

ORIGINAL RESEARCH: EMPIRICAL RESEARCH –
QUANTITATIVE

Garden greenery and the health of older people in residential care facilities: a multi-level cross-sectional study

Eva Dahlkvist, Terry Hartig, Annika Nilsson, Hans Högberg, Kirsti Skovdahl & Maria Engström

Accepted for publication 4 February 2016

Correspondence to E. Dahlkvist:
e-mail: evadat@hig.se

Eva Dahlkvist RN
PhD Student/Lecturer
Faculty of Health and Occupational Studies,
University of Gävle, Sweden
Department of Health and Medicine,
Örebro University, Sweden

Terry Hartig MPH PhD
Professor
Institute for Housing and Urban Research,
Uppsala University, Sweden

Annika Nilsson PhD RN
Senior Lecturer
Faculty of Health and Occupational Studies,
University of Gävle, Sweden
Department of Public Health and Caring
Sciences, Uppsala University, Sweden

Hans Högberg PhD
Statistician
Faculty of Health and Occupational Studies,
University of Gävle, Sweden

Kirsti Skovdahl PhD RN
Professor
Faculty of Health Sciences, Buskerud
University College, Tønsberg, Norway

Maria Engström PhD RN
Associate Professor
Faculty of Health and Occupational Studies,
University of Gävle, Sweden
Department of Public Health and Caring
Sciences, Uppsala University, Sweden

DAHLKVIST E., HARTIG T., NILSSON A., HÖGBERG H., SKOVDAHL K. & ENGSTRÖM M. (2016) Garden greenery and the health of older people in residential care facilities: a multi-level cross-sectional study. *Journal of Advanced Nursing* 72(9), 2065–2076. doi: 10.1111/jan.12968

Abstract

Aims. To test the relationship between greenery in gardens at residential facilities for older people and the self-perceived health of residents, mediated by experiences of being away and fascination when in the garden and the frequency of visitation there. To examine how these indirect effects vary with the number of physical barriers to visiting the garden.

Background. Many older people in residential facilities suffer from complex health problems. Access to a green outdoor environment may enable psychological distance, engage effortless attention, encourage more frequent visitation and promote resident health.

Design. A multi-level, cross-sectional, correlational design.

Methods. Questionnaires were administered June–August, 2011 to convenience samples of residents at 72 facilities for older people with complex healthcare needs. One to 10 eligible residents were sampled during self-motivated garden visits at each facility ($n = 290$). They reported on their garden experiences and health. Facility staff reported on objective garden characteristics and barriers to access. A serial mediation model was tested with multiple linear regression analysis.

Results. The total indirect effect of greenery on self-perceived health was positive and significant. Garden greenery appears to affect health by enhancing a sense of being away, affording possibilities to experience the outdoor environment as interesting and encouraging visitation. Among residents in homes with multiple barriers, only fascination mediated the relationship between greenery and self-perceived health.

Conclusion. Ample greenery in outdoor space at residential facilities for older people appears to promote experiences of being away and fascination, more frequent visitation and better health.

Keywords: health, nurses, nursing, outdoor environment, residential facilities, serial mediation

Why is this research needed?

- Access to a green outdoor environment has been associated with better health in older people; however, little is known about the qualities of experiences in gardens that may promote health.
- There is a lack of research on how barriers to movement into the gardens can undermine relations between the presence of greenery, positive experiences in gardens and in turn health.

What are the key findings?

- Greenery in gardens at residential facilities for older people appears to contribute indirectly to residents' self-perceived health.
- Garden greenery appears to promote residents' experiences of being away and fascination which in turn appear to promote better health, both directly and indirectly through more frequent visitation.
- Multiple barriers to the outdoors can prevent residents' experiences of being away and visitation and so may reduce health benefits from facility gardens.

How should the findings be used to influence policy/practice/research/education?

- Policy and design recommendations can further emphasize the potential significance of accessible outdoor spaces at residential facilities for older people.
- The care practices of clinical staff may be improved with knowledge about how the facility garden benefits the health of residents.
- Further research is needed concerning how residents' health may be affected by garden stays, how barriers to going outdoors may undermine health and how barriers may be removed.

Introduction

Older people living in residential facilities commonly suffer from problems such as multi-morbidity, reduced cognitive capacity (Akner 2009, Hutsteiner *et al.* 2013, Gordon *et al.* 2014), inability to perform activities of daily living (ADL) (Sjölund *et al.* 2013), depression, anxiety and pain (Boerlage *et al.* 2008, Tse *et al.* 2012, Drageset *et al.* 2013, Takai *et al.* 2013). They therefore usually require much formal care. Due to their poor health, fragility and lack of independence, it is not unusual that they spend a considerable part of their time in their rooms or apartments, which can entail a lack of stimulation, isolation and decreased socialization (Høyland *et al.* 2006, Nord 2011).

Access to green outdoor spaces may counter these negative effects. A positive association has been reported between the frequency of visitation in a garden or other outdoor green environment and residents' self-rated health in residential facilities for older people (Rappe *et al.* 2006). Visiting the garden or viewing it from a balcony also appeared to improve their mood, quality of sleep and peace of mind (Rappe & Kivelä 2005).

The present study considers the potential value of access to a nearby garden for older people in residential facilities. Extending the earlier work, our primary interest is in the relationship between garden greenery and residents' health as mediated by their experiences in the garden and the frequency of their visitation. We also consider the contingency of these relationships on the numbers of barriers that residents must overcome to visit the garden.

Background

Earlier studies have demonstrated that older people at residential facilities can benefit from green plants indoors, and views of a green space from a window (Cohen-Mansfield & Werner 1998, Tang & Brown 2005, Rappe & Topo 2007, Lee & Kim 2008, Mimi Mun 2010). Views of nature and needs for social interaction are among motives for using a garden (Oguz *et al.* 2010). The opportunity to go outside and visit the garden has also been associated with residents' experiences of better health, thriving, well-being and quality of life (Kearney & Winterbottom 2005, Bergland & Kirkevold 2006, McCaffrey 2007, Raske 2010). Furthermore, persons with dementia have in interviews said that not being able to go out was associated with feelings of depression (Duggan *et al.* 2008, Olsson *et al.* 2013).

