



The use of nature – based activities for the well-being of older people: An integrative literature review



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ABSTRACT

Background: During the last decades scientific literature has focused on the positive relationships between Nature - Based Activities (NBA) and health. The aging of the population and the increasing costs of health services make it important to investigate the benefits for older people.

Objective: The purpose of this study was to systematically review the existing literature regarding Nature – Based Activities addressed to older people.

Methods: A systematic search of the literature was made in PubMed, Web of Science and Scopus from 2005 till December 2018.

Results: We identified 42 articles that satisfied the inclusion criteria. The results highlighted the multi-disciplinary use of nature in many settings as well as a variety of different research designs, both quantitative and qualitative. The majority of experimental assessments were carried out in the setting of nursing homes and residential facilities. A variety of treatments, e.g. horticultural therapy, gardening, green visiting, green exercise and of settings, e.g. residential facilities or adult day services, participants' homes, outdoor settings, and green care farms were examined.

Conclusions: The examined studies offered numerous examples of the healing power of nature for the health and well-being of older people. Occupational therapists could gain substantial insight from earlier experiences of NBA for application in their practices.

1. Introduction

Wright and Lund introduced the concept of gray and green (Wright and Lund, 2000) emphasizing the need for awareness on the role of environment and nature for successful aging. In 2006 a review of the literature of Maller et al. highlighted in many respects the vital role of contact with nature for human health, suggesting the potentials in population-wide strategy of prevention and recommending for further investigations on the benefits of nature-based interventions (Maller et al., 2006). Afterwards, a review of qualitative studies highlighted how gardening as an occupational activity offers significant implications for occupational practice development, encouraging occupational therapists to establish partnerships with organizations working in garden settings to utilize their unique services (York and Wiseman, 2012).

This may be particularly important for an aging population facing an increasing trend of chronic diseases. Projections show that from

2015 to 2080 the European older population between 65 and 80 years and over will be 28.7% of the total population in the EU-28, (Eurostat, 2016). In addition to the high levels of human suffering, the burden on health systems deriving from chronic diseases is estimated around 70% to 80% of all healthcare costs in the EU (OECD/EU 2016). The global strategy for healthy ageing is to prevent or postpone disability through health promotion and disease prevention, (WHO, 2002) and in this perspective the use of nature for health purposes may represent a non-pharmacological treatment for increasing the well-being of older adults and moderating demand for health and care services.

Previous literature reviews focusing on older people limited their search to the area of gardening as indoor or outdoor activities of planting and growing live plants, herbs or food whose benefits on mental or physical health were reported (Wang and MacMillian, 2013) or gardening as planned activities designed to promote physical health (Nicklett et al., 2016). In light of what has been done, our aim is to carry out a broad literature review including perspectives within a

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spectrum of Nature-Based Activities (NBA) as an inclusive form for many complex interventions including gardening and therapeutic horticulture, agricultural care and green exercise, performed in different places such as hospital settings and institutional accommodations as well as agricultural farms and own home (Sempik, 2010).

For this aim the following research questions were formulated:

- 1) which are the various interventions of NBA addressed to older people since the year 2005?
- 2) Which is the level of evidence of scientific literature on NBA?
- 3) Which is the clinic and care relevance of the interventions?
- 4) Can NBA add new perspectives for occupational therapists for application in their practices?

2. Research methodology

2.1. Literature search strategy

The search strategy was conducted following standard methods. After testing a variety of terms to compensate the difficulty of searching for a broad typology of interventions and eliminating those producing few or too much results, a Boolean search was conducted combining those terms which showed to be sensitive for the research aim, that is nature-assisted therapy (or horticultural therapy, green care, farm care, gardening, green exercise) AND older people (or old*,elderly, ageing, aging) AND health (or mental health, physical health, rehabilitation, well-being, wellbeing). Search engines were PubMed, Web of science and Scopus in force of their different characteristics, namely the focus on clinical, medical and biological scientific literature the first, on databases embracing several disciplines the second, and spanning across many disciplines and sources the last. On PubMed the search combined both free-text and mesh terms to avoid missing relevant articles. The search was restricted to articles published in peer-reviewed journals from 2005 till December 2018 (last update of the engine search before submission). English was the selected language.

2.2. Inclusion and exclusion criteria

Only original studies regarding NBA and older people were included. An integrative perspective was utilized, including studies of any design in order to capture the context, processes and subjective elements of the topic better (Whittemore and Knaf, 2005). Measures of all kinds were considered of interest. Reviews of the literature, abstracts, conference papers, books and book chapters, reports and letters to the editor were excluded. Duplicates and non-related papers were excluded before full text reading.

2.3. Studies' analysis

In order to appraise and synthesize research evidence in the area of study, we systematically analyzed the studies in the review in terms of their main conceptual and methodological characteristics. A data extraction form was utilized to extract information about: year of publication, the setting of the study, the activities included in the treatment, the sample characteristics, description of the research methods used and a summary of the main results. This information is presented in Table 1. Given the variety of studies and results that makes it difficult to achieve a comprehensive classification based on homogeneous criteria, a narrative summary of the evidence of each study is provided.

3. Results

The electronic search yielded a total of 1428 (Pub-Med: 319; Web of Science: 771; Scopus: 338) After title review n. 1310 were excluded. Full text articles assessed for eligibility, after abstract reading and removal of duplicates n = 69. Abstract screening was independently

conducted by the authors who removed articles that did not address older people, or did not focus primarily on NBA interventions. Additional references retrieved from reference list of the articles n = 7. Full text articles excluded n = 35, total articles included in the review 41 (Fig. 1).

3.1. Description of the selected studies

In the following description the selected studies have been grouped according to NBA and setting of activities, namely residential facilities or adult day services, participants' homes, outdoor settings, and green care farms in order to differentiate appropriately the treatments, as suggested by integrative method model (Whittemore and Knaf, 2005). In fact, depending on each setting, the variety of applications of NBA and participants' characteristics differed considerably.

Study designs were both qualitative and quantitative. Following the levels/hierarchy of evidence (Byiers et al., 2012; Ho et al., 2008), we indicated quantitative studies as "purely experimental" when the NBA consisted of a treatment randomly assigned to a specific group versus a control group to compare the health outcome. For the other types of experimental studies, we referred to each specific study design by describing some of its features. Finally, studies conducted in the absence of a treatment were categorized as descriptive studies (Table 1).

