

Scoping Review: Investigating the Connection Between Dementia and the Benefits of Nature

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Abstract

Background

There is evidently a great deal recognised about the benefits of nature. It is well-documented that spending two hours a week in nature is associated with good health and wellbeing.¹ Dementia Adventure wishes to understand this connection for people living with dementia (PLWD), following on from our last piece of research which was conducted in 2017. Thus, a scoping review has been conducted to identify and map the available research to answer the question: *“How does exposure to nature or nature-based interventions impact or benefit individuals living with dementia and their carers?”*

Methods

A scoping search was conducted following guidance from the Arksey and O’Malley framework. Four databases were searched: PubMed, Emerald Insight, Clinicaltrials.gov, and Cochrane Library. Thirteen keywords were determined through discussion with team members across Dementia Adventure, to include: ‘dementia’, ‘Alzheimer’s’, ‘nature’, ‘green space’, ‘blue space’, ‘natural space’, ‘natural environment’, ‘outdoor’, ‘indoor’, ‘green care’, ‘garden’, ‘horticulture’ and ‘wellbeing’.

Results

The initial search generated 3424 results across the four databases. After screening of the titles and abstracts against the inclusion and exclusion criteria, the full texts were then reviewed. A list of 70 articles was retrieved from the process and subsequently reviewed.

Conclusions

Evidence for the connection between nature and PLWD has grown steadily over the past 10-15 years. There is a consensus in the literature that, with the appropriate support, engaging with nature is not only beneficial, but essential for PLWD as a basic human right. Exposure to green spaces provides the opportunity to positively impact psychological health, emotional health, and overall wellbeing in a plethora of ways. Whilst progress has been made in the field, this scoping review has highlighted that, 1) opportunities and support for PLWD remain insufficient, and 2) numerous research gaps exist. There is a strong need for more research exploring the ways in which nature-based interventions can be made accessible to PLWD. There are ample research opportunities available to Dementia Adventure, who already provide meaningful breaks to PLWD across UK destinations. This review has highlighted many gaps for further exploration.

1.0 Introduction

Dementia Adventure is a national charity with a vision of ‘a world where people with dementia are fully included in society, enjoying meaningful, dementia-inclusive experiences that are supported, not limited, by their condition. Our mission is to ‘to make adventure accessible for people living with or impacted by dementia, enabling them to connect with nature, themselves, and their communities through experiences that foster joy, confidence, and a sense of possibility.’² Nature has been found to have numerous benefits for the health and wellbeing of individuals, and this undoubtedly includes people living with dementia. It is important to recognise that dementia affects the quality of life for anyone affected by the disease.

Spending time in natural environments has been shown to reduce stress levels and promote relaxation, and exposure to nature can help lower cortisol levels, decrease blood pressure, and induce a sense of calm and tranquillity.^{3, 4} Nature also has a positive impact on mental health and wellbeing. Being in natural settings has been linked to reduced symptoms of depression, anxiety, and stress, and is associated with improved mood and increased positive emotions.^{5, 6} Engaging in physical activities in natural environments can contribute to improved cardiovascular health, increased physical fitness, and weight management.^{7, 8} Additionally, interacting with nature has been associated with improved cognitive function, attention restoration, and enhanced creativity. Nature exposure can help alleviate mental fatigue, enhance concentration, and improve cognitive performance.^{9, 10} A caveat must be recognised that, of course, specific benefits will vary among individuals and contexts. Being ‘in the moment’ will heavily impact mood and psychological benefits.

There is evidently a great deal recognised about the benefits of nature. It is well-documented that spending two hours a week in nature is associated with good health and wellbeing.¹ Dementia Adventure wishes to understand this connection for PLWD. Thus, a scoping review has been conducted to identify and map the available research to answer the research question: “*How does exposure to nature or nature-based interventions impact or benefit individuals living with dementia and their carers?*”

The aims of this review are twofold:

1. To uncover evidence of the benefits of nature or nature-based interventions for people living with dementia.
2. Review literature and identify gaps in research to make recommendations for areas of further research that would be valuable to Dementia Adventure.

This review is an internal document for the use of Dementia Adventure.

2.0 Method

2.1 Study Design

A scoping search was conducted following guidance from the Arksey and O’Malley framework.¹¹ The approach of a scoping review, as opposed to a systematic literature review, enabled a broad range of literature to be scanned and captured. It is not the purpose of this review to critically analyse all available information, the purpose is more so to provide a wider understanding of literature specific to the field of dementia and the connection to nature. A [Scoping Review Protocol](#) was developed to provide the framework for this review.

2.2 Study Identification

A search of the literature was conducted using four databases: PubMed, Emerald Insight, Clinicaltrials.gov, and Cochrane Library. Thirteen keywords were determined through discussion with team members across Dementia Adventure. The keywords were: 'dementia', 'Alzheimer's', 'nature', 'green space', 'blue space', 'natural space', 'natural environment', 'outdoor', 'indoor', 'green care', 'garden', 'horticulture' and 'wellbeing'. Where possible, relevant citations within articles were also reviewed.

2.3 Screening

Only articles from the search that met the inclusion criteria were shortlisted. Articles that fell within the exclusion criteria were not included within the scoping review.

Inclusion criteria:

- studies published in peer-reviewed journals
- studies with a focus on the connection between dementia and nature-based interventions, or exposure to natural environments
- review articles

Exclusion criteria:

- studies not focused on nature or the outdoors
- studies focussed on the elderly population or that are not specific to dementia
- study protocols
- unpublished material
- poster presentations
- studies not published in English
- studies focused on prevention of dementia

2.4 Study Selection

The title and abstract were screened against the inclusion and exclusion criteria, following this the full text was then reviewed. PubMed yielded the highest number of results of the four databases, therefore this search was completed in triplicate for accuracy.

2.5 Data Charting

A table of data was created to compile the search results. This captured the article title, author(s), year of publication and key message. Each article was also assigned a category or 'Key Theme'. Lastly, articles of similar themes were grouped together.

3.0 Results

The initial search generated 3424 results across the four databases. Duplicate results were removed to yield 3309 results. After screening of the titles and abstracts against the inclusion and exclusion criteria, the full texts were then reviewed. A list of 70 articles was retrieved from the process and subsequently reviewed. Of the 70 articles, 69 were identified as primary articles from the keyword searches, and 1 was identified as a secondary article from a citation source. Figure 1 shows the distribution of search results from the four databases.

It should be noted that over 10 000 results were generated from the search, whereby the keyword was deemed too 'broad' to generate meaningful results. For example, in PubMed the search for the keyword 'nature' with 'Dementia' and 'Alzheimer's' generated 6288 results, and similarly the search for 'wellbeing' generated 2385 results. These results were omitted from the scoping review and therefore not reviewed.