A relationship between gardens in residential facilities and resident health may occur for several reasons. An accessible garden space as part of the physical care environment could serve as a place for privacy or for socialization (Cooper Marcus & Barnes 1999). A garden could also provide older persons with sensory stimulation and support horticultural activities (Brawley 2001, Cox *et al.* 2004, Gonzalez & Kirkevold 2013, 2015). A recent review (Hartig *et al.* 2014) organized evidence of health benefits of contact with nature by four interrelated pathways: air quality, physical activity, social cohesion and stress reduction. That review mainly covered studies concerned with the general population, but the pathways identified are also relevant for residents in care facilities for older people (cf. Zeisel *et al.* 2003).

The stress reduction pathway, also commonly referred to as the restoration pathway, is in focus here. Evidence for

this pathway is relatively strong, given convergence of experimental results concerning plausible mechanisms with results from epidemiological studies of diverse outcomes and populations (Hartig *et al.* 2014). Contact with nature appears to engender a variety of restorative effects in emotion, cognition and physiology following demanding circumstances (Hartig *et al.* 2003, Berto 2005, Berman *et al.* 2008) and such short-term effects may over time cumulatively prevent or ameliorate a broad spectrum of chronic conditions and other health problems (Gonzalez *et al.* 2010, Raanaas *et al.* 2012).

Importantly, environmental experiences that support restoration can also be enjoyable for people for whom under-stimulation rather than acute stress reduction is at issue, which can be the case for older residents in care facilities (Høyland *et al.* 2006, Nord 2011). The promise of restorative and other enjoyable experiences can attract residents outdoors, entailing physical activity and opening possibilities for exchange with others. By supporting restorative and otherwise enjoyable experiences, a garden may thus motivate additional visitation and engage all four pathways between nature and health discussed by Hartig *et al.* (2014).

The meanings people attach to gardens and nature more generally are varying and individualistic, as are the motives for their visits to natural settings; however, much research in outdoor recreation has identified two pervasive motivational themes, escape from sources of stress and appreciation of the beauty of nature (Knopf 1987). These themes are represented in different theories concerning restorative experience (Van den Berg *et al.* 2007, Hartig *et al.* 2011). The present research builds on the corresponding concepts 'being away' and 'fascination' in attention restoration theory (ART) (Kaplan & Kaplan 1989, Kaplan 1995). Being away refers to a sense of distance from routine mental contents and demands; it need not involve substantial geographical distance. Fascination refers to the engagement of effortless attention, which allows for rest of a neurocognitive mechanism assumed to be needed for directing attention in everyday activities that are not of themselves interesting. In their presentation of ART, Kaplan and Kaplan (1989) assert that nature supports experiences of being away and fascination to a greater degree than many other everyday environments. For example, nature includes processes and stimuli that gently capture and hold attention, such as sunsets, snow patterns and the sound of leaves moving in a breeze. A garden could evoke feelings of being away and engage fascination, thereby distracting an older person from pain and rumination (Melzack 1996). Visits to a garden, or looking out onto a garden, could thus counteract problems with over- and underload, depression and

anxiety among older people in residential facilities (cf. Ottosson & Grahn 2005). Consistent with this possibility, Gonzalez *et al.* (2010) found that decline in the severity of depression for persons who participated in a 12-week therapeutic horticulture programme was mediated by their experiences of being away and fascination.

Whether or not an older resident can benefit from such experiences is, however, not only dependent on the environmental characteristics of the outdoor space itself, such as the amount of greenery. The value of the garden characteristics may be contingent on ease of access to the garden. Some barriers to access may not be open to physical design interventions. Previous studies (Kearney & Winterbottom 2005, Rappe & Kivelä 2005, Rappe *et al.* 2006) revealed that the main hindrances to outdoor visits were older residents' own physical limitations, lack of assistance and uncomfortable weather conditions. Other research has pointed to barriers that can be addressed by design. Rodiek (2005) investigated which physical features of residential facilities were perceived by older residents as either attractive for or a deterrent to outdoor usage. Participants reported that their outdoor usage was deterred by poor coordination between interior and exterior spaces (e.g. long corridors, heavy doors), poor surfaces for walking and insufficient room for movement in wheelchairs. They were attracted by seating areas, protection from the sun, walk ways, loops, greenery and flowers, water features and pets. In another study, Rodiek *et al.* (2014) found that problems with doors hindered access to gardens in residential facilities. Most common was difficulty in opening doors and/or doors that closed too rapidly. Moreover, thresholds that were difficult to cross- and self-locking doors made it difficult or impossible for older residents to enter the facility again after their visits outdoors.

In summary, previous studies have indicated that visiting green outdoor environments can generate psychological benefits which in turn can positively impact self-perceived health. However, research has yet to address the mediating role of older peoples' experiences of residential facility gardens in motivating their visits and otherwise promoting health. Also, there is a lack of research on how these relationships are affected by barriers to visiting and staying in a garden at a residential facility for older people.

The study

Aims

The study had two aims: (1) to test the relationship between greenery in gardens at residential facilities for

older people and the self-perceived health of residents, as mediated by experiences of being away and fascination when in the garden and the frequency of visitation there; (2) to examine the contingency of this set of indirect effects on the number of barriers residents must overcome to visit the garden. Specifically, we tested a conceptual model where the amount of greenery is positively associated with older residents' self-perceived health, as mediated by positive effects of greenery on experiences of being away and fascination and in turn a greater frequency of visitation in these outdoor spaces. We also considered how these relationships differed with the number of barriers in the physical environment that older residents had to overcome to visit the garden.

Design

The study had a multi-level, cross-sectional design that combined self-report data from individual residents and staff in 87 residential facilities in 13 municipalities in three regions in central and northern Sweden. Residents reported on garden experiences, frequency of garden visitation and self-perceived health, while staff (i.e. a manager or designated contact person) reported on objective garden characteristics and barriers to access at the given facility. The focus here is on the residents; a detailed description of the facilities and their gardens can be found in Dahlkvist *et al.* (2014).

Sample

Inclusion criteria were older age; physical and cognitive function sufficient for visiting the garden/patio alone or with help from staff; and ability to participate in a structured interview or independently fill out the questionnaire. Contact persons were asked to recruit residents they knew often visited their garden. We sought a mix of older women and men with complex health challenges, so we tried to recruit at least 10 eligible residents for each facility. If the given facility had fewer than 10 eligible residents, then all eligible residents were invited to participate. Of 684 questionnaires sent to residents, 415 (61%) were returned.