3.2. Horticulture and horticultural therapy in nursing homes/senior housing residences/adult day services

This typology of studies concerned older people living in residential facilities, whose psychological wellbeing and quality of life is to be improved by horticultural treatments, with the exception of one study treating post-stroke patients (Barello et al., 2016). Practices devoted to dementia care were grouped in a specific section. Three of ten papers were purely experimental studies, one was a quasi-experimental study, three were pre-post intervention studies, one was descriptive and two qualitative studies.

3.2.1. Quantitative studies

A significant difference in systolic and diastolic blood pressure was found in the randomized cross-over study of Hassan et al. (2018) after gardening, in a sample of depressed older women. Horticultural programmes in residential facilities yielded results in improving well-being and social connection of guests (Tse, 2010; Masuya et al., 2014; Chen and Ji, 2015). A significant decrease in depression (Chen and Ji, 2015; Masuya et al., 2014), an increase in satisfaction with life (Masuya et al., 2014; Tse, 2010), a reduction of feelings of isolation and loneliness (Chen and Ji, 2015; Tse, 2010), and an increase in self-perceived health (Dahlkviste et al., 2016) were the main benefits reported. An improvement in subjective happiness was also reported in two studies (Lai et al. 2018; Yao and Chen, 2017).

3.2.2. Qualitative studies

Qualitative data indicated that the provision of end products (fruit and vegetables) was one of the most appreciated reasons for participating in the gardening programme (Wang and Glicksman, 2013). Moreover, therapeutic gardening stimulated patients' proactive attitude in coping with the disease, acting as a catalyst in the patient-therapist relationship (Barello et al., 2016). Qualitative results from mixed methods studies highlighted that most of the participants in horticultural programmes gained a higher level of satisfaction from the horticultural experience and maintained their engagement in cultivating herbs and plants six weeks after the programme conclusion (Perkins, 2012). Moreover, benefits on social connections and hope, sense of achievement and companionship emerged from the mixed method study of Chen and Ji (2015).

Table 1
Description of the selected studies.

Authors, publication year	Setting	Activity	Participants	Methods	Results
Horticulture and horticultural therapy in nursing homes/senior housing residences/adult day services Barello et al. (2016)	Rehabilitation hospital	Therapeutic gardening	22 neurological post-stroke patients. Age ranged from 60 to 88 years	Qualitative study. Semi-structured interviews and diaries were administered to participants. Mini Mental State Examination (MMSE) and the Cumulative Index Rating Scale were also administered.	Five main themes were identified from interviews and diaries: 1) the positive experience of nature, 2) therapeutic gardening as a protected self-expression space, 3) contact with nature as a boost for self-efficacy, 4) the plant as a catalyst of the patient-therapist relationship, 5) therapeutic gardening as a bridge between the hospital environment and the outside world. Post-stroke patients who engage in therapeutic gardening perceived it as a way to foster their active role in medical care, enabling a proactive and positive attitude towards disease management.
Chen & Ji (2015)	Nursing Home	Horticultural programme	10 subjects Mean age: 75.3	Pre-post-test study, mixed method. The Geriatric Depression Scale Short-Form (GDS-SF) and the Loneliness Scale version 3 (UCLA) were administered at baseline and on the 5 th and 10 th week of the intervention. Qualitative interviews on participants' experiences were performed at the end of the programme and analysed by content analysis.	After the 10 weeks programme the depression rate decreased from 8.1 to 3.6, below the cut-off value of 5, while the loneliness score decreased from 42.9 to 35.9. Four categories emerged from qualitative data: benefits on social connection and hope, sense of achievement and companionship.
Dahlkviste et al. (2016)	Residential care facilities	Visit to the garden/patio	290 subjects Mean age: 85	Descriptive study. The greenery and barriers indices (Cohen-Mansfield and Werner, 1999), the Perceived Restorativeness Scale (PRS), and the EQ-VAS (EuroQol- Visual Analogue Scale) were collected by means of questionnaires.	A significant positive relationship between garden visitation and self-perceived health was found. When residents reported higher levels of being away and fascination, they tended to report better self-perceived health.
Yao and Chen (2017)	7 nursing homes in Kaohsiung (Taiwan)	HT weekly programme over a 8 weeks period. Sessions were carried out indoor by a trained intervener who received a 30 hours HT training. Each participant grew a small plant in a small pot.	85 nursing home residents aged 65 and above without cognitive impairment and no visual or auditory impairment. Of the seven nursing homes participating voluntarily in this study, 4 were assigned to the experimental group (n = 41 subjects), three to the control group (n = 44 subjects).	Quasi-experimental study with a pretest post test design. Outcomes measures included daily living functioning (Barthel Index), Happiness (Chinese Happiness Inventory), meaning and purpose of life perceived by participants (The meaning of life scale) and interpersonal intimacy (Interpersonal Intimacy Scale).	The experimental group had higher post test scores on ADL (p = .001), happiness (p < .001) and interpersonal intimacy (p < .001). No significant difference was found on the meaning of life.
Hassan et al. (2018)	Istitutional care setting	Transplanting activity	40 older women experiencing psychological stresses and depression Mean age: 79.5	Randomized cross-over study design. EEG and blood pressure measurement. Psychological behavior investigated by means of the stress-arousal checklist (SDM 10) and the State-Trait Anxiety Inventory (STAI).	There was a significant difference in systolic and diastolic blood pressure. The results of the EEG show that 15 min after the plant task, the overall brainwave mean values were higher than those after the control task. The participants showed statistically significant changes in their psychological responses after 15 min of activity.

