**Exposure to nature gardens has time-dependent associations with mood improvements for people with mid- and late-stage dementia: Innovative practice**

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**Abstract**

Exposure to green space and nature has a potential role to play in the care of people with dementia, with possible benefits including improved mood and slower disease progression. In this observational study at a dementia care facility in the UK, we used carer-assessed measures to **e**valuate change in mood of residents with mid- to late-stage dementia following exposure to a nature garden. We found that exposure to nature was associated with a beneficial change in patient mood. There was a non-linear relationship between time spent outdoors and mood outcome. Improvements in patient mood were associated with relatively short duration exposures to nature, and no additional measureable increases in mood were found with exposures beyond 80-90 minutes duration. Whilst further investigation is required before causality can be determined, these results raise important questions for policy about the integration of outdoor space into the design of dementia care facilities and programmes.

**Keywords**

care practice, garden, green care, green space, health, nature therapy

**Introduction**

Symptom management in people with dementia relies primarily on antidepressant and antipsychotic medication. However, the evidence of overall effectiveness is not clear-cut (Banerjee, 2009) and there is increasing interest in non-pharmacological approaches (Hulme, Wright, Crocker, Oluboyede, & House, 2010). A limited but increasing body of research links green spaces to a range of health benefits, including enhanced psychological wellbeing and improved self-esteem and mood (Lee & Maheswaran, 2011). Awareness is also growing of the preferences of people with dementia for walking, wildlife and favourite outdoor places (Mapes, et al., 2016).

A depressed emotional state in persons with dementia can be caused or intensified by psychosocial and physical environments, including poorly-designed living spaces (Department of Health, 2015). Opportunities to improve the environment through careful architectural design for dementia, or through the incorporation of nature and natural environments into care programmes and living spaces may provide a useful complement to other treatments (Detweiler, Murphy, Myers, & Kim, 2008), as well as contributing to other improvements in health (Annerstedt & Währborg, 2011).

Many people with dementia depend on their carers for opportunities to access and experience natural environments. Therapeutic interventions that are outside the normal range of treatments or require additional time and effort may present particular barriers. It is therefore important to deepen understanding of the relationship between exposure to nature and health gain, so that the therapeutic benefits of exposure can be maximised. In this study, we examine change in mood of people with mid- to late-stage dementia following carer-mediated exposure to a nature-rich garden. This is the first study to investigate specifically the associations between duration of exposure to nature and changes in mood for people at any stage of dementia.

**Methods**

Quantitative data were collected during 2012 on the mood of residents of a nursing home in the UK. These data were collected as part of a service development exercise in the care home during which data on the use of the outdoor space by residents, families and carers were routinely collected. The residents in the study were in the middle to later stages of dementia, and the patients themselves, their families and carers were informed about the service development exercise being conducted. The purpose was to evaluate the effectiveness of the service development which comprised garden design, implementation and staff training. External spaces had been extensively renovated and enhanced to encourage outdoor activity, through the provision of diverse planting including fruit trees and vegetable beds, and both passive and active spaces, following previously-established guidelines (Chalfont & Walker, 2013). The data were anonymised ahead of the specific analyses conducted for this paper. The academic authors had no access to individual details of patients or staff, and could not link data to specific individuals.

The data were derived from primary caregivers and activity coordinators, who were asked to complete datasheets on outdoor experiences of residents. Resident numbers were randomly assigned and anonymised, and data were collected on day of the week, day of the month, mood level of resident before going outdoors (carer-assessed score on a scale of 1-3, representing poor, medium and good respectively), time spent outdoors based on carer observation, and mood level of resident after returning indoors again (carer-assessed score as previously). Carer identities were recorded in an anonymised form, and patients were attended by different carers, depending on duty hours. The study was approved by the University of York Environment Department’s Ethics Committee.

We used a robust standard errors approach to analyse whether going outdoors was significantly associated with change in mood of residents, as scored by the caregivers. This allowed for having multiple observations on each person. We then used ordered logistic regression to evaluate the association between time spent outside and change in mood, both using the full dataset and then curtailing it for periods spent outside greater than 200 minutes, due to the highly skewed nature of the dataset. Data analysis was done using Stata version 12 (Stata Corps., College Station, Texas).

**Results**

Observations of patients were made fairly evenly during the week, with daily contributions to the total observations ranging from a minimum of 12.1% on Fridays to a maximum of 16.2% on Mondays. All months except January were represented in the observations, but 76.6% of outings occurred during May to September, with monthly contributions to the total observations over this period ranging from 12.1% in July to 18.6% in August. Patients were not observed every time they went outside, since observations depended on other duties of carers at the time. A total of 853 observations were carried out on 28 different individuals, with the number of observations per individual patient being highly variable, ranging from 1 to 79.

Mood score before going outside was related to mood score after going outside, and more participants increased their score than decreased it following time outside (Table 1). The data on changes in mood were recoded prior to analysis to -1 for a decrease in mood (whether by 1 or 2 points in the scale), 0 for no change, and +1 for an increase in mood (whether by 1 or 2 points on the scale). Robust standard errors showed there to be a significant increase in mood score (mean change score = 0.44, P < 0.001) after going outside.