In this study, we use data from those 290 residents in 72 facilities that had complete data for all variables in the intended analyses. This subsample included 203 women and 87 men with a mean age of 84.8 years (SD 8.3; range 53-103). Many of them (173, or 59.6%) had difficulties with mobility, self-care (180/62.1%) and/or usual activities (192/66.2%). Many also reported that they experienced pain/discomfort (223/76.9%) and/or anxiety/depression

(164/56.5%). Furthermore, 115 (39.7%) had vision impairments and 105 (36.2%) had hearing impairments. Additional details about the residents and the facilities are given in Table 1. We compared the socio-demographic characteristics of the 290 residents in this study and those that had not provided data for all variables of interest ($n = 125$). No statistically significant age or gender differences were found between residents with complete data and those without complete data.

Data collection

The data were collected during the summer months June–August 2011. The choice of period reflects the expectation that residents would seldom go outdoors during the colder months. The residents answered questionnaires in conjunction with a visit to the garden/patio, the better to capture their 'here and now' experience of the garden with some of the measures used (described below). Residents who had difficulties completing the survey received help from a contact person according to instructions provided.

To measure the characteristics and design elements of the garden/patio, we adopted an instrument developed and validated by Cohen-Mansfield and Werner (1999) for use in studying environmental predictors of resident behaviour and well-being in American Alzheimer care facilities. Before use, the Swedish version was tested for face validity by people working in elderly care, of itself (two specialist nurses) and with gardening (one occupational therapist, one manager, one gardener with doctoral competence in ethnography) (Dahlkvist *et al.* 2014). The instrument includes indices for greenery, barriers to getting out to the garden/patio and obstacles in the garden/patio, among other measures. These three indices were completed by the manager or designated contact person at the given facility.

In this study, we used the data only for the indices for greenery and barriers to getting out to the garden/patio. The greenery index consists of two questions. The first concerns the natural features in the broader view from the garden/patio (response alternatives: green areas, forest areas, water areas). The second question concerns the natural elements found in the immediate area of the garden/patio (response alternatives: trees, shrubs, lawn, flowers, large stones, garden beds, kitchen garden, raised garden beds, seasonal plants, bird baths, fountain/waterfall, ponds, brooks). Multiple response alternatives can be used for each of the questions. In the absence of clear guidance from the literature on how to weight the different environmental attributes, we used the total number of natural view components and natural elements in the garden/patio area as

the score for the index (scale range 0-16, one point for each element included in the index).

The barriers index consists of one question concerning the presence of physical boundaries or obstacles that make it difficult or dangerous to move from the resident's room to the garden/patio (response alternatives: long corridors, code locks in/outside elevators, stairs, locked doors, heavy doors, high thresholds, having to walk through a parking lot, having to walk over a trafficked road, having to walk up hill, having to open a big and heavy gate). Multiple response alternatives can be used and the score for the index is the total number of

barriers present, again without differential weighting (scale range 0-10, one point for each element included in the index). The distribution of scores for this index was heavily skewed, so we recoded the scores into two categories (1 = none or one barrier; 2 = multiple barriers).

The Cohen-Mansfield and Werner (1999) instrument also includes one other question relevant here. It concerns how often the resident visits the garden on average during a summer week. Responses were provided with a 6-point scale, ranging from daily (= 0)-1 day/week (= 5). Scores were reversed prior to analysis, so that higher scores represented more frequent visitation.

The Perceived Restorativeness Scale [PRS] (Hartig *et al.* 1997) was used to measure the extent to which residents experienced being away and fascination while visiting the outdoor space. The being away subscale consists of six items (e.g. 'This place is a refuge from unwanted distractions'; 'Spending time here gives me a break from my day-to-day routine'). The fascination subscale also consists of six items (e.g. 'There is much to explore and discover here'; 'My attention is drawn to many interesting things here'). Responses to all 12 items were made with an 11-point scale (0 = not at all; 10 = completely). Experimental studies attest to the utility of these measures in assessing the effects of physical environmental variations on expectations about restorative experiences (e.g. Nordh *et al.* 2009, Lindal & Hartig 2013) and intervention studies have demonstrated their utility in explaining change in health as a function of contact with nature (i.e. with regard to a reduction in severity of depression; Gonzalez *et al.* 2010).

To measure residents' self-perceived health at the time of their visit to the garden/patio, we used a visual analogue scale (VAS) developed by the EuroQual (EQ) group (Herdman *et al.* 2011). With this single-item measure a respondent can report on their health as they judge it on the given day, using a scale that ranges from 'worst imaginable health state' (= 0) to 'best imaginable health state' (= 100). The EQ-VAS is a complement to the five-dimensional self-report measure of health developed by the EuroQual Group, but it should not be mistaken for that measure, known as the EQ-5D-5L (Rabin *et al.* 2011). Single-item measures such as the EQ-VAS are widely used alternatives to multi-item measures that require more time to complete and they show good reliability and validity properties in comparison to longer health status measures (e.g. DeSalvo *et al.* 2006).

Ethical considerations

All participants received written and oral information from a contact person designated by the facility manager. They

Table 1 Characteristics of the residents and the residential facilities.

	N	%
Residents (N = 290)		
Female gender	203	70.0
Mobility		
No problems	97	33.4
Some problems	157	54.1
Confined to bed	16	5.5
Missing	20	6.9
Self-care		
No problems	105	36.2
Some problems	131	45.2
Unable wash or dress	49	16.9
Missing	5	1.7
Usual activities		
No problems	94	32.4
Some problems	126	43.4
Unable perform usual activities	66	22.8
Missing	4	1.4
Pain/discomfort		
No pain or discomfort	63	21.7
Moderate	192	66.2
Extreme	31	10.7
Missing	4	1.4
Anxiety/depression		
Not anxious or depressed	121	41.7
Moderately	150	51.7
Extremely	14	4.8
Missing	5	1.7
Vision impairments	115	39.7
Hearing impairments	105	36.2
Residential Livings (N = 72)		
Operator		
Municipal	70	97.2
Private	2	2.8
Staff around the clock	72	100.0
Number of floors		
Multi-story buildings	44	61.1
One-story buildings	16	22.2
Multi-story and one-story buildings in combination	7	9.7
Missing	5	6.9

were told about the purpose of the study and they were informed that their participation was voluntary and that their decision to participate or not would not in any way influence their care in the future. Written informed consent was obtained from all participants. In doing this work, we followed the ethical regulations described in the Swedish Code of Statutes 2003:460 and in accordance with The Code of Ethics of the World Medical Association for research involving human participants (World Medical Association Declaration of Helsinki 2004). Ethical approval for the study was obtained from the Regional Ethical Review Board.