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Table 1 (continued)

Authors, publication year	Setting	Activity	Participants	Methods	Results
Lai et al. (2018)	4 nursing homes in Honk Kong	HT weekly programme over a 8 weeks period. Sessions were carried out by a registered horticultural therapist experienced in HT for vulnerable groups. Each session consisted of different HT activities (watering,trimming, seeding, ecc.) tailored on participants characteristics.	111 nursing home residents aged 70 and above with a moderate level of impairment (functional or cognitive). Participants were randomly allocated into the HT group (n = 56) and control group (n = 55). Each group was composed by 6 to 8 participants.	Randomized controlled trial. Participants were assigned randomly into the experimental (HT) or control (social activities) conditions. Outcomes measures included the General Self-Efficacy Scale, the Geriatric Depression Scale (GDS), the Subjective Happiness Scale (SHS), the Social Engagement Scale, the Lubben Social Network Scale and the Personal Wellbeing Index.	A significant improvement in subjective happiness was found in the experimental group compared to the control condition. No significant change was found for the other outcome variables.
Masuya et al. (2014)	Nursing home	Horticultural programme during a 6-weeks period versus routine care	18 subjects Experimental group 9 people Mean age: 89.0 Control group 9 people Mean age: 82.22	Pure experimental study. Pre-treatment and post treatment assessment were performed using: the Vitality Index (VI), the Geriatric Depression Scale (GDS-15), the Activities of Daily Living Scale (ADL-20) and the Mini-Mental State Examination (MMSE). QOL was assessed using a set of items from the visual analogue scale.	After the interventions no significant changes were observed in the Vitality Index, the MMSE and the ADL scores of both groups. The GDS-15 score and the "satisfaction with life" QOL subscale score significantly improved ($P < 0.05$) in the intervention group compared to the control group.
Perkins (2012)	Age-restricted Residences	Horticultural programme based on an adaptation of the structured curriculum designed by researchers at Virginia Polytechnic Institute and State University (Blacksburg -Virginia- Usa)	31 subjects Mean age: 72 divided into a treatment and a waitlist control group	Pre-post-test study, mixed method. Measures used included the World Health Organization Well-being Index (WHO-5), the Rosenberg Self Esteem Scale (RSES), the Friendship Scale (FS) and a garden questionnaire developed by the investigator. All measures were administered before the intervention, after the intervention and 6-weeks post intervention. An exit survey was administered 6 weeks post intervention to gather qualitative data.	After the horticultural programme a significant improvement was observed in the level of self-esteem of the participants. No significant differences were found in relation to psychological wellbeing and social connectedness between in both groups after the intervention. Qualitative data from exit surveys indicated that participants gained a high level of satisfaction from the horticultural experience.
Tse (2010)	Nursing home	Gardening programme versus routine care	53 subjects Experimental group 26 people Mean age: 85 Control group 27 people Mean age: 83	Pre-post-test study. Participants were evaluated before and after the gardening programme using: the Life Satisfaction-A Index Form, the Loneliness scale revised (UCLA), the Lubben Social Network Scale (LSNS) and the Modified Barthel Index.	After the gardening programme significant improvements in all the psychological parameters (Life satisfaction, socialisation and loneliness) were observed in the experimental group compared to baseline, but no such improvements were found in the control group. No changes in activities of daily living were found in both groups after the intervention. Nine themes emerged as relevant in determining the senior's participation in the programme: the perceived mental health benefits, the provision of final products, the continuity with past life, the sense of responsibility and accomplishments, the connection with nature, the cooperation with others, the opportunity to learn something new and the physical benefits. The self-administered survey results indicated the provision of fruits and vegetables as the most appreciated reason to participate.
Wang and Glicksman (2013)	Senior housing	Community gardening programme	20 subjects Mean age: 71.5	Qualitative study. A focus group to discuss benefits and motivations for participation was held at the end of the gardening programme. A short self-administered survey, including questions on reasons for gardening and socio demographic aspects, was also administered.	(continued on next page)

Table 1 (continued)

Authors, publication year	Setting	Activity	Participants	Methods	Results
Horticultural therapies devoted to people with dementia Edwards et al. (2013)	Nursing home	Attending a therapeutic garden in the residential facility	10 subjects with a diagnosis of dementia ranging from mild to severe, and their carers. Mean age: not available	Pre-post-test study. The Mini Mental State Examination (MMSE) was used to assess the dementia level of each participant at the baseline. The Dementia Quality of Life Instrument (DEM-QOL and DEM-QOL Proxy), the Cornell Scale for Depression in Dementia (SCDD) and the Cohen Mansfield Agitation Inventory (CMAI) were used to measure quality of life of participants three months before and three months after the new garden construction	After attending the garden, residents reported a lower score in both agitation and depression. Moreover, an increase in their quality of life was observed.
Gigliotti, and Jarrott (2005)	Adult day Centre	Horticultural programme during a 9-weeks period versus Adult Day Services activities	48 subjects with a diagnosis of dementia Mean age: 80	Observational method study, mixed-method. An observational tool to assess the engagement and the affect (mood) of the participants during HT activities and traditional activities were used by two trained research assistants. A short interview targeting participants' opinions on HT activities was performed at the end of each session	Results confirmed significant differences in the amount of time that participants spent actively engaged during the horticultural programme compared to ADS activities. The average affect score for horticultural activities was 2.43 (Max = 5), while the average affect score for ADS activities was 1.90
Hall et al. (2016)	Therapeutic garden at long-term care home	Horticultural programme	14 subjects with a diagnosis of dementia Mean age: 84	Observational study, mixed methods. An observational tool (dementia care mapping) was used to determine the state of wellbeing during horticultural therapy. Narrative notes were recorded by the research team.	The study evidenced that during therapeutic gardening participants reported higher level of wellbeing.
Jarrott and Gigliotti (2010)	Nursing home and adult day centre	Horticultural programme versus traditional leisure activities	129 subjects with a diagnosis of dementia Mean age: 80.09 Experimental group 75 people Control group 54 people	Pure experimental study. An observational tool including the Apparent Affect Rating Scale (AARS) and the Menorah Park Engagement Scale (MPES) were used by trained observers.	After the intervention the horticultural programme group demonstrated higher levels of adaptive behaviour (such as active or passive engagement) than the comparison group. Traditional activities group exhibited higher levels of maladaptive behaviour (such as self-engagement). No group differences were observed on any affective state.
Kang et al. (2010)	Adult day centre service	Integrated dementia intervention including four components: horticulture, cognitive stimulation training, music and art during a 9-week period versus routine care	38 subjects with a diagnosis of mild dementia aged 65 and older Experimental group 20 people Control group 18 people	Pre-post-test study. The Korean version of Mini Mental State Examination (MMSE-K), the Korean version of Geriatric Depression Scale (K-GDS) and the Mental Emotional Health assessment tool of Choi, Back and Lee were utilized to assess cognitive function and depression before and after intervention.	After the integrated intervention, the median cognitive function score in the treatment group increased from 17.78 to 22.03, while in the control group the score decreased from 21.49 to 16.69. The median depression score decreased from 21.30 to 13.75, while in the control group the score increased from 17.50 to 25.89. The mental-emotional health score increased from 38.85 to 45.45 in the experimental group, while the increase in the control group was from 37.00 to 38.00.
Lee and Kim (2008)	Nursing Home	Indoor gardening programme during a 5-weeks period (1 week of baseline and 4 weeks of treatment)	23 subjects with a diagnosis of dementia Mean age: not available	Repeated measures study. Twenty-four hours sleep diaries including parameters such as sleep onset (pm), wake up time (am) and wake after sleep onset (WASO) were recorded during 1 st and 5 th week of the study period. Agitation was evaluated using the Modified Cohen-Mansfield Agitation Inventory (M-CMAI). Cognition was evaluated using the Hasegawa Dementia Scale Revised (HDS-R).	Indoor gardening was associated with significant improvements in wake after sleep onset (WASO), naps, Nocturnal sleep time (NST) and Nocturnal sleep efficacy (NSE). Sleep onset and wake-up time, which are determined by circadian phases did not change after the programme. Improved cognition and reduced agitation were observed.

