840.2014.932872.

20 Gorman, R., 2017. Smelling therapeutic landscapes: Embodied encounters within spaces of
21 care farming. *Health & Place* 47, 22-28 doi:<https://doi.org/10.1016/j.healthplace.2017.06.005>.

1 Graham-Cochrane, T., 2010. Gardens that Care: Planning Outdoor Environments for People
2 with Dementia.,
3 [http://www.enablingenvironments.com.au/uploads/5/0/4/5/50459523/gardens_that_care.plan](http://www.enablingenvironments.com.au/uploads/5/0/4/5/50459523/gardens_that_care_planning_outdoor_environments_for_people_with_dementia.pdf)
4 [ning_outdoor_environments_for_people_with_dementia.pdf](http://www.enablingenvironments.com.au/uploads/5/0/4/5/50459523/gardens_that_care_planning_outdoor_environments_for_people_with_dementia.pdf), 1-32, (Accessed: 27 September
5 2017).

6 Grant, M.J., Booth, A., 2009. A typology of reviews: an analysis of 14 review types and
7 associated methodologies. *Health Info Libr J* 26, 91-108 doi:10.1111/j.1471-
8 1842.2009.00848.x.

9 Handley, M., Bunn, F., Goodman, C., 2017. Dementia-friendly interventions to improve the
10 care of people living with dementia admitted to hospitals: a realist review. *BMJ Open* 7,
11 e015257 doi:10.1136/bmjopen-2016-015257.

12 Hansen, G., Alvarez, E., 2016. Landscape Design: Analyzing Site Conditions. ENH1165,
13 <http://edis.ifas.ufl.edu/ep426>, (Accessed: 20 March 2018).

14 Health Building Notes, 2015. Dementia-friendly health and social care environments (HBN
15 08-02). DH health building notes and Dementia,
16 [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/416780/HBN](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/416780/HBN_08-02.pdf)
17 [08-02.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/416780/HBN_08-02.pdf), 1-179, (Accessed: 28 March 2018).

18 Hernandez, R.O., 2007. Effects of Therapeutic Gardens in Special Care Units for People with
19 Dementia. *Journal of Housing for the Elderly* 21, 117-152 doi:10.1300/J081v21n01_07.

20 Jarrott, S.E., Gigliotti, C.M., 2010. Comparing responses to horticultural-based and
21 traditional activities in dementia care programs. *Am J Alzheimers Dis Other Demen* 25, 657-
22 665 doi:10.1177/1533317510385810.

1 Jencks, C., 2010a. Architecture and Health, in: Heathcote, E. (Ed.), The architecture of hope:
2 Maggie's cancer caring centres. frances lincoln ltd, pp. 52-91.

3 Jencks, C., 2010b. The architecture of hope: Maggie's cancer caring centres. frances lincoln
4 ltd.

5 Kales, H.C., Gitlin, L.N., Lyketsos, C.G., 2015. Assessment and management of behavioral
6 and psychological symptoms of dementia. *BMJ : British Medical Journal* 350, h369
7 doi:10.1136/bmj.h369.

8 Kearns, R.A., Gesler, W.M., 1998. Putting health into place: landscape, identity, and well-
9 being, 1st ed. Syracuse University Press, Syracuse, N.Y.

10 Kuo, F.E., 2010. Parks and Other Green Environments: Essential Components of a Healthy
11 Human Habitat. *Australasian Parks and Leisure* 14, 1-48,
12 <http://www.cootestoescarpmentpark.ca/file/download/VAe0NMIKNnvClwSVi7135w>.

13 Lee, Y., Kim, S., 2008. Effects of indoor gardening on sleep, agitation, and cognition in
14 dementia patients--a pilot study. *Int J Geriatr Psychiatry* 23, 485-489 doi:10.1002/gps.1920.