Data analysis

Although the data had a two-level hierarchical structure, with residents clustered in residential facilities, preliminary analyses indicated that we could conduct our analyses on the resident level alone, given weak clustering. A preliminary linear mixed model (LMM) analysis yielded a small intraclass correlation coefficient ($ICC = 0.07$) and showed the between-cluster variation to be small ($\sigma_b^2 = 25.3$), with a relatively large standard error (21.0). Also, we had data for only one resident in 13 of the 72 residential facilities and for only two residents in another 13 facilities. Ordinary least squares (OLS) multiple regression analysis and the LMM analysis produced nearly the same values for the estimated regression coefficients. Given these considerations, we used the techniques available for testing multiple mediation with the simpler OLS regression methods.

Our inferences regarding the direct and indirect effects of greenery on self-reported health are based on tests of serial multiple mediator models conducted using procedures described by Hayes (2013). The indirect effects are those mediated by being away, fascination and/or visitation, in that order. We tested them in serial order because being away and fascination had a strong partial correlation after adjustment for greenery. An alternative approach would have been to treat being away and fascination as parallel mediators; however, such a model assumes that no mediator causally influences another (Hayes 2013). Available theory and research do not provide clear guidance with regard to a choice of causal order for these variables, which may be mutually influential. Resolving this issue is beyond the scope of the present work and we placed being away first in the series, before fascination and visitation, consistent with the idea that getting away or escaping from the usual situation opens up for the experience of fascination. To assess effect modification by barriers to access to the garden, we tested the respective models separately for the

group with none or only one barrier and for the group with multiple barriers. To aid inference with all of these model tests, we used the bootstrapped confidence intervals available through Hayes' (2013) PROCESS macro for SPSS, with the number of bootstrap samples set at 5000. Gender was included as a covariate in the analyses as it was related to both being away and fascination. We also considered age as a covariate but found that it was not significantly associated with the other variables in the analyses and did little to improve the explanatory power of our model. We have excluded it to simplify the presentation. Point estimates for the multiple mediator models and bias-corrected and accelerated (BCA) 95% confidence intervals (CIs) are presented. The residuals were judged as normally distributed based on visual inspection and the Shapiro–Wilks test. Variance inflation factor values were all below 2.0, indicating no problems with multicollinearity between independent variables in the model (Tabachnick & Fidell 2013). Statistical analyses were conducted using IBM SPSS Statistics 22 (SPSS, Inc., 2013). The level for statistical significance was set at $P < 0.05$ for all tests.

Validity and reliability

We used instruments with good validity and reliability as documented in previous research, cited above. As in previous studies, the two experiential measures had high internal consistency coefficients; for being away, $\alpha = 0.89$ and for fascination, $\alpha = 0.92$ (cf. Hartig *et al.* 1997). The data analysis used advanced statistical methods in combination with visual inspection of variable distributions and residuals to ensure conformance with assumptions of the tests. Potential confounding factors were considered and included as covariates, although dropped if found to lack influence.

Results

Relationships between variables in the multiple mediator model tests

Descriptive statistics for the key variables indicated that the residents visited the garden about three times each week on average during the summer and that they tended to experience moderate levels of being away and fascination in conjunction with their outdoor visits. The mean value for their self-perceived health fell slightly above the middle of the scale, a bit closer to 'the best possible health' than 'the worst possible health'. On average, the available outdoor space contained approximately 6 out of the 16 possible natural features/elements listed in our greenery index

(Table 2). Greenery was not significantly related to either visitation or self-reported health in the bivariate analyses; however, initial evidence of the expected indirect effect on health can be seen in the pattern of significant positive associations. The bivariate correlations indicated that when the garden/patio area had more natural view components and natural elements, residents experienced higher levels of being away and fascination during their visit. When the residents experienced higher levels of being away and fascination, they also tended to report better self-perceived health. Also, higher being away was attended by more frequent visitation.

Test of the conceptual model

An initial test of the serial mediation model indicated positive and significant effects of garden greenery on self-reported health through being away (a_1b_1) and through fascination (a_2b_2) (Figure 1). Furthermore, the indirect effects of greenery on self-reported health through being away and fascination in serial ($a_1d_2b_2$) and through being away and visitation in serial ($a_1d_3b_3$) were also positive and significant. The specific indirect effect that passed through all three mediators in serial was practically zero (-0.0007) and did not contribute to the total indirect effect after adjustment for the other effects. An increase of one unit on the greenery index is associated with a 0.7857 unit increase in health as a result of all specific indirect causal sequences in the model (Figure 1 and Table 3).

The significant specific indirect effects and the significant total indirect effect can be contrasted with the non-significant total (c) and direct effects (c') of greenery on self-perceived health. In such a mediation test, the direct effect is the effect of the initial variable (greenery) on the outcome (self-perceived health), after adjustment for the mediators. The non-significant direct effect simply suggests that greenery of itself offers little benefit, independent of the experiences it appears to afford and the visitation it appears to encourage. The total effect is the sum of the direct and

specific indirect effects of the initial variable on the outcome. That we have a significant total indirect effect and a non-significant total effect presumably owes to the combination of positively and negatively signed direct and indirect paths between greenery and health; such competitive paths counter one another (Hayes 2013). The regression analysis revealed that the model could explain 17.6% of the variance in self-perceived health (adjusted $R^2 = 0.162$).

Contingency of the relationships on barriers

To test whether these relationships differ depending on the number of barriers that older residents must overcome to visit their garden, we tested two additional models, one for residents in facilities with no or only one barrier ($n = 154$) and one for residents in facilities with two or more barriers ($n = 136$). In both models, the total effect (c) and the direct effect (c') between greenery and self-perceived health remained non-significant. For residents with no more than one barrier, the significant indirect paths were the same as those uncovered in the test with the total sample. For residents with multiple barriers, greenery was significantly and positively associated with self-perceived health only through fascination, while all other indirect paths were non-significant (Table 3).