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Table 1 (continued)

Authors, publication year	Setting	Activity	Participants	Methods	Results
Luk et al. (2011)	Nursing home	Horticultural programme during a 6-weeks period versus traditional leisure activities	13 subjects with a diagnosis of dementia Mean age: 84.9 Experimental group 7 people, Control group 6 people	Pure experimental study. Agitation was evaluated in a pre and post treatment using the Chinese version of the Cohen-Mansfield Agitation Inventory (C-CMAI). Cognitive function was evaluated using the Chinese version of Mini Mental State examination (C-MMSE).	No significant reduction of agitation was observed after the intervention. Two trends were noted in the correlation results: horticultural activities decreased the frequency of agitated behaviour in those subjects with relatively low C-MMSE score, while increased agitation in those with relatively higher cognitive functioning.
Park et al. (2008)	Group-home for elderly people with dementia	Seven Months Horticultural programme (once a week from June 21, 2005 to January 10, 2006 for a total of 20 times)	16 female residents with a mean age of 81.3 years	Case Study. Activities of Daily Living (ADL) were measured three times using the ADL Scale -Japanese version, 13-item. Emotional response to activities, enthusiasm for the activities and level of cooperation during the activities were assessed five times over the seven-month programme with the help of the assistive staff	ADL was significantly improved, especially intellectual activities. Cooperation significantly increased at the second test and then was maintained. Significant changes were found between pre-horticulture activity and post-horticulture activity in the faces scales in all five surveys.
Garden resting and views					
Dalton et al. (2016)	Home neighbourhood	Exposure to neighbourhood greenspace	15,673 participants Mean age: 62	Longitudinal cohort study. Physical activity level was evaluated at baseline and at follow-up with the Physical Activity Questionnaire (EPAQ2)	Participants in the greenest quartile were more physically active than those in the least green quartile, measured in metabolic equivalent cost (MET) at baseline. Decline in physical activity was lower in greener neighbourhoods at follow-up. The wander garden stage of the stroke rehabilitation programme helped the patient to overcome a period of treatment resistance, enabling him to achieve his treatment goals. Most of the benefits usually related to restorative environments, such as improved attention, stress reduction, improved mood and self-esteem were observed in the patient during his wander garden treatment stage. The landscape of the Japanese Garden induced viewers to scan a wide area, increased alertness and decreased physiological stress compared to viewing a control unstructured garden space. The introduction of olfactory elements further lowered heart rate. Design characteristics of the Japanese garden recalled old memories associated with the scenery in many observers. Allotment garden emerged as a context for social experience, for restorative experience and for reminiscence. Post-intervention GDS scores (mean 9.4) were significantly lower than before the garden walking intervention (mean 13.0). Qualitative interviews, focused on the participants' reflective writing, confirmed the reduction of depressive feelings in the sample.
Detweiler and Warf (2005)	Dementia wander garden in nursing home	Stroke rehabilitation programme	1 subject aged 74	Case-study. The restorative programme was held in the wander garden	
Goto et al. (2017)	General Hospital (Japan)	Viewing a Japanese Garden in four different conditions: 1) viewing a non-Japanese Garden through an open glass door (control condition); 2) Viewing the Japanese Garden; 3) Viewing the Japanese Garden with door closed; 4) Viewing the Japanese Garden with door closed plus aroma.	25 Japanese older people with middle-late stage dementia.	For each session a member of the medical staff familiar with the subject filled out a behavioural assessment checklist. Checklist contents was reviewed using videos taken during the experiment by experienced researchers. Heart rate was monitored using a fingertip heart rate monitor. An eye tracking monitor was used for the eye movement test and an olfactory test was performed using a vaporizer(creating a chrysanthemum-like aroma). Qualitative study with semi-structured interview. Malterud's strategy for systematic text condensation was applied Pre-post-test study, mixed method. GDS (Geriatric Depression Scale) was administered before and after completing 12 walks. A feedback form asking participants' reflections gathered from the garden walks was collected at the end of the intervention and discussed during a semi-structured interview with the researcher.	
McCaffrey et al. (2010)	Garden at the Morikami Museum Gardens (Delray Beach, Florida)	Reflective garden walking programme	8 healthy elderly 40 subjects with physician diagnosed or self-diagnosed depression Mean age:71.3		

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Table 1 (continued)