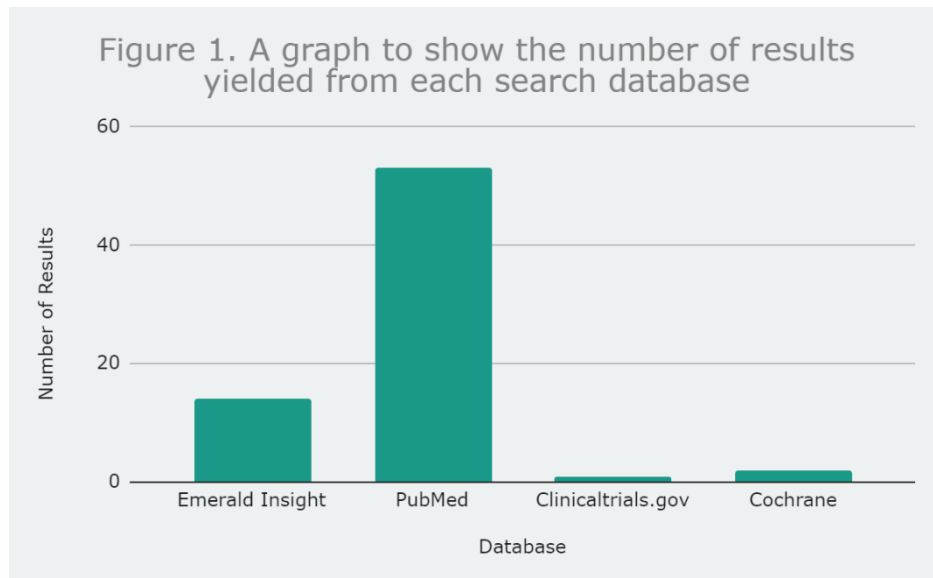
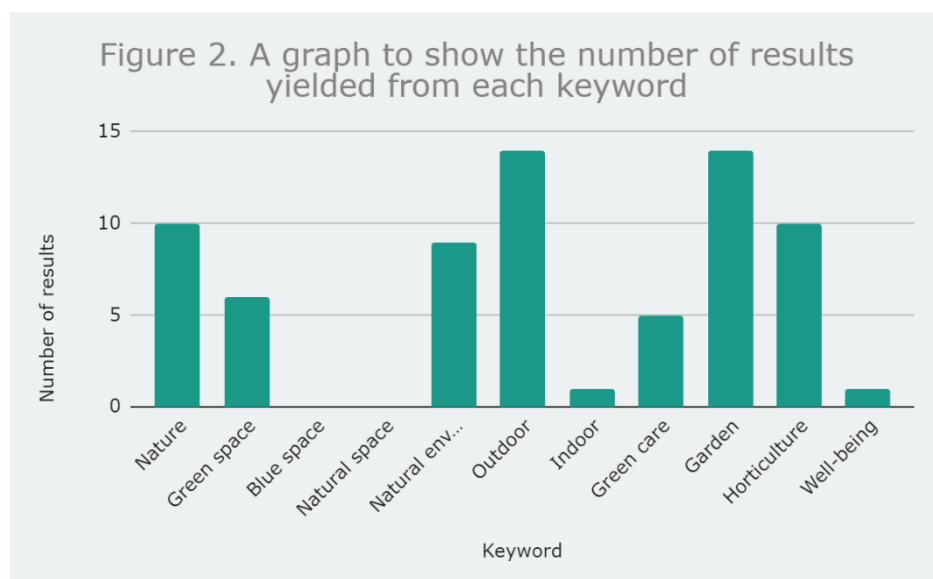


Figure 2 shows the number of key words that were generated in total from the search.



The 70 selected articles were grouped into key themes, which included:

- Connection and benefits with nature
- Horticultural therapy/sensory gardens
- Non-horticulture nature-based interventions
- Design of outdoor areas
- Challenges related to connecting with nature
- Walking
- Animal-based therapy
- Nature connections specific to care settings
- Indoor nature interventions

The search tables are included in appendices A-D for each of the databases.

4.0 Thematic Analysis and Discussion

4.1 Connection and Benefits with Nature

This scoping review identified four other reviews which centre on the connection and benefits of nature for PLWD. These were published between 2010¹²-2020¹³⁻¹⁵. The importance of nature engagement is described such that green spaces have the potential to enable active and meaningful community-life for PLWD via four mechanisms: engaging in meaningful activities; empowerment; positive risk taking; and reinforcing identity.¹³

Two review articles had similar aims to our own scoping review.

Firstly, Bennett *et al* reviewed the benefits of engaging with nature for PLWD in their own homes. Themes of personal significance, connecting with others, supporting self and identity, freedom and independence, wellbeing and quality of life, support from others, and the impact of dementia were all explored. The authors took these themes into consideration and concluded that meaningful connections with nature can be a valuable tool when support mechanisms are adequately utilised.¹⁵

Secondly, Sturge *et al* based their review around the research question: “*How do people with dementia who live at home perceive the features of the social and built environment, outside the home, and how do these environments contribute to their well-being?*” This literature indicates that any contact with the outdoors is essential to a PLWD in terms of improving wellbeing and quality of life. Social environments can equally have positive and negative effects upon a person.¹⁴ The lessons to be learnt here are that, not one size fits all, and training and awareness in society must be improved if PLWD are to benefit from community-based outdoor spaces.

There is also recent evidence to suggest that the natural environment may positively affect physical and mental health, via the transfer of microbes from the environment to the body. Biodiversity may bring about positive effects through biophysiological mechanisms, though further research into the specific effects for PLWD needs to be undertaken.¹⁶

The review articles found in this search strongly advocate for nature as a means to improve wellbeing. The following sections further delve into the different types of interventions available to PLWD, and the challenges they may face.

4.2 Horticultural Therapy/Sensory Gardens

Horticultural therapy and access to sensory gardens is widely published. This section reports solely on horticulture and garden use on the connection to PLWD.

Nine different reviews provided comparable evidence for the benefits of horticulture and/or sensory gardens, and are mutually supportive of improved wellbeing. Benefits include:

- improvement in agitated behaviours and distress¹⁷⁻²³
- improvement in sleep patterns¹⁸
- reduced occurrence of serious falls^{18, 19, 23}
- lowering of medications^{18, 19, 23}
- enhanced wellbeing and alleviation of social isolation to community-residents through outdoor engagement and community involvement²⁴
- reduction in pain¹⁹
- improved attention¹⁹
- reduction in stress^{19, 23}
- improved engagement^{20, 22, 23}
- reduction in depression symptoms or improved mood^{21, 23}
- improved sense of self and identity^{24, 25}

Four of these reviews have been published since 2020,²⁰⁻²³ proving that there is a demand to understand the benefits of horticultural therapy for PLWD. The size of this demand remains unanswered.

Five pilot studies investigated the efficacy of horticultural therapy. Borella *et al* recently in 2023 suggested that, though dementia severity must be individually assessed for people, horticultural therapy can be as beneficial for people with severe dementia as it is for people in the early stages of the condition.²⁶

Another recent pilot study published 2022 appears to be the first of its kind that focuses solely on the impact that gardening has on quality of life and sense of purpose in life. Residents of a care home placed importance on growing something from nothing, and this affirming sense of pride persisted on non-gardening days. A charitable aspect was also discussed, whereby PLWD experienced purposefulness after donating vegetables.²⁷

Community-based gardening was compared to another outdoor intervention, adaptive riding, for PLWD. Both interventions supported quality of life. Adaptive riding appeared to support longer durations of active participation.²⁸ Analysis of community gardening has been shown to uncover strong themes of; activating the sense of touch; creating links to the past and reminiscence; and creating curiosity, wonder and lifelong learning.²⁹

4.3 Non-horticulture Nature-Based Interventions

This section reports on outdoor nature-based interventions for PLWD, which are not related to gardens or horticulture.

Five articles were generated from the search. Two of these articles were published by Dementia Adventure ('It's a walk in the park: exploring the benefits of green exercise and open spaces for people living with dementia',³⁰ and 'Have you been down to the woods today?',³¹ and were published in 2010

and 2012 respectively. This highlights a gap in literature since 2012 relating to outdoor nature-based interventions for PLWD, particularly for those who live in their homes.