Discussion

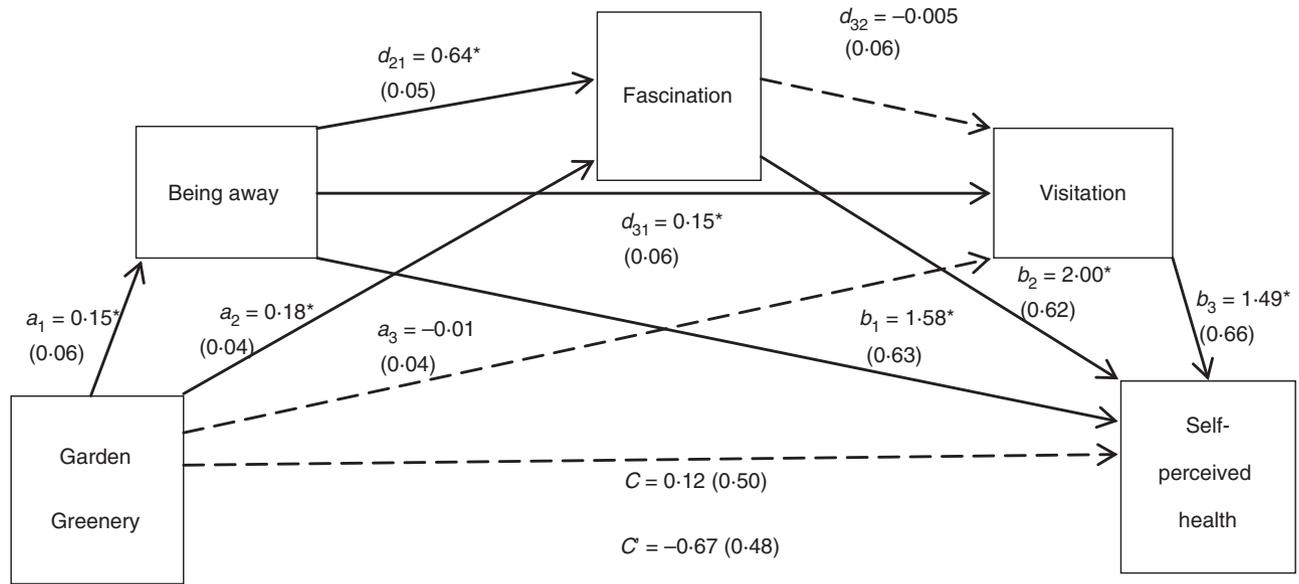
Our study extends earlier research concerning the relationship between garden greenery, garden visitation and self-perceived health by contributing information about the mediating role of the experiences that older residents have with gardens in care facilities. Like Rappe *et al.* (2006), we found a significant positive relationship between garden visitation and self-perceived health. Going further, we also uncovered a specific indirect effect from garden greenery through being away to visitation and in turn to health. In addition, we found that being away and fascination, each one separately and also together, appeared to mediate posi-

Table 2 Descriptive statistics and correlation matrix for the variables in the serial mediation model tests ($N = 290$).

Variables	Mean	SD	Median	Min	Max	1.	2.	3.	4.
1. Self-perceived health	62.6	21.2	65.0	0.0	100.0				
2. Garden greenery	6.2	2.5	6.0	2.0	11.0	0.01			
3. Being away	6.1	2.4	6.3	0.0	10.0	0.33***	0.15*		
4. Fascination	5.3	2.5	5.3	0.0	10.0	0.33***	0.26***	0.66***	
5. Visitation	3.3	1.8	3.0	0.0	5.0	0.18**	-0.01	0.17**	0.09

Spearman's rho was used for bivariate correlations.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.



Indirect effect of GG on H through BA only = 0.2331*
 Indirect effect of GG on H through BA and FA in serial = 0.1907*
 Indirect effect of GG on H through BA and VI in serial = 0.0329*
 Indirect effect of GG on H through BA, FA and VI in serial = -0.0007
 Indirect effect of GG on H through FA only = 0.3527*
 Indirect effect of GG on H through FA and VI in serial = -0.0013
 Indirect effect of GG on H through VI only = -0.0218
 Total indirect effect of GG on H = 0.7857*
 Non-significant paths marked with dotted lines.

Figure 1 The model of the effect of garden greenery on self-perceived health as mediated by restorative quality variables and visitation in serial. The values represent unstandardized regression coefficients with accompanying standard errors in parentheses. The coefficients a_i represent the effects of garden greenery (GG) on the mediators being away (BA), fascination (FA), and visitation (VI), controlling for earlier mediators in serial. The coefficients b_i represent the effects of the mediators on self-perceived health (H), controlling for the direct effect of GG and the other mediators. The coefficients d_{ij} represent the effects of earlier mediators on subsequent mediators in serial. The coefficient c is the total effect of GG on H and c' is the direct effect of GG on H with adjustment for the three mediators. Test was used by bootstrapped confidence intervals available through Hayes' (2013) PROCESS macro for SPSS, with the number of bootstrap samples set at 5000. The variables are adjusted for gender $N = 290$. * $P < 0.05$.

tive effects of greenery on health, independent of the amount of visitation. Thus, aside from more frequent visitation and all that it implies with regard to, for example, physical activity with movement out to the garden area, the quality of the experience that residents had with their visits appeared to contribute to self-perceived health.

Our results suggest that being away and fascination can both serve as mediators of an effect of garden greenery on visitation and health, although in somewhat different ways. The effects seem to be modest in magnitude, just as the levels of being away and fascination reported by the residents were in general not particularly high. A study from the present research project (Dahlkvist *et al.* 2014) revealed that many gardens at residential facilities for older people had obvious deficiencies and the lack of desired design

elements in the present sample of gardens is one possible reason that the indirect effects through both being away and fascination were not particularly strong. Nonetheless, despite the constrained variation, it appears from our results that the residents' experiences of being away and fascination contributed positively to their ratings of self-perceived health. Also, the combination of a non-significant direct effect of garden greenery on health with a significant total indirect effect suggests that greenery of itself offered little benefit for the health of the residents, independent of the experiences it afforded them and the visitation it encouraged. Our findings are thus consistent with theory and earlier research affirming that restorative benefits of nature experiences can serve health over time (Hartig *et al.* 2011).

Table 3 Direct and indirect effects of the association between garden greenery (GG) and self-perceived health (H), through being away (BA), fascination (FA) and visitation (VI) for all participants and for each of two levels of barriers to entry to the outdoor garden/patio space.