Authors, publication year	Setting	Activity	Participants	Methods	Results
Ottosson and Grahn (2006)	Senior housing	Resting in a garden versus resting indoors	15 subjects Mean age: 86	Pre-post-test study. Power of concentration, blood pressure and heart rate measures were collected before and after an hour of rest in a garden and in an indoor setting. Power of concentration was tested using the Necker Cube Pattern Control Test (NCPC), Digit Span Forward (DSF), Digit Span Backward (DSB) and The Symbol Digit Modalities Test (SDMT). Background data (e.g. socio-demographic characteristics, questions on residents' past homes, and preferences regarding their surroundings) were collected by means of structured interviews with participants and staff members.	Both the conditions (resting outdoors/indoors) increased participants' power of concentration, whereas no significant effects were found on blood pressure or heart rate. Correlation results showed that participants with low psycho-physiological balance at the outset benefited more from resting outdoors than subjects with higher levels of balance.
Ottosson et al. (2015)	Natural environment	Walking test in a specially designed outdoor setting: a hedge opening with or without a built element (i.e. the doorframe passage)	5 subjects with Parkinson's disease (PD) Mean age: 65.2	Single subject study, mixed methods. An experiencing sample methodology approach (ESM) was used to gather data concerning freezing of gait (FOG) experiences from PD patients. Gait pattern data were collected by means of an accelerometer and the entire walking sequence was videotaped. Self-estimation of FOG reactions were measured before and immediately after each test round.	No FOG reactions were observed during the hedge opening without a built element condition, whereas two out of five subjects had clear FOG reactions when a doorframe was added to the hedge opening.
Rappe and Kivela (2005)	Activity garden at a nursing home	Garden visiting and viewing	30 subjects (17 independently mobile and 13 using some assistive device for walking) Mean age: 84	Descriptive study. A questionnaire including open-ended questions and scaled statements on socio-demographic aspects, garden visiting and perceived effects of garden stays was administered to the sample. The Zung self-rating depression scale (ZSDS) was also administered.	The prevalence of depression was high in the sample (46% of the total). Visiting the garden was associated with enhanced emotional well-being both in depressed and non-depressed participants. Half of the depressed patients assessed their health to be poor, and two-thirds of them mentioned the unavailability of assistance as the main hindrance to garden visiting.
Wu et al. (2015)	Home neighbourhood	Exposure to green space and gardens	2,424 participants Median age: 81	Descriptive cross-sectional study. Depression and anxiety symptoms were measured by means of the Geriatric Depression Scale (GDS) and the associated diagnostic algorithm (AGECAT).	A high exposure to natural environments, such as green spaces and gardens in communities was associated with fewer mental disorders among older people.
Gardening activities for community-dwelling older people Chen and Janke (2012)	Home garden	Domestic gardening, yard work	3237 subjects Mean age: 74.20	Descriptive study. Data retrieved from the Health and Retirement Study (HRS 2006) and the Consumption and Activities Mail Survey supplement (CAMS) including questions on health (number of falls in the last two years, number of chronic conditions and functional limitations) and gardening habits. Three balance tests (the side by side, semi-tandem and full-tandem stances) and a gait speed test (the timed walk test) were performed at participant's homes.	Gardening was associated with better health status in terms of a number of chronic conditions and functional limitations reported (e.g. gardeners were significantly less likely to report a fall in the previous two years). Gardeners compared to non-gardeners showed better performances in the balance and gait speed tests.
Cheng et al. (2010)	Home garden	Domestic gardening	433 subjects Age: 55 years and over	Descriptive study. Self-administered questionnaire survey including Leisure Satisfaction Scale (LSS) and a multiple-choice questionnaire, including level of garden engagement, contribution of gardening to overall life satisfaction, gardening related variables and socio-demographic aspects.	Older gardeners obtained high level of leisure satisfaction from gardening, especially in regard to relaxation, psychological well-being and physiological needs. Participants who identified themselves as serious gardening hobbyists reported the highest contribution of gardening in their overall life satisfaction.

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Table 1 (continued)

Authors, publication year	Setting	Activity	Participants	Methods	Results
Leaver & Wiseman (2016)	Parks, public and private gardens	Garden visiting	7 subjects aged between 60 and 81	Qualitative study. Individual semi-structured interviews were administered to participants whilst walking through public gardens in order to deepen how a garden visit is experienced.	Respondents explicitly discussed the physical, emotional, social and spiritual benefits of garden visiting. Visiting the garden is a source of profound pleasure and makes an important contribution to quality of life.
Léng and Wang (2016)	Home garden	Domestic gardening	1,029 gardeners Mean age: 66 years versus 3547 non-gardeners Mean age: 67	Longitudinal cohort study. Time dependent models were used to examine, after adjusting for mobility, depression, comorbidities, baseline confounders, the long-term effect of daily gardening on all-cause mortality.	Daily gardeners had lower mortality than non-gardeners after adjusting for age, sex and partner at baseline. For those with mobility limitations, daily gardening may increase longevity.
Ng et al. (2018)	Parks/gardens, nature reserve in Singapore	Indoor gardening, guided walks in the parks	59 elderly Mean age: 67.1 Experimental group 29 people Control group 30 people	Randomized Controlled Trial. Biological and psychosocial data were collected. Biomarkers included IL-1, IL-6, sgp-130, CXCL12/SDF-1, CCL-5/RANTES, BDNF (brain-derived neurotrophic factor), hs-CRP, cortisol and DHEA (dehydroepiandrosterone). Psychosocial measures examined cognitive functions, depression, anxiety, psychological well-being, social connectedness and satisfaction with life.	
Park et al. (2008)	Home garden	Domestic gardening	14 subjects Mean age: 72	Observational method study. Observation and metabolic measures (HR and VO2) during gardening sessions. A short form of the 36 Health Survey (SF-36) was administered.	Daily gardening can be considered as a moderately intense physical activity (3.8 ± 1.4 metabolic equivalents). SF-36 data indicated that health conditions of gardeners were above average, while that of their norm-based cohort was below average.
Park et al. (2012)	Garden at the Konkuk, University Campus, (Seoul, South Korea)	Making a vegetable garden, propagating herbs, transplanting	17 subjects Mean age: 66.9	Observational method study. Metabolic equivalents measures Heart Rate (HR) and Volume of Oxygen (VO2) were collected during the three activities.	Make a vegetable garden was found to be a moderate physical activity (PA) for adults over 65 (3.7 ± 0.7 metabolic equivalents). Propagating herbs and transplanting were found to be low intensity physical activities (2.4 ± 0.5 METs and 2.7 ± 0.5 METs, respectively), suited for subjects that require a lower level of PA.
Scott et al. (2014)	Home garden	Domestic gardening	331 subjects Mean age: 68.86	Descriptive study. Mail or online survey, including a garden activity inventory, socio-demographic aspects, self-rated measures on health status and an open answer questionnaire exploring what respondents felt were the most satisfying aspects of their gardening activities and the perceived benefits related to domestic gardening.	Participants reported numerous psychological, physiological and tangible benefits of gardening. The majority of them expressed the desire to continue engaging in gardening activities as they age, adapting or modifying the manner to perform certain activities or tasks.
Van Den Berg et al. (2010)	Allotment garden site	Gardening	184 subjects Age < 62 years: 93 people ≥62 years: 91 people	Descriptive study. A survey questionnaire including questions on respondents' health status, use of health care, well-being (life satisfaction, loneliness, social contacts with friends) and physical activity was administered to allotment gardeners (121 subjects) and their neighbours (63 subjects) without an allotment.	Allotment gardeners of 62 years and older reported better scores on all measures of health and wellbeing than neighbours in the same age category, whereas younger gardeners not differ in health and well-being from younger neighbours.