15 Luk, K.Y., Lai, K.Y., Li, C.C., Cheung, W.H., Lam, S.M., Li, H.Y., Ng, K.P., Shiu, W.H.,
16 So, C.Y., Wan, S.F., 2011. The effect of horticultural activities on agitation in nursing home
17 residents with dementia. *Int J Geriatr Psychiatry* 26, 435-436 doi:10.1002/gps.2493.

18 Mackay, G.J., Neill, J.T., 2010. The effect of "green exercise" on state anxiety and the role of
19 exercise duration, intensity, and greenness: A quasi-experimental study. *Psychology of Sport
20 and Exercise* 11, 238-245 doi:10.1016/j.psychsport.2010.01.002.

21 Marcus, C.C., 2007. Garden of the Family Life Center, Grand Rapids, Michigan. *Journal of
22 Housing for the Elderly* 21, 285-304 doi:10.1300/J081v21n03_15.

1 Marcus, C.C., Sachs, N.A., 2014. Therapeutic Landscapes: An Evidence-Based Approach to
2 Designing Healing Gardens and Restorative Outdoor Spaces, 1 ed. John Wiley & Sons Inc,
3 US.

4 Marin, R.S., 1990. Differential diagnosis and classification of apathy. *Am J Psychiatry* 147,
5 22-30 doi:10.1176/ajp.147.1.22.

6 McLean, A., 2007. The therapeutic landscape of dementia care: Contours of intersubjective
7 spaces for sustaining the person. *Therapeutic landscapes*, 315-332.

8 Mokos, J.T., 2017. Stigmatized places as therapeutic landscapes. *medicine antropology*
9 *theory* doi.org/10.17157/mat.4.1.362 doi:doi.org/10.17157/mat.4.1.362.

10 Mytton, O.T., Townsend, N., Rutter, H., Foster, C., 2012. Green space and physical activity:
11 An observational study using Health Survey for England data. *Health & Place* 18, 1034-1041
12 doi:<https://doi.org/10.1016/j.healthplace.2012.06.003>.

13 Nagib, W., Williams, A., 2018. Creating “therapeutic landscapes” at home: The experiences
14 of families of children with autism. *Health & Place* 52, 46-54
15 doi:<https://doi.org/10.1016/j.healthplace.2018.05.001>.

16 Nutsford, D., Pearson, A.L., Kingham, S., Reitsma, F., 2016. Residential exposure to visible
17 blue space (but not green space) associated with lower psychological distress in a capital city.
18 *Health & Place* 39, 70-78 doi:<https://doi.org/10.1016/j.healthplace.2016.03.002>.

19 Pluye, P., Robert, E., Cargo, M., Bartlett, G., O’Cathain, A., Griffiths, F., Boardman, F.,
20 Gagnon, M.P., Rousseau, M.C., 2011. Proposal: A mixed methods appraisal tool for
21 systematic mixed studies reviews., <http://mixedmethodsappraisaltoolpublic.pbworks.com>.,
22 (Accessed: 20 September 2017).

1 Rabinowitz, J., Davidson, M., De Deyn, P.P., Katz, I., Brodaty, H., Cohen-Mansfield, J.,
2 2005. Factor analysis of the Cohen-Mansfield Agitation Inventory in three large samples of
3 nursing home patients with dementia and behavioral disturbance. *Am J Geriatr Psychiatry* 13,
4 991-998 doi:10.1176/appi.ajgp.13.11.991.

5 Rappe, E., Topo, P., 2007. Contact with outdoor greenery can support competence among
6 people with dementia. *Journal of Housing for the Elderly* 21, 229-248,
7 [http://libraryproxy.griffith.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=tr](http://libraryproxy.griffith.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=105908436&site=ehost-live&scope=site)
8 [ue&db=rzh&AN=105908436&site=ehost-live&scope=site.](http://libraryproxy.griffith.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=105908436&site=ehost-live&scope=site)

9 Raske, M., 2010. Nursing home quality of life: study of an enabling garden. *J Gerontol Soc*
10 *Work* 53, 336-351 doi:10.1080/01634371003741482.