Parameter	All participants (<i>n</i> = 290)		No or one barrier (<i>n</i> = 154)		Multiple barriers (<i>n</i> = 136)	
	Point estimate	BCa 95% CI	Point estimate	BCa 95% CI	Point estimate	BCa 95% CI
Indirect effects						
1 GG → BA → H	0.233	0.037, 0.588	0.307	0.042, 0.820	0.120	−0.090, 0.855
2 GG → BA → FA → H	0.191	0.045, 0.443	0.167	0.022, 0.487	0.182	−0.138, 0.784
3 GG → BA → VI → H	0.033	0.004, 0.121	0.088	0.014, 0.290	−0.003	−0.108, 0.012
4 GG → BA → FA → VI → H	−0.001	−0.024, 0.015	−0.001	−0.047, 0.042	<−0.001	−0.022, 0.018
5 GG → FA → H	0.353	0.152, 0.670	0.286	0.066, 0.661	0.468	0.099, 1.158
6 GG → FA → VI → H	−0.001	−0.037, 0.030	−0.001	−0.067, 0.071	<−0.001	−0.041, 0.036
7 GG → VI → H	−0.022	−0.195, 0.100	0.233	−0.011, 0.661	0.070	−0.377, 0.573
Total Indirect effect	0.786	0.365, 1.307	1.079	0.511, 1.855	0.837	0.028, 1.839
Direct effect (<i>c'</i>)	−0.665	−1.609, 0.278	−0.419	−1.508, −0.671	−1.740	−3.567, 0.087

The direct effect (*c'*) is the effect of the initial variable (garden greenery) on the outcome (self-perceived health), after adjustment for the mediators. Point estimates of regression coefficients and bias-corrected and accelerated (BCa) confidence intervals (CI). Test was used by bootstrapped confidence intervals available through Hayes' (2013) PROCESS macro for SPSS, with the number of bootstrap samples set at 5000, with estimates adjusted for gender. Statistically significant effects ($P < 0.05$) are shown in bold font.

Our results also suggest that older residents' experiences of being away depend on a low level of barriers to access to facility gardens. The significance of barriers is not surprising, but we extend previous results in that regard (Kearney & Winterbottom 2005, Rappe & Kivelä 2005, Rappe *et al.* 2006) by indicating that the presence of multiple barriers may modify indirect effects of garden greenery through restorative quality and visitation. If visiting the garden involves risks due to barriers, either in going out or in coming back, residents may choose to stay indoors in their rooms or in public areas in the facility, much as they might want to go outside.

Previous research (Kearney & Winterbottom 2005, Rappe & Kivelä 2005, Rappe *et al.* 2006) has shown that the main hindrances to outdoor visits were the residents' own physical limitations, lack of assistance and uncomfortable weather. Given that the majority of the older residents have significant health challenges, it is understandable that they may hesitate to go outdoors, even when they can experience a verdant garden under nice weather conditions. In this regard, however, we found it interesting that the number of natural components still had an indirect effect on self-perceived health through fascination in particular among those residents who went outdoors despite multiple barriers. Conceivably, this reflects on the desire to engage with and experience nature as a motivating factor in their outdoor visitation. In sum, our results aid understanding of the relationships between garden greenery and resident health, complementing existing research findings and in some respects adding essential knowledge.

Limitations

This study has several limitations. We have with our serial mediation model examined plausible cause-effect relationships; however, our cross-sectional data prevent causal statements and reverse or reciprocal causation is possible with some of the indirect paths we have assessed. Definitions of 'garden/greenery' and 'residential facilities' may vary between countries; our results may not generalize beyond a Swedish context. We used convenience samples of residents and residential facilities and this may also constrain generalizability. The measures of objective garden characteristics and barriers to access were completed by facility managers or designated contact persons and not by the research staff, allowing for biased responses by those who wanted to present a particular image of their facility (e.g. overestimation of greenery, underestimation of barriers). The measures used to represent garden greenery and barriers to getting out to the garden/patio (based on work by Cohen-Mansfield & Werner 1999) may have failed to cover relevant aspects of the given constructs. These neglected aspects could have to do with other aspects of nature as represented in the outdoor spaces (e.g. the naturalness of the arrangement of green elements) and institutional rather than physical barriers to movement to the outdoors. Finally, older people who did not visit the gardens were not included in our sample and this limits understanding of how barriers can affect visitation. Our focus on people who did visit the gardens is justified by our interest in the mediating role of experiences of being away and

fascination in relationships between garden greenery and health. Ours is an initial test of a complex model, parts of which are well-grounded in theory and previous research while others, such as the serial order of being away and fascination, need further empirical and theoretical scrutiny.

Conclusion

This study suggests that having more greenery and other natural elements in outdoor spaces at residential facilities for older people will promote experiences of being away and fascination when residents' go outdoors and that this in turn will promote more frequent visitation and better health. It also appears, however, that such advantages will not be fully realized if residents face multiple barriers to going outdoors. It is therefore important that staff in residential facilities for older people know how residents can realize psychological and physical activity benefits from their garden visits and how barriers to visitation can disallow or reduce those benefits. Moreover, the siting and design of residential facilities should consider the amount of greenery as an important aspect of outdoor space provisions (cf. Cooper Marcus & Barnes 1999). Further research can deepen knowledge of the experiences different kinds of residents desire when going outdoors, the extent to which those experiences depend on contact with nature and the implications of those experiences for their health. Further research can also consider which objective and perceived barriers are most challenging for different kinds of residents (e.g. those with severe vs. mild cognitive impairment) and examine ways to eliminate or minimize those barriers. For this purpose it can be valuable to consider the experiences of residents who would like to go outdoors but cannot do so, given the combination of their own limitations and physical barriers in the care facility.

Acknowledgements

We thank all of the residential facility managers, staff and residents for their cooperation.

Funding

This study was supported by Faculty of Health and Occupational Studies, University of Gävle and the School of Health and Medical Sciences, Örebro University. It was also funded by grants from the Swedish Society of Nursing, the Maja Johansson & Maja Brantefors Foundation (Örebro), the Annalisa Detlow-Bergs Foundation (Gävle) and

the Göranssonska Foundation (Sandviken), but these organizations had no role in the design and running of the study.

Conflict of interest

No conflict of interest has been declared by the authors.