A study by Evans *et al* designed a project that aimed to give PLWD opportunities and support to access the natural environment. Research interviews were conducted following nature-based activities, with high indications that the activities were enjoyable, meaningful and provided purpose. The authors stressed that access to nature and the outdoors, which is often denied to PLWD, is a basic human right.³²

The benefits of a woodland intervention were explored by Gibson *et al*. Feedback from a cohort of eighteen PLWD revealed feelings of joy in learning new activities in the woodland, and inspiration from feeling part of nature. Wellbeing was supported by this natural approach.

Smellscape was reviewed as a novel topic of interest. The health benefits of aromatic scents incorporated into healing gardens and outdoor interventions were recognised for mental health, physical health, reduced agitation behaviour, improved cognitive function and wellbeing (Huang).

In comparison to research centred around horticulture therapy, non-horticulture-based activities are far less reported. The gap in research here is quite evident.

4.4 Design of Outdoor Areas

The design of outdoor areas emerged as a small theme when considering the connection between dementia and nature, with four articles reporting on the topic.³³⁻³⁶ The development of dementia-friendly areas is based on six design principles: familiarity, legibility, distinctiveness, accessibility, comfort and safety. Recommendations for inclusive safe spaces include consideration for street patterns, buffer zones between footpaths and roads, seating and furniture, signage, and appropriate surfaces for walking. The involvement of PLWD and focus groups as stakeholders in the design space is crucial. Bowes *et al* found that fully planted gardens provided little open space for care home residents who wished to partake in gardening themselves and thus found the design of such gardens too elaborate.³⁴ Virtual reality can be a valuable tool which enables PLWD to experience, test-run or measure the outdoor environment, thereby shaping the design of areas.

The design of a healing garden within care settings has been reported by Rivasseau-Jonveaux *et al*.³⁷ Lessons can be learnt from the strategies employed by other countries, and the French Alzheimer's Plan (2008-2012) provided many research outcomes. From this, healing gardens have been incorporated into cognitive rehabilitation units specifically for Alzheimer's patients. The design of the healing garden successfully incorporated a theme of 'art, memory and life.'

It is encouraging to see that the design of environments is beginning to shift to the outdoors. However, the information is scarce and there is a larger focus on the design of gardens and outdoor spaces within care homes than there is for urban areas. This may lead to PLWD residing at home exposed to vulnerabilities.

It must also be noted that within this scoping review search, many results emerged on the design of outdoor environments for the prevention of dementia, for example designing green canopies and investigating greenness associated with dementia prevention. Prevention is outside the scope of this review, but it is worth noting that this topic of prevention and greenness appears to be widely researched with gaining momentum.

4.5 Challenges Related to Connecting with Nature

The challenges associated with the creation or access of new outdoor interventions are not widely published. Dementia Adventure has previously been involved in the implementation of a nature-based intervention 'Dementia Adventure In A Box' and the challenges faced in doing so.³⁸ Four other articles reported on how PLWD access the outdoors, the barriers they face and briefly how they manage a lack of access to nature.³⁹⁻⁴² The term 'vulnerable' was examined in detail; through fifteen interviews with PLWD in the domestic setting, it was found that they often do not view themselves as vulnerable, rather this is a term given to people diagnosed with dementia by society. Those interviewed tended to manage risks and 'vulnerabilities', often independently. In the care setting, barriers can arise from the person diagnosed with dementia, from their family members, or from care staff. Barriers from a person diagnosed with dementia may include personal physical incapacities, personal attitudes, reluctance to socialise and a fear of leaving their safe environment. Concerns from family members for their loved one to explore the outdoors may create strong barriers. From the care staff's perspective, there may be resource-related challenges, lack of training opportunities, lack of staff interest, lack of volunteers, fear of residents wandering, or in some cases continual pushback from care home residents to not participate in activities may dishearten staff members. There is also a theme surrounding the challenge for staff to create meaningful and engaging activities; one staff member from the care sector said during an interview *'it's more about having enough activities for there to be constantly something to do... there was not that much that they could actually do.'* Solutions to overcome such challenges are not widely reported; an article published by Dementia Adventure in 2017⁴³ is the only result in this scoping review search which explores and makes recommendations for positive risk taking in nature.

There are ongoing challenges faced by heritage sites to provide services for PLWD.⁴⁴ The requirement to maintain historical site preservation is reported to conflict with site adaptation to allow for inclusive access for various groups of people. Together with a lack of financial resources to support inclusivity, this may mean that PLWD encounter limited access to heritage sites.

Nature-based services for PLWD in urban areas, and the associated challenges, were studied in the Netherlands.⁴⁵ Service providers reported a lack of green space to be a major obstacle in urban areas, though social farms and community gardens offer promising sites. Such developments mean that PLWD can interact with other members of the public. This concept is appealing for many with dementia, but can create difficulties to cater for different user needs. Collaboration between care facilities and other external organisations can offer a solution to community-orientated nature-based services.

Only one article was found which reported on challenges faced by men living in rural areas and their ability, or inability, to access nature.⁴⁶ Physical barriers of the rural landscape meant that access became more difficult as the cohort of seventeen men aged, or as their dementia progressed and the onset of other conditions developed. Hilly terrains, using a walking stick, the onset of diabetes, the decreasing capability to walk, and navigating stairs to leave the home are some examples of the issues the men faced when interviewed, consequently in some cases leading to social isolation. It was reported that some men found outdoor activities increasingly difficult to partake in, or they experienced a lack of desire and motivation to do so. These activities included playing golf, playing tennis, motorbiking or attending a rambling club. A lack of transport options in rural areas also contributed to issues around physical accessibility; many men also had their driving licences revoked and expressed feelings of despair because of this. Reliance on caregivers impacted their social confidence, and for some it became easier to stay at home rather than continue with outdoor pursuits.

This scoping review did not find any articles which reported challenges faced by other specific groups of people wishing to connect with nature, for example challenges faced by people living with dementia and disabilities. Overall, there is a lack of information in literature that reports on challenges around access to outdoor spaces for PLWD, or indeed the solutions to overcome these issues.

4.6 Walking

Only one article related to the benefits of walking in nature emerged from the search. Bartlett *et al* explored via a scoping review the challenges that PLWD face when they wish to walk with purpose, across domestic and care settings³⁹. With a diagnosis of dementia, this is often viewed as undesirable behaviour from the caregiver's perspective as it requires additional time. Staff training and awareness is also required to ensure safe walking can be carried out, but this is rarely a priority across care settings. Often caregivers will resort to distraction or redirection strategies to prevent walking. A person-centred approach is required in these instances. Additionally, it was reported that the design of outdoor walking environments for PLWD requires great improvement.

The article also found that much of the literature was focused on the use of technology to aid walking with purpose. Assistive technology, such as CCTV and door alarms, requires greater funding due to the high costs associated, and also requires more awareness for PLWD to realise the benefits and aid walking.

Our scoping review also observed a trend in assistive technology for walking within the scoping search, particularly for GPS systems, personal trackers and mobile phones. Though this topic falls outside the scope of our review and was omitted from the results, there is clearly a growing interest in the topic, and this must be recognised.

4.7 Animal-Based Therapy

Two articles described the positive benefits of animal-based therapy for PLWD. Both articles focus on different areas. Fields *et al* described how equine assisted therapy was demonstrated to enhance the quality of life of PLWD in care facilities.⁴⁷ Edwards *et al* found that people living with advanced dementia in care homes responded positively to aquariums in their dining environment; a positive impact on appetite and increase in body weight was recorded in the majority of the study participants.⁴⁸

For the purpose of this scoping review, it is assumed that animal-assisted therapy must play a larger role for PLWD outside of the two articles found here. Therefore, an additional search was completed in PubMed for the terms 'Dementia' OR 'Alzheimer's' AND 'animal', which generated 9108 results. A similar search for the term 'animal therapy' generated only 4 results. It is recommended that this area of animal-based therapy and the connection to PLWD is reviewed further, with a consideration for reliable keywords.