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Table 1 (continued)

Authors, publication year	Setting	Activity	Participants	Methods	Results
Green care at agricultural farms de Boer et al. (2016)	Green care farms and large- and small-scale nursing home care environments	Daily lives of the residents	158 subjects with a diagnosis of dementia Mean age: 84	Observational longitudinal study. Primary outcome was the daily life of residents assessed by means of the Maastricht electronic daily life observation tool (MEDLO-tool). Secondary outcomes were measured by means of the Revised Index for Social Engagement (RISE), the Quality of Life Alzheimer's Disease (QoL-AD), the Dementia specific quality of life scale (QUALIDEM) the Neuropsychiatric Inventory Nursing Home version (NPI-NH) and the Cohen Mansfield Agitation Inventory (CMAI). Cross-sectional design.	Residents of green care farms were significantly less involved in passive activities compared with residents of both traditional and small-scale nursing homes, while more were involved in outdoor green exercise. It can be argued that the farms add some unique characteristics, such as gardens, animals and outdoor areas allowing them to initiate activities and go outside whenever they want.
de Boer et al. (2017)	Green care Farms, nursing homes and regular small-scale living facilities	Attending day care services	115 subjects with a diagnosis of dementia Mean age: 83.8	Quality of life was measured by means of the Quality of Life-Alzheimer's Disease scale (QoL-AD) [19] and the QUALIDEM Home version (NPI-NH) was used to measure behavioral Symptoms. Agitation was measured using the Cohen Mansfield Agitation Inventory (CMAI), The Cornell Scale for Depression (GSD) [27] was used to assess signs and symptoms of depression. Cognitive impairment at the time of the study was assessed with the Standardized Mini-Mental State Examination (S-MMSE)	Self-reports of the QoL-AD did not differ significantly between green care farms and the other types of nursing homes, however, they did indicate a meaningful difference (3 or more points) between residents of green care farms and residents of traditional nursing homes
de Bruin et al. (2010)	Care farms and residential homes	Attending day care services	Residential home 30 subjects Mean age: 77.6; care farms 25 subjects Mean age: 81.9	Cross-sectional study. Aimed at comparing dietary intake of older people with dementia attending day care at residential homes or care farms.	The study suggests that the type of day care provided at care farms stimulates dietary intake. Energy and fluid intake were significantly higher in the care farm group than in the residential home group.
de Bruin et al. (2015)	Care farms and adult day care centres	Attending day care services	n. 51 dyads composed of people with dementia and their family caregivers (care farm group 21 people Mean age: 71 care farm waiting list 12 people Mean age: 76.1 day care facility group 17 people Mean age: 85.4	Qualitative study. Semi-structured interviews were administered to explore social participation at care farms for patients and caregivers. Content analysis was utilized to analyse data.	Both groups indicated that day services attendance resulted in more social interactions and gave them a sense of belonging. Clients of the farm do not feel they are in a care setting but rather in a normal daily life setting. This is mainly due to the fact that the activities at the farm are part of the daily routine of the farm.

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Table 1 (continued)

Authors, publication year	Setting	Activity	Participants	Methods	Results
Han et al. (2018)	Care farm, outdoor garden	Horticultural programme	28 elderly with mental health problems Experimental group 14 people Mean age: 80.1 Control group 14 people Mean age: 77.4	Pre- and post-test design with experimental and control groups. Senior Fitness Test to assess physical functional ability. The Senior Fitness Test comprises six subtests and measures muscle strength in the upper and lower body, flexibility, agility, aerobic endurance, and balance. Saliva samples were collected noninvasively from all participants and subjected to cortisol measurements. Qualitative study. Semi-structured interviews were performed with elderly, care farmers and care professionals. Content analysis was utilized to analyse data.	The most valued aspects of care farms mentioned by older people were: the sense of community of the farm, the personal and involved attitude of the farmer, the provision of close to normal life activities, the ability to choose activities that meet their individual wishes and the opportunity to spend time in a natural environment. The same aspects were also considered relevant by care farmers and care professionals.
Hassink et al. (2010)	Care farms	Daily care activities at the farm	12 frail older people without severe signs of dementia		

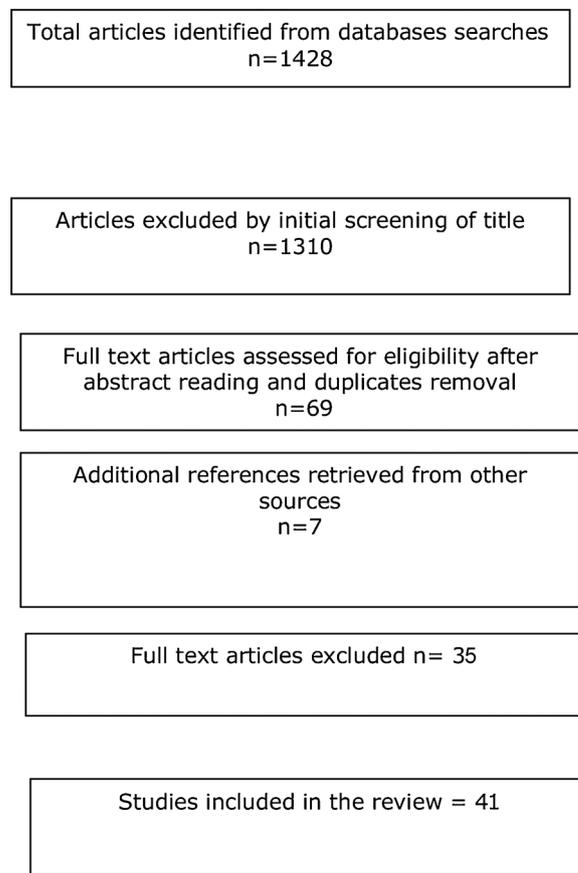


Fig. 1. Results of search and study selection process (flow chart).