Author contributions

All authors have agreed on the final version and meet at least one of the following criteria [recommended by the IC-MJE (http://www.icmje.org/ethical_1author.html)]:

- substantial contributions to conception and design, acquisition of data or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

References

- Akner G. (2009) Analysis of multimorbidity in individual elderly nursing home residents: development of a multimorbidity matrix. *Archives of Gerontology and Geriatrics* 49(3), 413–419.
- Bergland A. & Kirkevold M. (2006) Thriving in nursing homes in Norway: contributing aspects described by residents. *International Journal of Nursing Studies* 43(6), 681–691.
- Berman M.G., Jonides J. & Kaplan S. (2008) The cognitive benefits of interacting with nature. *Psychological Science* 19(12), 1207–1212.
- Berto R. (2005) Exposure to restorative environments helps restore attentional capacity. *Journal of Environmental Psychology* 25(3), 249–259.
- Boerlage A.A., van Dijk M., Stronks D.L., de Wit R. & van der Rijt C.C.D. (2008) Pain prevalence and characteristics in three Dutch residential homes. *European Journal of Pain* 12(7), 910–916.
- Brawley E.C. (2001) Environmental design for Alzheimer's disease: a quality of life issue. *Aging & Mental Health* 5(1), 79–83.
- Cohen-Mansfield J. & Werner P. (1998) The effects of an enhanced environment on nursing home residents who pace. *Gerontologist* 38(2), 199–208.
- Cohen-Mansfield J. & Werner P. (1999) Outdoor wandering parks for persons with dementia: a survey of characteristics and use. *Alzheimer Disease & Associated Disorders* 13(2), 109–117.
- Cooper Marcus C.C. & Barnes M. (1999) *Healing Gardens: Therapeutic Benefits and Design Recommendations*. John Wiley & Sons, United States of America.
- Cox H., Burns I. & Savage S. (2004) Multisensory environments for leisure: promoting well-being in nursing home residents with dementia. *Journal of Gerontological Nursing* 30(2), 37–45.
- Dahlkvist E., Nilsson A., Skovdahl K. & Engström M. (2014) Is there a caring perspective in garden/patio design in elderly care? A description and a comparison of residents' and staff members'

- perceptions of these outdoor spaces. *Journal of Housing for the Elderly* 28(1), 85–106.
- DeSalvo K.B., Fisher W.P., Tran K., Bloser N., Merrill W. & Peabody J. (2006) Assessing measurement properties of two single-item general health measures. *Quality of Life Research* 15 (2), 191–201.
- Drageset J., Eide G.E. & Hylén Ranhoff A. (2013) Anxiety and depression among nursing home residents without cognitive impairment. *Scandinavian Journal of Caring Sciences* 27(4), 872–881.
- Duggan S., Blackman T., Martyr A. & Van Schaik P. (2008) The impact of early dementia on outdoor life: a 'shrinking world'? *Dementia* 7(2), 191–204.
- Gonzalez M.T. & Kirkevold M. (2013) Benefits of sensory garden and horticultural activities in dementia care: a modified scoping review. *Journal of Clinical Nursing* 23(19–20), 2698–2715.
- Gonzalez M.T. & Kirkevold M. (2015) Clinical use of sensory gardens and outdoor environments in norwegian nursing homes: a cross-sectional e-mail survey. *Issues in Mental Health Nursing* 36(1), 35–43.
- Gonzalez M.T., Hartig T., Patil G.G., Martinsen E.W. & Kirkevold M. (2010) Therapeutic horticulture in clinical depression: a prospective study of active components. *Journal of Advanced Nursing* 66(9), 2002–2013.
- Gordon A.L., Franklin M., Bradshaw L., Logan P., Elliott R. & Gladman J.R. (2014) Health status of UK care home residents: a cohort study. *Age and Ageing* 43(1), 97–103.
- Hartig T., Kaiser F.G. & Bowler P.A. (1997) *Further Development of a Measure of Perceived Environmental Restorativeness* (Working Paper no. 5). Institute for Housing and Urban Research, Uppsala University, Uppsala, Sweden.
- Hartig T., Evans G.W., Jamner L.D., Davis D.S. & Garling T. (2003) Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology* 23(2), 109–123.
- Hartig T., van den Berg A.E., Hagerhall C.M., Tomalak M., Bauer N., Hansmann R., Ojala A., Syngollitou E., Carrus G., van Herzele A., Bell S., Camilleri Podesta M.T. & Waaseth G. (2011) Health benefits of nature experience: psychological, social and cultural processes. In *Forests, Trees and Human Health* (Nilsson K., Sangster M., Gallis C., Hartig T., De Vries S., Seeland K. & Schipperijn J., eds), Springer, New York, pp. 127–168.
- Hartig T., Mitchell R., de Vries S. & Frumkin H. (2014) Nature and health. *Annual Review of Public Health* 35, 207–228.
- Hayes A.F. (2013) *Introduction to Mediation, Moderation and Conditional Process Analysis: A Regression-based Approach*. Guilford Press, New York.
- Herdman M., Gudex C., Lloyd A., Janssen M.F., Kind P., Parkin D., Bonsel G. & Badia X. (2011) Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Quality of Life Research* 20, 1727–1736.
- Høyland K., Østnor B., Bogen B. & Kvinge T. (2006) Egen bolig også når helsa svikter? Evaluering av nye omsorgsboliger for hjelpetrengende eldre. Retrieved from <http://www.sintef.no/globalassets/upload/egen-bolig-ogsa-nar-helsa-svikter.pdf> on 15 March 2016.
- Hutsteiner P., Galler S., Mendoza M.C. & Klünemann H.H. (2013) Prevalence of dementia in a rural nursing home population in southern Germany. *The European Journal of Psychiatry* 27(3), 174–184.
- IBM SPSS (2013) SPSS for Windows, version 22.0. SPSS Inc., USA, IL.
- Kaplan S. (1995) The restorative benefits of nature: toward an integrative framework. *Journal of Environmental Psychology* 15 (3), 169–182.
- Kaplan R. & Kaplan S. (1989) *The Experience of Nature: A Psychological Perspective*. Cambridge University Press, New York.
- Kearney A.R. & Winterbottom D. (2005) Nearby nature and long-term care facility residents: benefits and design recommendations. *Journal of Housing for the Elderly* 19(3), 7–28.
- Knopf R.C. (1987) Human behavior, cognition and affect in the natural environment. In *Handbook of Environmental Psychology: Volume 1* (Stokols D. & Altman I., ed), Wiley, New York, pp. 783–825.
- Lee Y. & Kim S. (2008) Effects of indoor gardening on sleep, agitation and cognition in dementia patients: a pilot study. *International Journal of Geriatric Psychiatry* 23(5), 485–489.
- Lindal P.J. & Hartig T. (2013) Architectural variation, building height and the restorative quality of urban residential streetscapes. *Journal of Environmental Psychology* 33, 26–36.
- McCaffrey R. (2007) The effect of healing gardens and art therapy on older adults with mild to moderate depression. *Holistic Nursing Practice* 21(2), 79–84.
- Melzack R. (1996) Gate control theory: on the evolution of pain concepts. *Pain Forum* 5(2), 128–138.
- Mimi Mun Y.T. (2010) Therapeutic effects of an indoor gardening programme for older people living in nursing homes. *Journal of Clinical Nursing* 19(7), 949–958.
- Nord C. (2011) Architectural space as a moulding factor of care practices and resident privacy in assisted living. *Ageing & Society* 31, 934–952.
- Nordh H., Hartig T., Hagerhall C.M. & Fry G. (2009) Components of small urban parks that predict the possibility for restoration. *Urban Forestry & Urban Greening* 8(4), 225–235.
- Oguz D., Cakci I., Sevimli G. & Ozgur S. (2010) Outdoor environment preferences in nursing homes: case study of Ankara, Turkey. *Scientific Research & Essays* 5(24), 3987–3993.
- Olsson A., Lampic C., Skovdahl K. & Engström M. (2013) Persons with early-stage dementia reflect on being outdoors: a repeated interview study. *Ageing & Mental Health* 17(7), 793–800.
- Ottosson J. & Grahn P. (2005) A comparison of leisure time spent in a garden with leisure time spent indoors: on measures of restoration in residents in geriatric care. *Landscape Research* 30 (1), 23–55.
- Raanaas R.K., Patil G.G. & Hartig T. (2012) Health benefits of a view of nature through the window: a quasi-experimental study of patients in a residential rehabilitation center. *Clinical Rehabilitation* 26(1), 21–32.
- Rabin R., Oemar M., Oppe M., Janssen B. & Herdman M. (2011) *EQ-5D-5L User Guide: Basic Information on How to Use the EQ-5D-5L (Version 1.0)*. EuroQual Group, Rotterdam.
- Rappe E. & Kivelä S. (2005) Effects of garden visits on long-term care residents as related to depression. *Horttechnology* 15(2), 298–303.
- Rappe E. & Topo P. (2007) Contact with outdoor greenery can support competence among people with dementia. *Journal of Housing for the Elderly* 21(3–4), 229–248.