Mood score before going outside was used as a categorical factor in an ordered logistic regression to determine the factors affecting change in mood. Time spent outside was a predictor of change in mood score, but this relationship was non-linear. To investigate this statistically, we therefore applied a square transformation to the time variable, subtracting a constant close to mean time (40.97 minutes) before squaring, to give an additional variable which is not highly correlated with time itself. Because the distribution of time spent outside was highly skewed (Table 2), we also excluded the three observations where time spent outside was greater than 200 minutes (240, 480 and 640 minutes, recorded from three different patients). Day of the week and month of the year were also included in the logistic regression model, but the only significant factors were mood before going outside, time and time2. Increasing duration of time spent outside was associated with increasing positive change in mood score but in a non-linear fashion (Figure 1). Marked improvements in mood were associated with outdoor time of only 20 minutes’ duration and the greatest benefits were associated with an outdoor time of 80-90 minutes’ duration. After this point, the extent of positive change in mood score declined with greater time spent outside, although the shape of this relationship is uncertain due to the relative lack of observations beyond this time.

**Discussion**

We found that exposure to nature was associated with an improvement in mood as measured by carer assessment, and that the magnitude of benefit was associated with the length of time for which the patient is exposed to the natural environment. The correlation between benefits obtained with time of exposure was non-linear, suggesting a target level of exposure may exist. The extent of benefits associated with exposure to a natural environment increased initially with time, but only up to a certain level. Above 80-90 minutes of exposure, there were no additional benefits associated with spending more time outside, and at durations of exposure greater than 100 minutes, the benefits reduced rapidly.

The nature-enhanced garden created at the nursing home, which formed the case study for this research, is just one example of a beneficial outdoor space for dementia care. Further investigation could also be made into the wide range of green spaces known to benefit people with dementia living in the community. These findings indeed corroborate the ‘Greening Dementia’ report (Clark et al, 2013) which demonstrated that over 95% of stakeholders identified ‘enhanced mood’ as a benefit of access to nature for people with dementia. There is potential for some of the beneficial features of these natural environments to be increased in larger, integrated design and care schemes that include both natural and built environments (Alcock, White, Wheeler, Fleming, & Depledge, 2014). Further work should be conducted to determine causality and investigate mechanisms, with a long-term goal of providing specific recommendations to inform policies and regulations on the development of dementia facilities, in terms of the size, quality and components of outdoor areas to supplement existing design recommendations and building regulations currently in place for the indoor environment.

It should be recognised that both this patient group and nature as an intervention pose considerable challenges for a methodologically-robust intervention study. Our approach was observational, and causality should not be inferred from the associations we recorded. However, the associations observed may provide the impetus for further, more detailed research focusing on causality and underlying mechanisms, and replicated across different residential care settings. Such research could also be extended usefully to other settings such as private homes, given the increase in dementia care at home (Hulme, Wright, Crocker, Oluboyede, & House, 2010) and include an analysis of the cost-effectiveness of such non-pharmacological treatments (Banerjee, 2009).

**Conclusions**

This study has demonstrated an association between duration of exposure to a nature-rich garden and the mood of patients with dementia. Specifically, it has shown that this association is non-linear and that substantial benefits through increases in mood are associated with relatively low levels of exposure to nature.

**Declaration of Conflicting Interests**

The author declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

**Funding and Other Acknowledgements**

HG and PCLW are grateful to the Economic and Social Research Council (ESRC) for funding through the Health of Populations and Ecosystems (HOPE) project (Grant Number ES/L003015/1). The views expressed are those of the authors and not necessarily those of the ESRC. GC is grateful to AW and the HIEC, NHS Central Lancashire as well as PH and Hica who made this service development work possible. We are especially grateful to the residents and care staff at the home, who contributed the data on which this study was based.

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**Figure 1**

 (a)



(b)



**Figures 1(a) and (b).** Pattern of association between change in mood score and time spent outside for (a) statistically modelled curve and (b) actual data. The skewed nature of the data means that the shape of the modelled curve beyond the peak has a high degree of uncertainty. Actual data are shown on a logarithmic scale, with the size of the symbol proportional to the number of episodes for that recorded time.

**Table 1.** Frequency table of observations showing mood scores before and after going outside.

|  |  |  |
| --- | --- | --- |
| Mood score before going outside | Mood score after going outside | Total |
|  | 1 | 2 | 3 |  |
| 1 | 75 | 121 | 105 | 301 |
| 2 | 34 | 303 | 190 | 527 |
| 3 | 4 | 1 | 20 | 25 |
| Total | 113 | 425 | 315 | 853 |

**Table 2.** Frequency distribution of time spent outside during each observation.

|  |  |  |
| --- | --- | --- |
| Time (minutes) | Frequency of observations | Percentage of observations |
| 10 | 11 | 1.82 |
| 15 | 44 | 7.27 |
| 25 | 12 | 1.98 |
| 30 | 200 | 33.06 |
| 35 | 1 | 0.17 |
| 40 | 11 | 1.82 |
| 45 | 18 | 2.98 |
| 60 | 79 | 13.06 |
| 90 | 17 | 2.81 |
| 120 | 41 | 6.78 |
| 150 | 4 | 0.66 |
| 240 | 1 | 0.17 |
| 480 | 1 | 0.17 |
| 640 | 1 | 0.17 |
| Total | 605 | 100.00 |