4.8 Nature Connections Specific to Care Settings

Nature-related interventions in literature appear to be for either PLWD in care settings or for PLWD in their own homes. There is quite a divide in studies between the two groups of people. This section reports on nature connections for PLWD specific to the care sector. There is cross-over here with other sections within this review, i.e. section 4.2 Horticultural Therapy/Sensory Gardens, but it was deemed appropriate to consider the care setting separately here.

Eight review articles were found in this search. A review by Barrett *et al* is perhaps the most valuable article generated by this search. The authors conducted a comprehensive review into green dementia care within care settings. The overriding message of the article is that though there is compelling evidence that interaction with the natural environment is beneficial to PLWD, the research is lacking. The authors highlighted the following significant gaps in literature knowledge; lack of consistency in tools to measure wellbeing outcomes; limited information on blue spaces; lack of robust research animal assisted therapy and pet ownership; lack of research into spiritual health; and the lack of research on the impact of taking PLWD out of care settings to experience nature further field, i.e. day trips or excursions.⁴⁹

Another review by Evans *et al* explored nature connection in care homes in comparison to extra care housing schemes.³² They found differences between nature-based services offered by the two different types of care providers; care homes were more likely to offer structured activities, less likely to allow pets in the setting, and residents of care homes were less likely to organise activities themselves due to a culture of being led by activity coordinators. Residents of housing schemes were, perhaps unsurprisingly, found to be more independent and arrange nature-based activities themselves.

Other reviews explored the effect of outdoor spaces on PLWD in care facilities. The wide range of positive effects of natural environments were documented,⁵⁰⁻⁵² but despite this, outdoor spaces remain under-utilised.⁵³ Concerns about study design and methodological approaches across the research were expressed,⁵⁴ and the general consensus is that the topic is 'understudied and undervalued'.⁵⁵

Seven articles were generated in our scoping review search that reported on the impact of outdoor spaces on PLWD in care settings. Outdoor spaces included traditional gardens, enriched gardens and therapeutic gardens. Enriched gardens are specifically designed to include different stimuli modules, for example, sundials, easels, ground painting, sounds, music, and balance equipment, to name but a few. Enriched gardens offer a new approach to therapeutic mediation for PLWD in nursing homes; cognitive function measured by Mini-Mental State Exam scores were improved when residents frequented an enriched garden, in comparison to visiting a conventional sensory garden or not visiting a garden at all.⁵⁶ The use of therapeutic gardens in care facilities was found to increase social behaviour, decrease agitation and depressive symptoms,⁵⁷ and improve quality of life by enhancing resident-carer relationships.⁵⁸ The value of horticultural therapy has found similar results, where therapy reduced apathy and promoted cognitive function,⁵⁹ and also had positive effects on behaviour and engagement within the care setting.⁶⁰

One study by Velde-van Buuringen was found to take a distinct innovative approach by taking care outside to the garden for a minimum of thirty minutes. This approach was implemented by taking scheduled tasks outdoors, rather than creating additional tasks, thereby incorporating nature into the day. Benefits were seen to both residents and staff.⁶¹ The duration of thirty minutes was based upon the findings of White *et al*, who determined that improvements in patient mood were seen after 20 minutes, but interestingly, no additional benefits were seen beyond 80-90 minutes. In fact, negative effects to mood were observed after 80-90 minutes. This research suggests that engagement with nature is beneficial to PLWD after relatively short durations of exposure.⁶²

Another topic of interest that emerged was green care farms. These care farms have increasingly proved to have radicalised the dementia care setting, particularly within Nordic countries. Green care farms may come in different forms, but all aim to improve quality of care and quality of life for PLWD. Here, four articles reported the benefits of green care farms, including a rice farm in East Asia.⁶³⁻⁶⁶ Four themes can be identified from green care farms: stimulating the senses, engaging in purposeful activities, sharing responsibilities, and creating a community in a new home. Benefits of green care

farming are plentiful with positive benefits reaped from time spent outdoors, activity engagement, physical activity, social interactions, healthy eating, and a purposeful meaning of belonging and in life. de Bruin *et al* recognise that though the benefits of green care farming are evident, the field is relatively new and many research questions remain unanswered, such as:

- *“To what extent will physical activity at care farms slow down the deterioration of physical functioning?”*
- *“What is the impact of spending time outdoors on sleep patterns of people with dementia?”*
- *“How will living at a farm affect end of life processes?”*
- *“Will the temporary relief that care farms provide to family carers result in longer perseverance time or delay of institution alization of the person with dementia?”⁶⁶*

4.9 Indoor Nature Interventions

Indoor nature interventions were explored as it is not always appropriate for many people with dementia to physically go outside. Only seven articles were generated from this search.

Forbes *et al* conducted a review to investigate the relationship between indoor light intervention and cognition.⁶⁷ The authors did not find any correlation and reported that indoor light interventions do not appear to provide any significant benefits for PLWD. However, a citation within the article led to a study conducted in 2007 where the effect of outdoor light exposure was investigated.⁶⁸ The study was conducted over the course of one year and compared the effects of an outdoor activity program to an indoor activity program. Both outdoor and indoor activities were equivalent. Sleep was improved in both groups, but the outdoor group experienced significant improvements in maximum sleep epoch. The frequency of aggression and verbal agitation also decreased in both groups, suggesting that the participation in activities was positive for both groups. Verbal agitation increased in the indoor group, whereas it decreased in the outdoor group.

Hayden *et al* conducted a scoping review for sensory interventions for PLWD, to include nature.⁶⁹ Indoor nature interventions were described as a new subject in multisensory research and the authors reported an emerging trend whereby traditional multisensory rooms are replaced with indoor natural environments. Multisensory rooms are declining in interest as increasing evidence shows fewer advantages for PLWD. A preference for garden environments (specifically a Japanese garden) over Snoezelen rooms has been reported.⁷⁰ Viewing a Japanese garden may reduce heart rate, indicating a more relaxed physiological state and reduced stress, and also encourage PLWD to recall memories associated with the scenery and smells.⁷¹ Indoor therapeutic gardens provide a safe environment and may offer the following advantages: reduced behavioural and psychological symptoms of dementia, reduced medication intake, and reduced cortisol levels.⁷² Showing images of nature to PLWD residing in a care home has reportedly improved overall engagement and reduced agitated behaviours following the intervention (Eggert). A similar music intervention within this same study showed similar positive benefits.

There appear to be few efforts to introduce novel indoor nature-based interventions into care settings. Tseng *et al* designed an indoor gardening table game aimed to improve the cognitive performance of PLWD, based on user demands and satisfaction needs. The authors found that the Mini-Mental State Exam score was improved, but not significantly. Nonetheless, the users showed great interest and engagement in the intervention.

Given that it is estimated 70% of care home residents are living with dementia,⁷³ it is encouraging that indoor nature interventions are beginning to grow, though the available information is currently limited.

5.0 Recommendations

5.1 Research Areas

An aim of this scoping review was to “review literature and identify gaps in research to make recommendations for areas of further research that would be valuable to Dementia Adventure.”