3.3. Horticultural therapies devoted to people with dementia

Of the eight papers considered in this sub-section, two were purely experimental studies, the others were respectively a repeated measure design study, a case study, two observational designs, and two pre-post intervention studies.

3.3.1. Quantitative studies

Two studies reported a significant decrease in patient agitation after attending a therapeutic garden in a residential facility and after an indoor gardening programme was implemented, respectively (Edwards et al., 2013; Lee and Kim, 2008). Horticultural activities lowered the frequency of agitation in severely cognitive-impaired patients in the study by Luk et al. (2011), suggesting the potential for horticulture to lower agitation in a late stage of the disease. Other findings of the above studies concerned improvements in depression (Edwards et al., 2013), cognitive function and sleeping patterns (Lee and Kim, 2008), activities of daily living (ADL), cooperation with peers and general quality of life (Park et al., 2008), and in well-being (Hall et al., 2016). Horticultural activities, in comparison with traditional leisure activities, significantly increased the average time that patients spent actively engaged in their tasks (Gigliotti and Jarrott, 2005), and roused higher levels of adaptive behavior (Jarrott and Gigliotti, 2010). A study using horticulture as part of a multi-component dementia care programme, also including cognitive stimulation training, music and art, obtained relevant improvements in cognitive function, mental health status and depression (Kang et al., 2010).

3.3.2. Qualitative studies

Qualitative section of the mixed method study of Hall et al. (2016) was aimed to highlight how horticultural activities appeared to impact on perceived participant wellbeing. Four themes were identified: the

positive choice of combining structured/unstructured activity to stimulate participation, the importance of teamwork, frequent episodes of garden reminiscence associated with extremely high levels of well-being, and the positive risk-taking (light sunburn dehydration, fatigue) allowing others to learn from these.

3.4. Garden resting and views

Studies exploring the positive effects of the exposure to green environments without any active engagement of the participants were collected in this section. This typology of studies concerned both older people suffering of mental disorders, stress, Parkinson disease and healthy subjects living in the community.

Of the nine studies included, two were pre-post treatment studies, one an observational study, one a longitudinal cohort study, two were descriptive studies, one a case-study and two qualitative studies.

3.4.1. Quantitative studies

Time spent resting in a garden setting was shown to be advantageous to restoration from stress when compared to time spent indoors (Ottosson and Grahn, 2006). Viewing a Japanese garden induced a decrease of physiological stress in subjects with middle-late stage of dementia (Goto et al., 2017). Depression rates of a group of older people significantly decreased after a garden walking intervention of 12 weeks (McCaffrey et al., 2010), while subjective well-being of both depressed and non-depressed seniors changed positively during garden visits or being on the balcony overlooking the garden (Rappe and Kivela, 2005). A green environment was used to achieve a therapeutic goal in the case-study of Detweiler and Warf (2005), overcoming treatment resistance of a 74-year-old male patient. Two studies examined the effects of being exposed to green spaces in the home neighborhood: Dalton et al. (2016) highlighted that elderly people living in very green areas were more physically active than those living in less green areas. Wu et al. (2015) noticed that exposure to green spaces was associated with less mental disorders in older people.

3.4.2. Qualitative studies

Qualitative findings from the mixed method study of Mc Caffrey et al. (2010) emerging from the participant's reflective writing, highlighted a reduction of depressive feelings after a garden walking programme. Natural environments compared to build environments decreased freezing of gait reactions in five Parkinson's disease patients in the single subject design study of Ottosson et al. (2015), suggesting that patients could obtain benefits by stays in natural surroundings.

3.5. Gardening activities for community-dwelling older people

This typology of studies concerned older people in good health and living in the community. Of the nine studies focused on gardening for community-dwelling older adults, one was a pure experimental study, one a longitudinal cohort study, two were observational tools studies, four were descriptive studies and a qualitative one.

3.5.1. Quantitative studies

Two studies (Park et al., 2008; Park et al., 2012) found that domestic gardening and growing a vegetable garden can both be considered as moderate physical activities for adults over 65 and as helping to improve health conditions. Moreover, examining participant metabolic equivalent (MET) values for three gardening tasks (e.g. growing a vegetable garden, propagating and transplanting), the authors found that tasks that worked the upper and lower body were moderately intense physical activities (e.g. making a vegetable garden), while those that worked primarily the upper body were less intense physical activities (e.g. propagating and transplanting), concluding that gardening is a practice suitable for subjects with different physical activity needs (Park et al., 2012). A study concerning allotment gardening showed

that gardeners of 62 years and older obtained better scores in health and well-being measures than their neighbors without an allotment in the same age category (Van den Berg et al., 2010). Another study suggested that domestic gardening, through its effect on health, balance and gait speed, could be beneficial in preventing the risk of falls in the elderly (Chen and Janke, 2012). The longitudinal study of Lêng and Wang (2016) highlighted that daily gardening is associated with lower mortality and increasing longevity for those elderly suffering from mobility impairments. Gardening in the park was associated to a significant reduction in plasma IL-6 level in the randomized trial of Ng et al. (2018). Other descriptive studies mainly underlined the subjective benefits of gardening, showing that older gardeners obtained a high level of leisure and personal satisfaction from gardening (Cheng et al., 2010; Scott et al., 2014) and that most of them would like to keep engaging in gardening as they age, adapting their manner to perform certain activities or tasks (Cheng et al., 2010; Scott et al., 2014).

3.5.2. Qualitative studies

The qualitative study of Leaver and Wiseman (2016) highlighted how garden visiting was considered by the respondents an important contribution to quality of life due to physical, emotional, social and spiritual benefits.