11 Reardon, C., 2013. The design process. [http://www.yourhome.gov.au/you-begin/design-](http://www.yourhome.gov.au/you-begin/design-process)
12 [process](http://www.yourhome.gov.au/you-begin/design-process), (Accessed: 10 May 2018).

13 Robert, P., Onyike, C.U., Leentjens, A.F., Dujardin, K., Aalten, P., Starkstein, S., Verhey,
14 F.R., Yessavage, J., Clement, J.P., Drapier, D., Bayle, F., Benoit, M., Boyer, P., Lorca, P.M.,
15 Thibaut, F., Gauthier, S., Grossberg, G., Vellas, B., Byrne, J., 2009. Proposed diagnostic
16 criteria for apathy in Alzheimer's disease and other neuropsychiatric disorders. *Eur*
17 *Psychiatry* 24, 98-104 doi:10.1016/j.eurpsy.2008.09.001.

18 Sharma-brymer, V., Brymer, e., Davids, k., 2015. The relationship between physical activity
19 in greenspace and human health and wellbeing: An ecological dynamics perspective. *Journal*
20 *of Physical Education Research* 2, 07-22.

21 Streep, P., 2003. *Spiritual gardening: Creating sacred space outdoors*. New World Library.

1 Sulander, T., Karvinen, E., Holopainen, M., 2016. Urban Green Space Visits and Mortality
2 Among Older Adults. *Epidemiology* 27, e34-e35 doi:10.1097/ede.0000000000000511.

3 Tse, M.M., 2010. Therapeutic effects of an indoor gardening programme for older people
4 living in nursing homes. *Journal of Clinical Nursing* 19, 949-958 doi:10.1111/j.1365-
5 2702.2009.02803.x.

6 Van Herzele, A., de Vries, S., 2011. Linking green space to health: a comparative study of
7 two urban neighbourhoods in Ghent, Belgium. *Population and Environment* 34, 171-193
8 doi:10.1007/s11111-011-0153-1.

9 Volker, S., Kistemann, T., 2011. The impact of blue space on human health and well-being -
10 Salutogenetic health effects of inland surface waters: a review. *Int J Hyg Environ Health* 214,
11 449-460 doi:10.1016/j.ijheh.2011.05.001.

12 Waller, S., 2012. Redesigning wards to support people with dementia in hospital. *Nurs Older*
13 *People* 24, 16, 18-21 doi:10.7748/nop2012.03.24.2.16.c8953.

14 Waller, S., Masterson, A., 2015. Designing dementia-friendly hospital environments. *Future*
15 *Hospital Journal* 2, 63-68.

16 White, M., Smith, A., Humphryes, K., Pahl, S., Snelling, D., Depledge, M., 2010. Blue space
17 The importance of water for preference, affect, and restorativeness ratings of natural and built
18 scenes. *Journal of Environmental Psychology* 30, 482-493 doi:10.1016/j.jenvp.2010.04.004.

19 Williams, A., 1998. Therapeutic landscapes in holistic medicine. *Social Science & Medicine*
20 46, 1193-1203 doi:[https://doi.org/10.1016/S0277-9536\(97\)10048-X](https://doi.org/10.1016/S0277-9536(97)10048-X).

- 1 Williams, A., 2002. Changing geographies of care: employing the concept of therapeutic
- 2 landscapes as a framework in examining home space. *Social Science & Medicine* 55, 141-
- 3 154 doi:[https://doi.org/10.1016/S0277-9536\(01\)00209-X](https://doi.org/10.1016/S0277-9536(01)00209-X).
- 4 World Health Organisation, 2007. *Global Age-friendly Cities: A Guide*.
- 5 http://www.who.int/ageing/publications/Global_age_friendly_cities_Guide_English.pdf, 9-
- 6 18, (Accessed: 5 October 2018).