The review has enabled gaps in research to be identified, and together with recommendations from other reviews, the following areas of further research are proposed:

- The short-term and long-term benefits of nature connections

It is evident from the literature that there are many benefits for PLWD to connect with nature and the outdoors. However, the literature is scant in regard to what the immediate benefits of this are in comparison to the long-term. For example, what are the immediate effects to a person after taking a short walk in the garden? Do these benefits continue into the following day? Are the effects different to those experienced after a holiday outdoors? There are many questions that could form the basis of research.

- Time required for nature connections

White *et al* demonstrated in 2018 that improvements in mood for PLWD were associated after twenty minutes of exposure to nature, and negative effects were actually seen after 80-90.⁶² This appears to be the only article for PLWD and the duration of time in nature that is required for positive effects to be seen. The findings suggest that there may be a ‘target level’ of exposure. Consequently, this research area requires further investigation.

- Enabling carers to overcome barriers to access nature

Carers often face many challenges and barriers of their own when it comes to accessing nature with the person that they care for, whether this is in the care setting or at home. To our knowledge there isn’t a body of work that investigates specifically the issues faced by carers, and the solutions available for them. This appears to be less reported for carers at home.

- Tourism

It is evident that the majority of studies identified within this scoping review focus on nature-engagement from horticultural therapy. Alternative interventions, such as exploring woodlands, heritage sites, or tourist areas, are far less reported. The literature is completely lacking on tourism specifically for PLWD. As such, the opportunities for research here are endless. The outcomes of day trips and indeed holidays for PLWD are not reported, other than ‘historical’ work conducted by Dementia Adventure circa 2017. Is there merit in taking PLWD out of their care environment to experience nature further afield?

- Blue space

There is absolutely insufficient information on the connection between blue spaces and dementia. Other than the IDEAL programme⁷⁴ this scoping review only found information related to green spaces; searches for ‘blue space’ returned no other results. Again, there are many opportunities for research here. It must firstly be questioned whether blue spaces are available to PLWD. Is there a preference for green spaces over blue spaces? What are carers’ views on this?

- Animal-assisted therapy

There appears to be a lack of evidence relating to PLWD and animal-assisted therapy. Does animal-assisted therapy have the potential to improve mood and wellbeing? Early indications from this scoping review suggest so, however further scanning of literature is required.

- Challenges faced by different cohorts of PLWD

This scoping review discussed the challenges that PLWD face when engaging with nature. The majority of studies reported were relevant for people in care facilities, and then to a lesser extent for people living in their homes. The information available broadly groups PLWD together. At best, the studies provide details on gender and the stage of dementia for study participants. There is extremely limited information on equality, diversity and inclusion (EDI). For instance, what challenges do PLWD from ethnic minority groups or those with disabilities face?

- Spirituality

Improved quality of life has been explored in terms of increasing social interactions, and reducing agitation, stress and depression levels, etc. However, lesser-explored aspects of quality of life, such as spirituality remain to be investigated.¹³

An observation was made from the search results that articles relating to the prevention of dementia and the connection to green spaces is gaining interest in the research field. Examples of new research include *“Neighbourhood greenspace exposure as a protective factor in dementia risk among U.S. adults 75 years or older: a cohort study”*,⁷⁵ *“Residential greenness and risk of incident dementia: A prospective study of 375,342 participants”*⁷⁶ and *“Is Greenness Associated with Dementia? A Systematic Review and Dose–Response Meta-analysis.”*⁷⁷ These studies were published in 2022, 2023 and 2022 respectively. Themes of tree canopies, air pollution and green space were covered. It is highly recommended that Dementia Adventure takes this into consideration for future work.

A second observation was made on the number of search results relating to the use of technology for PLWD. The results were not included within our review, as a scoping review and trial by Professor Scarles at the University of Surrey concludes that both virtual reality (VR) and multisensory stimulation environments (MSSE) have been found to have a positive impact on emotional, psychological and social wellbeing of PLWD (articles in review). These findings show that technology as an indoor nature-based intervention has the potential to be highly effective for PLWD, and therefore, this is an area of further research for Dementia Adventure.

6.0 Strengths and Limitations

A strength of the scoping review methodology is that it has enabled a broad overview of the literature to be captured. A further strength is that it has allowed inclusion of a wide range of publications, to include reviews, pilot studies and randomised controlled trials.

This scoping review is limited by the fact that one author conducted the search and scanning of the literature. Typically, this task is carried out by a minimum of two authors. To mitigate this limitation, the search in PubMed search engine was performed in triplicate, a practice which is not usual for scoping reviews. For this reason, it is recommended that this work should not be put forward for publication, unless the search is repeated with the involvement of at least one more author.

7.0 Conclusions

In conclusion, evidence for the connection between nature and PLWD has grown steadily over the past 10-15 years. There is a consensus in the literature that, with the appropriate support, engaging with nature is not only beneficial, but essential for PLWD and a basic human right. Exposure to green spaces provides the opportunity to positively impact psychological health, emotional health and overall wellbeing in a plethora of ways. Whilst progress has been made in the field, this scoping review has highlighted that 1) opportunities and support for PLWD remain insufficient, and 2) numerous research gaps exist. There is a strong need for more research exploring the ways in which nature-based interventions can be made accessible to PLWD. There are ample research opportunities available to Dementia Adventure, who already provide meaningful breaks to PLWD across UK destinations. Next steps will be to form further research questions based upon the gaps in literature in order to broaden and contribute to this field of research.

8.0 Other Information

The author declares no conflicts of interest.

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Appendices

Appendix A. Results generated from Emerald Insight.

Search Term	Title	Author	Year	Theme	Key message	Link
Nature	Connections with nature for people living with dementia	Evans et al	2019	Nature connection in care settings	Research project that explores the theme and makes recommendations for good nature practice in care homes based on an online survey presented to care settings. Positive benefits reported included improved mood, higher levels of social interaction and increased motivation for PLWD, in addition to greater job satisfaction for staff. Recommendations for the design and layout of indoor and outdoor spaces are made, and this impacts staff's ability to promote connections with nature.	https://www.researchgate.net/publication/333855396_Connections_with_nature_for_people_living_with_dementia
	Green dementia care in accommodation and care settings: a literature review	Barrett	2019	Nature connection in care settings	A literature review providing evidence for health and well-being benefits for PLWD in care settings, but more research is needed.	https://eprints.worc.ac.uk/8587/7/Green%20Dementia%20Care%20AAM%20with%20cover.pdf
	Nature-based activities for people living with dementia: a nice day out or a matter of human rights?	Evans et al	2021	Connection/benefits with nature (outdoor intervention)	Improvements in well-being reported after nature activity sessions. The authors highly advocate for nature-based activities.	https://www.emerald.com/insight/content/doi/10.1108/WWOP-08-2021-0040/full/html
	Neighbourhoods for life: Designing dementia-friendly outdoor environments	Mitchell et al	2006	Connection/benefits with nature (design of outdoor areas)	Findings for requirements of outdoor spaces, street furniture, urban areas.	https://www.emerald.com/insight/content/doi/10.1108/14717794200600005/full/html
	It's a walk in the park: exploring the benefits of green exercise and open spaces for people living with dementia	Mapes	2010	Connection/benefits with nature (outdoor intervention)	Benefits of nature explored with a case study from Dementia Adventure.	https://www.emerald.com/insight/content/doi/10.5042/wwop.2010.0680/full/html
	Have you been down to the woods today?	Mapes	2012	Connection/benefits with nature (outdoor intervention)	Benefits of nature reported.	https://www.emerald.com/insight/content/doi/10.1108/13663661211215105/full/html
	Spreading the word: enablers and challenges to implementing a	Bray et al	2022	Connection/benefits with nature (challenges)	Reports on a nature-based intervention which could be applied to other areas.	https://eprints.worc.ac.uk/11684/1/Spreading%20the%20word%20enablers%20and%20