3.6. Green care at agricultural farms

This typology of studies concerned older people with dementia except one applied to a broader category of elderly with mental health problems (Han et al., 2018). Of the six studies included in this section, two were cross-sectional, one was a pre-post treatment study with experimental and control group, one an observational longitudinal study and two qualitative studies.

3.6.1. Quantitative studies

In the descriptive study which involved older people with dementia attending day care at a green care farm or at a traditional day care center, the daily dietary intake of each was compared (De Bruin et al., 2010). The results showed that energy and fluid intake at the green care facility were significantly higher than those at the traditional day care center. Elderly subjects with dementia living in large- and small-scale nursing homes or in green care farms were observed and compared in their daily life routines and in their levels of social engagement. Results highlighted that residents of green farms were significantly less involved in passive activities than residents of the nursing homes, where more were involved in outdoor and green exercise, engaged in more social interactions (De Boer et al., 2016) and presented higher levels of quality of life (De Boer et al., 2017). In the recent pre-post study of Han et al. (2018) the cortisol levels decreased significantly in a group of older people with mental health problems such as depressive or anxiety disorder and cognitive impairment performing horticultural therapy in the farm with respect of a control group.

3.6.2. Qualitative studies

Elderly people with severe signs of dementia were interviewed in the qualitative study developed in green care farms in the Netherlands (Hassink et al., 2010). Some people attending the farms for a few half days per week with the aim of reducing isolation and providing respite to their family, were asked to describe their stay and experience at the farm and what they valued most. Results were analyzed with the content analysis technique. Recurrent themes found by the analysis were the coziness of the group, the feeling of being valued, the personal relationship with the farmer, and an informal, non-care context of normal life, and the variety of real and useful activities. The qualitative study of De Bruin et al. (2015) was aimed at comparing three groups of older people with dementia and their family caregivers, respectively attending day care services at a green care farm, or on a waiting list for attending a green care farm or attending day care services at a more

traditional adult day center. The objective of the research was to evaluate factors associated with the selection of one type of day service over another and the value of services in terms of social participation in each group. Results highlighted that stimulation of participation was the main reason for attendance in all groups. The care farm group underlined mostly the involvement in useful and meaningful activities. One of the most interesting results was that the care farm attendants declared they did not feel to be in a care setting.

4. Discussion

The results highlighted the multidisciplinary use of NBA for the health of older people in many settings as well as the variety of research designs. Among all these, the majority of experimental assessments were carried out in nursing homes and residential facilities, due to more suitable contexts for designing such interventions. The major clinical outcomes concerned depression, agitation, sleep disturbance and cognitive functions and were consistent with those referred to the general population (Irvine and Warbler, 2002), and confirmed the usefulness of horticulture in rehabilitation programmes as a non-drug strategy for improving mental health. Qualitative findings as well were obtained by mean of thematic analysis, a method aimed at creating a condition of objectivity and methodological measurability, thus embracing a good technical approach to move qualitative results towards evidence-based medicine (Thomas and Harden, 2008). Psychological well-being and a decrease in loneliness highlighted by qualitative studies could have relevant implications for what concerns residential facilities design, and for the planning of healthcare and rehabilitative settings, suggesting the need to include green outdoor spaces.

Results from quantitative studies of community-dwelling gardening confirmed the health benefits of this practice by measuring the metabolic cost of activities and by finding a reduced likelihood of falling in the old population, thus contributing to a better understanding of the benefits of tending a home garden in old age by giving measurable results in the perspective of more effective therapeutic programmes. In fact, by using direct measures of health to quantify the benefits, it was possible to determine associations between the practice of home gardening and a reduced likelihood of falling in the old population. Home gardening studies highlighted the subjective perception of well-being and the satisfaction arising from gardening, thus offering a prospect of this practice as an adaptive occupation throughout the course of old age. Furthermore, gardening seems to be an activity that could be tailored to the participants' needs by allowing a progression in task complexity, confirming its relevance in preserving the quality of life of older people even when some physical limitation occurs.

Finally, most studies held in outdoor settings or green care farms emphasized the therapeutic effect of nature in providing an opportunity for multisensory stimulation of physical and cognitive competences, while improving self-esteem and sociability. The genuineness of the farm environment was able to offer to the participants a variety of pleasant and purposeful activities together with the possibility of learning new skills. Moreover, obtaining tangible results in terms of end products, such as fruits, vegetables or flowers, enhanced the sense of competence and self-fulfillment. In conclusion, green care farms experience added some unique characteristics to therapeutic programmes, consisting of both physical environment and the opportunities provided therein.

5. Conclusions: new perspectives for research and practice

The examined studies showed that human-nature interaction is highly appreciated by participants, providing an opportunity to develop connectedness with nature that satisfies physical, psychological and spiritual needs. One purpose of this review was to draw attention to the use of natural settings and activities as forms of therapy practice with the intention of adding new perspectives for occupational therapists.

What differentiates NBA from other therapeutic approaches in any setting, allotments, gardens, hospital grounds, farms, public parks, urban green spaces is the belief that the nature component is fundamental for the intervention, the role of plants bringing meaning to individuals first (Relf, 2006). The examined studies offer, therefore, numerous examples of the healing power of nature. Furthermore, the scientific evidence of results given by the selected studies contributes, in our opinion, to incentive occupational therapists gaining substantial insight from NBA earlier experiences for application in their practices, as previous authors have suggested (Parkinson and Vecsey, 2011; Sempik and Bragg, 2013). In this perspective the review can be useful in offering a wide prospect of the tools utilized in the examined studies, in order to properly select instruments in relation to specific therapeutic study design. In addition, innovative training in these subjects could be introduced to the professional path, for instance establishing partnerships with organizations working in garden settings (York & Wiseman 2012). To give an example, the United Kingdom Charity Thrive provided to professionals a training course in the use of gardening and Social and Therapeutic Horticulture together with a tool for the assessment of participants' progress, with the aim of assisting therapists in both setting goals for their clients and measuring progress and change (Thrive 2012). Future efforts to increase the scientific evidence could be in the direction of deepening the extent to which these programmes can be considered a valid option to address older people health needs, thus moderating demands for more intrusive and costly care solutions.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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