- Rappe E., Kivelä S. & Rita H. (2006) Visiting outdoor green environments positively impacts self-rated health among older people in long-term care. *Horttechnology* 16(1), 55–59.
- Raske M. (2010) Nursing home quality of life: study of an enabling garden. *Journal of Gerontological Social Work* 53(4), 336–351.
- Rodiek S. (2005) Resident perceptions of physical environment features that influence outdoor usage at assisted living facilities. *Journal of Housing for the Elderly* 19(3), 95–107.
- Rodiek S., Lee C. & Nejati A. (2014) You can't get there from here: reaching the outdoors in senior housing. *Journal of Housing for the Elderly* 28(1), 63–84.
- Sjölund B., Wimo A., Qiu C., Engström M. & von Strauss E. (2013) Time trends in prevalence of activities of daily living (ADL) disability and survival: comparing two populations (aged 78+ years) living in a rural area in Sweden. *Archives of Gerontology and Geriatrics* 58(3), 370–375.
- Tabachnick B.G. & Fidell L.S. (2013) *Using Multivariate Statistics*, 6th edn. Pearson, New York.
- Takai Y., Yamamoto-Mitani N. & Ko A. (2013) Prevalence of and factors related to pain among elderly Japanese residents in long-term healthcare facilities. *Geriatrics & Gerontology International* 14(2), 481–489.
- Tang J.W. & Brown R.D. (2005) The effect of viewing a landscape on physiological health of elderly women. *Journal of Housing for the Elderly* 19(3), 187–202.
- Tse M., Leung R. & Ho S. (2012) Pain and psychological well-being of older persons living in nursing homes: an exploratory study in planning patient-centred intervention. *Journal of Advanced Nursing* 68(2), 312–321.
- Van den Berg A., Hartig T. & Staats H. (2007) Preference for nature in urbanized societies: stress, restoration and the pursuit of sustainability. *Journal of Social Issues* 63(1), 79–96.
- World Medical Association Declaration of Helsinki (2004) Ethical Principles for Medical Research Involving Human Subjects. Retrieved from <http://www.wma.net/en/30publications/10policies/b3/> on 15 March 2016.
- Zeisel J., Silverstein N.M., Hyde J., Levkoff S., Powell Lawton M. & Holmes W. (2003) Environmental correlates to behavioral health outcomes in Alzheimer's special care units. *The Gerontologist* 43(5), 697–711.

The *Journal of Advanced Nursing (JAN)* is an international, peer-reviewed, scientific journal. *JAN* contributes to the advancement of evidence-based nursing, midwifery and health care by disseminating high quality research and scholarship of contemporary relevance and with potential to advance knowledge for practice, education, management or policy. *JAN* publishes research reviews, original research reports and methodological and theoretical papers.

For further information, please visit *JAN* on the Wiley Online Library website: www.wileyonlinelibrary.com/journal/jan

Reasons to publish your work in *JAN*:

- **High-impact forum:** the world's most cited nursing journal, with an Impact Factor of 1.741 – ranked 8/109 in the 2014 ISI Journal Citation Reports © (Nursing (Social Science)).
- **Most read nursing journal in the world:** over 3 million articles downloaded online per year and accessible in over 10,000 libraries worldwide (including over 3,500 in developing countries with free or low cost access).
- **Fast and easy online submission:** online submission at <http://mc.manuscriptcentral.com/jan>.
- **Positive publishing experience:** rapid double-blind peer review with constructive feedback.
- **Rapid online publication in five weeks:** average time from final manuscript arriving in production to online publication.
- **Online Open:** the option to pay to make your article freely and openly accessible to non-subscribers upon publication on Wiley Online Library, as well as the option to deposit the article in your own or your funding agency's preferred archive (e.g. PubMed).