	nature-based intervention for people living with dementia					challenges%20to%20implementing%20a%20nature-based%20intervention%20for%20people%20living%20with%20dementia.pdf
	Woodland Wellbeing: a pilot for people with dementia	Gibson et al	2017	Connection/benefits with nature (outdoor intervention)	Benefits of nature explored after a woodland intervention. The natural approach supports wellbeing.	https://www.emerald.com/insight/content/doi/10.1108/WOP-05-2017-0012/full/html
	Think outside: positive risk-taking with people living with dementia	Mapes	2017	Connection/benefits with nature (challenges)	Positive risk taking explored.	https://www.emerald.com/insight/content/doi/10.1108/WOP-03-2017-0007/full/html
	Designing Dementia-Friendly Neighbourhoods: Helping People with Dementia to Get Out and About	Mitchell et al	2010	Connection/benefits with nature (design of outdoor areas)	Recommendations for designing neighbourhoods to be dementia friendly	https://www.emerald.com/insight/content/doi/10.5042/jic.2010.0647/full/html
Green space	Designing Environments for People with Dementia	Bowes et al	2019	Connection/benefits with nature (design of outdoor areas)	Recommendations for designing care settings.	https://www.emerald.com/insight/content/doi/10.1108/978-1-78769-971-720191004/full/html
Natural environment	Impact of a dementia-specific program of equine-assisted activities: providers' perspectives	Fields et al	2019	Animal based therapy	Equine assisted therapy was shown to enhance the quality of life of PLWD in care facilities.	https://www.emerald.com/insight/content/doi/10.1108/OAOA-10-2018-0047/full/html
Outdoor	Understanding and supporting safe walking with purpose among people living with dementia in extra care, retirement and domestic housing	Barrett et al	2020	Walking	Explored barriers to walking with purpose, across all care and domestic settings. The connection to nature was not implicitly explored, however much can be learnt from the challenges faced by PLWD as described here.	https://www.emerald.com/insight/content/doi/10.1108/HCS-03-2020-0004/full/html
Well-being	Dementia-friendly heritage settings: a research review	Sharma et al	2020	Providing PLWD the opportunities and support to access nature/facing challenges	Reviews heritage sites for PLWD, in terms of sensory issues etc, and adapting to their needs. Describes challenges faced by the tourism industry, and provides recommendations for further work.	https://www.emerald.com/insight/content/doi/10.1108/IJBP-01-2019-0005/full/html

Appendix B. Results generated PubMed.

Search Term	Title	Author	Year	Theme	Key Message	Link
Green space	Healing gardens: recommendations and criteria for design.	Rivasseau-Jonveaux T et al	2012	Connection/benefits with nature (design of outdoor areas)	Findings for design of healing gardens in the care setting.	https://pubmed.ncbi.nlm.nih.gov/23015232/
	Exposure to nature gardens has time-dependent associations with mood improvements for people with mid- and late-stage dementia.	White PC et al	2018	Nature connection in care settings	Improvements in patient mood were associated with relatively short duration exposures to nature, and no additional measurable increases in mood were found with exposures beyond 80-90 minutes duration.	https://pubmed.ncbi.nlm.nih.gov/28835119/
	Green spaces, dementia and a meaningful life in the community: A mixed studies review. Health Place.	Mmako NJ et al	2020	Connection/benefits with nature	The authors conducted a mixed study review and reported that green spaces have the potential to enable an active and meaningful community-life for PLWD.	https://pubmed.ncbi.nlm.nih.gov/32543430/
	Perceived and objective availability of green and blue spaces and quality of life in people with dementia: results from the IDEAL programme.	Wu YT et al	2021	Providing PLWD the opportunities and support to access nature.	Only perceived availability was related to quality of life in people with dementia. The article explores blue space	https://pubmed.ncbi.nlm.nih.gov/33484297/
	Biodiversity Effects on Human Mental Health via Microbiota Alterations.	Wong YS et al	2022	Connection/benefits with nature	The environment could directly transfer microbes to humans, positively affecting physical and mental health.	https://pubmed.ncbi.nlm.nih.gov/36231182/
Natural Environment	Using the natural environment to address the psychosocial impact of neurological	Lakhani A et al	2019	Nature connection in care settings	Engaging with gardens, and gardening, can favourably impact the emotional and social health of people with dementia	https://pubmed.ncbi.nlm.nih.gov/30583914/

disability: A systematic review.					
Therapeutic gardens as a design approach for optimising the healing environment of patients with Alzheimer's disease and other dementias: A narrative review.	Uwajeh PC et al	2019	Connection/benefits with nature (therapeutic gardens / technology)	Therapeutic gardens should be used to improve the health and wellbeing of Alzheimer's disease and dementia patients, as it positively impacts the emotional and social health of PLWD. VR technology also explored.	https://pubmed.ncbi.nlm.nih.gov/31230998/
A scoping review: Sensory interventions for older adults living with dementia.	Hayden L et al	2022	Nature connection in care settings (indoor intervention)	A scoping review into sensory interventions in the care setting, to include nature. The authors recommend that traditional multisensory rooms be replaced with natural environments (which are inherently multisensory).	https://pubmed.ncbi.nlm.nih.gov/35230906/
The effect of garden use on quality of life and behavioural and psychological symptoms of dementia in people living with dementia in nursing homes: a systematic review.	van der Velde-van Buuringen et al	2023	Nature connection in care settings	There appear positive effects of garden use on quality of life, and improving Behavioural and Psychological Symptoms of Dementia	https://pubmed.ncbi.nlm.nih.gov/37124273/
The influence of aquariums on weight in individuals with dementia	Edwards et al	2013	Animal based therapy	People with advanced dementia responded to aquariums in their environment, this positively impacted appetite maintenance of body weight.	https://pubmed.ncbi.nlm.nih.gov/23138175/
Features of the social and built environment that contribute to the well-being of people with dementia who live at home: A scoping review	Sturge et al	2020	Connection/benefits with nature	A scoping review that concludes that regardless of whether a person with dementia is walking outside or sitting in on their balcony, access to nature (e.g., fresh air, the beach, sunlight, flowers, plants and animals) is described as essential. The scoping review is one of two results that is similar to ours in aims.	https://pubmed.ncbi.nlm.nih.gov/33254054/

	Experiences of rural life among community-dwelling older men with dementia and their implications for social inclusion	Hicks et al	2019	Connection/benefits with nature (challenges)	Benefits of rural living including the pleasant, natural environment, supportive informal networks and some accessible formal dementia support.	https://pubmed.ncbi.nlm.nih.gov/31718267/
Outdoor	What is the impact of using outdoor spaces such as gardens on the physical and mental well-being of those with dementia? A systematic review of quantitative and qualitative evidence	Whear et al	2014	Nature connection in care settings	There are promising impacts on levels of agitation in care home residents with dementia who spend time in a garden.	https://pubmed.ncbi.nlm.nih.gov/25037168/
	Me, myself, and nature: living with dementia and connecting with the natural world - more than a breath of fresh air? A literature review	Bennett et al	2022	Connection/benefits with nature	Engaging with the natural world can be a valuable to enable continuity, providing a sense of connectedness to self, place and others. This recent literature review is important to understand how PLWD can benefit from nature. This review is also similar to ours in terms of aims.	https://pubmed.ncbi.nlm.nih.gov/35939420/
	On being outdoors: How people with dementia experience and deal with vulnerabilities	Bartlett et al	2019	Connection/benefits with nature (challenges)	Explores vulnerability and the outdoors.	https://pubmed.ncbi.nlm.nih.gov/31272077/
	Beyond garden design: A review of outdoor occupation in hospital and residential care settings for people with dementia	Ng et al	2023	Nature connection in care settings	Quantitative studies suggested that benefits of outdoor occupations for people with dementia were improvements in activity participation, social connection, mood, agitation, light exposure, and sleep.	https://pubmed.ncbi.nlm.nih.gov/35773964/
	Benefits of sensory garden and horticultural activities in dementia	Gonzalez et al	2014	Connection/benefits with nature (horticultural therapy)	Non-pharmacological interventions may improve well-being, and affect and reduce the occurrence of disruptive behaviour.	https://pubmed.ncbi.nlm.nih.gov/24128125/

care: a modified scoping review					
Creating a dementia-friendly environment through the use of outdoor natural landscape design intervention in long-term care facilities: A narrative review	Motealleh et al	2019	Nature connection in care settings	The reviewed studies predominantly support the positive effects of outdoor natural landscapes on agitation, apathy and engagement of people with dementia in care settings.	https://pubmed.ncbi.nlm.nih.gov/31220798/
Effects of an outdoor horticultural activities program on cognitive and behavioral functioning, mood, and perceived quality of life in people with dementia: a pilot study	Borella et al	2023	Connection/benefits with nature (horticultural therapy)	Engaging PLWD in horticultural therapy can decrease their dementia symptoms and their caregivers' distress, but also increase the PLWD's quality of life.	https://pubmed.ncbi.nlm.nih.gov/37529310/
The importance of getting back to nature for people with dementia	Bossen	2010	Connection/benefits with nature	Literature review.	https://pubmed.ncbi.nlm.nih.gov/20128524/
Digging for Dementia: Exploring the experience of community gardening from the perspectives of people with dementia	Noone	2018	Connection/benefits with nature (horticultural therapy)	Gardening can be an effective vehicle for the promotion of social citizenship and expression of selfhood and agency in dementia.	https://pubmed.ncbi.nlm.nih.gov/29068703/
Digging into the experiences of therapeutic gardening for people with dementia: An interpretative	Smith-Carrier	2021	Connection/benefits with nature (horticultural therapy)	Therapeutic gardening as a valuable practice for people with dementia.	https://pubmed.ncbi.nlm.nih.gov/31426675/

	phenomenological analysis					
	Persons with early-stage dementia reflect on being outdoors: a repeated interview study	Olsson et al	2013	Connection/benefits with nature	Independent outdoor activities seem to contribute to the well-being and feelings of self-worth among persons with early-stage dementia who want to be and are able to be outdoors.	https://pubmed.ncbi.nlm.nih.gov/23701394/
	Evaluating the Impact of Community Gardening on Sense of Purpose for Persons Living with Dementia: A Cluster-Randomized Pilot Study	Styck et al	2022	Connection/benefits with nature (horticultural therapy)	Gardening has biopsychosocial benefits for persons living with dementia, i.e. improved mood, physical benefits, fostered a sense of community, sense of self, sense of purpose and pride.	https://pubmed.ncbi.nlm.nih.gov/36072363/
	The nourishing soil of the soul: The role of horticultural therapy in promoting well-being in community-dwelling people with dementia	Noone et al	2017	Connection/benefits with nature (horticultural therapy)	Evidence suggests that the benefits of horticultural therapy may offer a practical and effective solution to alleviating social isolation and improving well-being for PLWD in the community.	https://pubmed.ncbi.nlm.nih.gov/26701960/
Indoor and Nature	What is the evidence to support the use of therapeutic gardens for the elderly?	Detweiler et al	2012	Connection/benefits with nature (horticultural therapy)	Data supporting future studies of the effects of natural settings for the long-term care and rehabilitation of the elderly	https://pubmed.ncbi.nlm.nih.gov/22707959/
Greencare	Living at the farm, innovative nursing home care for people with dementia - study protocol of an observational longitudinal study	de Boer et al	2015	Nature connection in care settings (green care farms)	Quality of care was increased at green care farms.	https://pubmed.ncbi.nlm.nih.gov/26527159/
	Rice farming care as a novel method of green care farm in East Asian	Ura et al	2021	Nature connection in care settings (green care farms)	A green care farm group showed a significant improvement in well-being but no significant difference in cognitive function compared to a typical care group.	https://pubmed.ncbi.nlm.nih.gov/33836669/

	context: an implementation research					
	How the interrelated physical, social and organizational environment impacts daily life of residents with dementia on a Green Care Farm	Rosteius et al	2022	Nature connection in care settings (green care farms)	Green care farms are increasingly proving to have radicalised the care environment. The benefits are explored in depth.	https://pubmed.ncbi.nlm.nih.gov/36106159/
	Care Farming for People with Dementia; What Can Healthcare Leaders Learn from This Innovative Care Concept?	de bruin et al	2020	Nature connection in care settings (green care farms)	Recommendations for healthcare leaders based on early research into green care farms.	https://pubmed.ncbi.nlm.nih.gov/32210657/
	Smellscape as a healing factor in institutional gardens to enhance health and well-being for older people with dementia: A scoping review	Huang et al	2023	Connection/benefits with nature (outdoor intervention)	There is mounting evidence for the health benefits of aromatic scents; mental health; physical health; reduced agitation behaviour; improved cognitive function; and well-being.	https://pubmed.ncbi.nlm.nih.gov/37902159/
Horticulture	Well-Being Benefits of Horticulture-Based Activities for Community Dwelling People with Dementia: A Systematic Review	Scott et al	2022	Connection/benefits with nature (horticultural therapy)	Horticulture-based activities led to positive impacts on engagement, social interactions, and mental and physical well-being in PLWD in the community.	https://pubmed.ncbi.nlm.nih.gov/36078239/
	Effectiveness of horticultural therapy: a systematic review of randomized controlled trials	Kamioka et al	2014	Connection/benefits with nature (horticultural therapy)	Horticultural therapy may be an effective treatment for dementia, as well as other conditions such as schizophrenia, depression, and terminal-care for cancer.	https://pubmed.ncbi.nlm.nih.gov/25440385/

Therapeutic Horticulture for Dementia: A Systematic Review	Whelden et al	2023	Connection/benefits with nature (horticultural therapy)	Horticultural therapy was shown to decrease agitation and depression in PLWD.	https://pubmed.ncbi.nlm.nih.gov/37379043/
Horticultural Therapy in Patients With Dementia: A Systematic Review and Meta-Analysis	Lu et al	2020	Connection/benefits with nature (horticultural therapy)	Horticultural therapy in this review was shown to alleviate agitation, increase time of engaging in activities and decrease time of doing nothing.	https://pubmed.ncbi.nlm.nih.gov/31690084/
An Indoor Gardening Planting Table Game Design to Improve the Cognitive Performance of the Elderly with Mild and Moderate Dementia	Tseng et al	2020	Connection/benefits with nature (indoor intervention)	MMSE was improved, but not significantly., by introducing an indoor gardening planting table in the care setting.	https://pubmed.ncbi.nlm.nih.gov/32106583/
A comparison of quality of life indicators during two complementary interventions: adaptive gardening and adaptive riding for people with dementia	Lassel et al	2021	Connection/benefits with nature (horticultural therapy)	Adaptive gardening in the community and adaptive riding were compared. Both interventions supported quality of life. Adaptive riding appeared to support longer durations of active participation.	https://pubmed.ncbi.nlm.nih.gov/33429038/
Effects of viewing a preferred nature image and hearing preferred music on engagement, agitation, and mental status in persons with dementia	Eggert et al	2015	Connection/benefits with nature (indoor intervention)	Nature images and music were shown to PLWD in the care setting, where improved engagement and reduced disordered behaviours were observed, thus potentially enhancing quality of life.	https://pubmed.ncbi.nlm.nih.gov/26770801/
I used to be a gardener': Connecting aged care residents to gardening and to each other through communal garden sites	Fielder et al	2021	Connection/benefits with nature (challenges)	Garden sites can improve quality of life and enable connectedness.	https://pubmed.ncbi.nlm.nih.gov/32881262/

Garden	My father is a gardener ...': A systematic narrative review on access and use of the garden by people living with dementia	Newton et al	2021	Connection/benefits with nature (challenges)	A review of benefits and challenges in domestic and care settings.	https://pubmed.ncbi.nlm.nih.gov/33610889/
	Horticultural therapy in dementia care: a literature review	Blake et al	2016	Connection/benefits with nature (horticultural therapy)	A review of horticultural therapy, explored in terms of expense to care providers, emotional benefits to PLWD and levels of engagement.	https://pubmed.ncbi.nlm.nih.gov/26786461/
	The Impact of a Dementia-Friendly Garden Design on People With Dementia in a Residential Aged Care Facility: A Case Study	Motealleh et al	2022	Nature connection in care settings	Qualitative findings to support the theme that garden use reduces agitation in PLWD.	https://pubmed.ncbi.nlm.nih.gov/34911368/
	An Indoor Therapeutic Garden for Behavioral Symptoms in Alzheimer's Disease: A Randomized Controlled Trial	Pedrinolla et al	2019	Connection/benefits with nature (indoor intervention)	An indoor therapeutic garden appears safe, may reduce BPSD, medication intake, and cortisol levels in Alzheimer's Disease.	https://pubmed.ncbi.nlm.nih.gov/31424399/
	Daily garden use and quality of life in persons with advanced dementia living in a nursing home: A feasibility study	Velde-van Buuringen	2021	Nature connection in care settings	Reports the observed benefits of going outside for PLWD in the care setting.	https://pubmed.ncbi.nlm.nih.gov/33348453/
	Effectiveness of Therapeutic Gardens for People with Dementia: A Systematic Review	Murroni	2021	Connection/benefits with nature (horticultural therapy)	16 studies were identified in this review that reported on the connection of therapeutic gardens to PLWD. All but 2 studies reported positive benefits. The authors conclude that evidently interest in this field has been growing in the last decade, 'but there is still a shortage of empirical evidence of the beneficial effects of therapeutic gardens in relation to the type and severity of dementia, and of garden design guidelines.'	https://pubmed.ncbi.nlm.nih.gov/34574519/

The Positive Effects of Viewing Gardens for Persons with Dementia	Goto et al	2018	Nature connection in care settings (indoor intervention)	Viewing Japanese gardens is holistic, and a low cost way to improve the quality of life of PLWD.	https://pubmed.ncbi.nlm.nih.gov/30507568/
Characteristics and Challenges for the Development of Nature-Based Adult Day Services in Urban Areas for People with Dementia and Their Family Caregivers	Hassink et al	2019	Connection/benefits with nature (challenges)	Services in urban areas were explored, where 17 service providers were interviewed. Challenges to providers were described, such as recruiting volunteers.	https://pubmed.ncbi.nlm.nih.gov/31013959/
Differential responses of individuals with late-stage dementia to two novel environments: a multimedia room and an interior garden	Goto et al	2014	Connection/benefits with nature (indoor intervention)	Viewing Japanese garden reduced stress in comparison to Snoezelen room, in PLW advanced dementia in nursing homes (American cohort). Heart rate and behavioural changes were measured.	https://pubmed.ncbi.nlm.nih.gov/25024307/
The Power of Traditional Design Techniques: The Effects of Viewing a Japanese Garden on Individuals With Cognitive Impairment	Goto et al	2017	Indoor intervention	Viewing Japanese gardens reduced heart rate in a Japanese cohort.	https://pubmed.ncbi.nlm.nih.gov/28643564/
An evaluation of a therapeutic garden's influence on the quality of life of aged care residents with dementia	Edwards et al	2013	Nature connection in care settings	Therapeutic gardens can improve the quality of life of PLWD and their carers.	https://pubmed.ncbi.nlm.nih.gov/24336957/
When Art Meets Gardens: Does It Enhance the Benefits? The Nancy Hypothesis of Care for Persons with Alzheimer's Disease	Jonveaux	2018	Connection/benefits with nature (design of outdoor areas)	Enhanced design of garden with art is explored. (Full access is around £30)	https://pubmed.ncbi.nlm.nih.gov/29332052/

	Psychological impacts of intervention to improve a therapeutic garden for older adults with dementia: a case study conducted at a care facility	Meneghetti	2023	Nature connection in care settings	PLWD were encouraged to visit a newly renovated therapeutic garden in a care home. The residents who frequented the garden (10 of the 21 group) and had increased social behaviour then showed less severe baseline depressive symptoms.	https://pubmed.ncbi.nlm.nih.gov/37234215/
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Appendix C. Results generated from Clinicaltrials.gov.

Search Term	Title	Author	Year	Theme	Key message	Link
Garden	Enriched gardens improve cognition and independence of nursing home residents with dementia: a pilot controlled trial	Bourdon et al	2021	Nature connection in care settings	Enriched gardens offer a new approach to therapeutic mediation for PLWD in nursing homes. Cognitive function measured by MMSE scores were improved when residents frequented an enriched garden, in comparison to frequenting a conventional sensory garden or not visiting a garden at all.	https://pubmed.ncbi.nlm.nih.gov/34134758/

Appendix D. Results generated from Cochrane Library.

Search Term	Title	Author	Year	Theme	Key message	Link
Outdoor	Light therapy for improving cognition, activities of daily living, sleep, challenging behaviour, and psychiatric disturbances in dementia	Forbes et al	2014	Indoor intervention (light therapy)	A review which concludes that indoor light intervention does not appear to show any benefits for PLWD. However, there are citations within the text for links to the benefits of outdoor light for PLWD.	https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD003946.pub4/full
	Therapeutic Effects of an Outdoor Activity Program on Nursing Home Residents with Dementia	Connell et al	2007	Connection/benefits with nature (outdoor intervention)	Outdoor light/bright light exposure increased sleep and behaviour disturbance in nursing home residents LDW.	http://drbalcom.pbworks.com/w/file/attach/63336518/connell_sanford_lewis_therapeutic_2007.pdf
Horticulture	Effect of horticultural therapy on apathy in nursing home residents with dementia: a pilot randomized controlled trial	Yang et al	2021	Nature connection in care settings	A trial whereby horticultural therapy was found to be feasible for PLWD and apathy. The therapy reduced apathy, and promoted cognitive function, but effects on quality of life and functional capacity were not observed.	https://www.cochranelibrary.com/central/doi/10.1002/central/CN-02263065/full
	Comparing responses to horticultural-based and traditional activities in dementia care programs	Jarrott et al	2010	Nature connection in care settings	The value of horticultural therapy was demonstrated on behaviour and engagement in the care setting.	https://www.cochranelibrary.com/central/doi/10.1002/central/CN-00786106/full