Does time spent on visits to green space mediate the associations between the level of residential greenness and mental health?

van den Berg, Magdalena; van Poppel, Mireille; Smith, Graham; Triguero-Mas, Margarita; Andrusaityte, Sandra; van Kamp, Irene; van Mechelen, Willem; Gidlow, Christopher; Gražulevičiene, Regina; Nieuwenhuijsen, Mark J.; Kruize, Hanneke; Maas, Jolanda

published in
Urban Forestry and Urban Greening
2017

DOI (link to publisher)
10.1016/j.ufug.2017.04.010

document version
Publisher's PDF, also known as Version of record

Urban Forestry & Urban Greening 25 (2017) 94–102

Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.com/locate/ufug

Original article

Does time spent on visits to green space mediate the associations between the level of residential greenness and mental health?

Magdalena van den Berg[a,*], Mireille van Poppel[a,j], Graham Smith[b], Margarita Triguero-Mas[e,f,g], Sandra Andrusaityte[h], Irene van Kamp[d], Willem van Mechelen[a], Christopher Gidlow[c], Regina Gražulevičiene[h], Mark J. Nieuwenhuijsen[e,f,g], Hanneke Kruize[d], Jolanda Maas[a,i]

[a] Department of Public & Occupational Health and EMGO Institute for Health and Care Research, VU University Medical Center, van der Boechorststraat 7, 1081 BT, Amsterdam, The Netherlands
[b] Institute for Environment, Sustainability and Regeneration, Staffordshire University, Leek Road, Stoke-on-Trent, Staffordshire ST4 2DF, UK
[c] Centre for Sport, Health and Exercise Research, Staffordshire University, Leek Road, Stoke-on-Trent, Staffordshire ST4 2DF, UK
[d] Center for Sustainability, Environment and Health National Institute for Public Health and the Environment (RIVM), Antonie van Leeuwenhoeklaan 9, 3721 MA, Bilthoven, The Netherlands
[e] ISGlobal, Centre for Research in Environmental Epidemiology (CREAL), Barcelona Biomedical Research Park, Barcelona Biomedical Research Park, Dr. Aiguader, 88, 08003 Barcelona, Spain
[f] University Pompeu Fabra (UPF), Plaça de la Mercè, 10, 08002 Barcelona, Spain
[g] CIBER Epidemiology y Salud Publica (CIBERESP), C/ Monforte de Lemos 3-5, 28029, Madrid, Spain
[h] Vytauto Didžiojo Universitetas, K. Donelaičio g. 58, Kaunas 44248, Lithuania
[i] Department of Clinical, Neuro and Developmental Psychology, Vrije Universiteit Amsterdam, van der Boechorststraat 1, NL 1081 BT, Amsterdam, The Netherlands
[j] Institute of Sport Science, University of Graz, Mozartgasse 14, 8010 Graz, Austria

ARTICLE INFO

Keywords:
Cross-sectional study
Green space
Mental health
Mediation
Residential greenness
Time spent on visits

ABSTRACT

Objective: The objective of the current study was to explore whether time spent visiting green space near home acts as a mediator in the association between level of residential greenness and perceived mental health.
Methods: Questionnaire data and satellite data of residential greenness were gathered in four European cities (total n = 3748): Barcelona (SP), Doetinchem (NL), Kaunas (LT) and Stoke-on-Trent (UK).
Results: Mediation analyses showed that time spent visiting green space near home was a weak, but statistically significant, mediator in the pooled data and in the Dutch sample only.
Conclusions: The findings provide little support for the hypothesis that purposeful visits are a mediator linking indirectly greenness with mental health. More research is needed to explore other mediators related to different exposure pathways, such as visual exposure, and alternative mechanisms, such as (perceived) safety.

1. Introduction

Many epidemiological studies have shown that exposure to greenness in the immediate residential environment is positively associated with mental health (Gascon et al., 2015; James et al., 2015; van den Berg et al., 2015). Several mechanisms have been proposed that might explain this association. Residential greenness or green space with natural elements, such as trees, forests and urban parks, might offer opportunities for psychological restoration (Kaplan, 1995; Ulrich et al., 1991). Many experimental studies have indicated that exposure to natural or green environments, as opposed to built environments, positively affects mood and helps people to recover from stress and mental fatigue (Bowler et al., 2010; Bratman et al., 2012; Health Council of the Netherlands, 2004). Furthermore, two indirect pathways have been suggested through which green space might confer health benefits, i.e. through proving suitable spaces for leisure activities and for meeting people, thereby, promoting physical activity and social contacts (Dadvand et al., 2016; de Vries et al., 2013; Hartig et al., 2014; Maas et al., 2009a,b). A growing number of epidemiological studies have investigated these indirect pathways, including several studies on mediation see for reviews e.g. (Hartig et al., 2014; James et al., 2015). However, the evidence supporting this is still inconclusive (Hartiget al.

* Corresponding author.
E-mail addresses: mm.vandenberg@vumc.nl (M. van den Berg), mnm.vanpoppel@vumc.nl (M. van Poppel), g.r.smith@staffs.ac.uk (G. Smith), margarita.triguero@isglobal.org (M. Triguero-Mas), s.andrusaityte@gmf.vdu.lt (S. Andrusaityte), irene.van.kamp@rivm.nl (I. van Kamp), w.vanmechelen@vumc.nl (W. van Mechelen), c.gidlow@staffs.ac.uk (C. Gidlow), r.grazuleviciene@gmf.vdu.lt (R. Gražulevičiene), mark.nieuwenhuijsen@isglobal.org (M.J. Nieuwenhuijsen), hanneke.kruize@rivm.nl (H. Kruize), jolanda.maas@vu.nl (J. Maas).

http://dx.doi.org/10.1016/j.ufug.2017.04.010
Received 1 November 2016; Received in revised form 18 February 2017; Accepted 20 April 2017
Available online 06 May 2017
1618-8667/

2014). One reason might be that a variety of measures of level of residential greenness have been used and none of them do capture actual use of green space, which might be a better indicator of exposure to or contact with greenness than the level of greenness per se.

Several researchers have suggested that intentional visits or visits on purpose to green space in the residential environment play an important role in explaining health benefits of green space (Bedimo-Rung et al., 2005; Hartig et al., 2014; Lachowycz and Jones 2013). However, some studies have provided indications for exposure to greenness which is not related to visits on purpose. The finding that streetscape greenery, i.e. small green spaces such as gardens and street trees visible from the home, was more strongly associated with mental health than nearby green spaces, suggests a direct pathway of exposure, for example through visual exposure from windows at home (van Dillen et al., 2011). Another study found that mental health benefits were associated with surrounding greenness in a circular buffer of 300 m around the residence, but not with presence of one or more green areas, such as urban parks and forests, in the same buffer (Triguero-Mas et al., 2015). This finding supports the possibility of a direct pathway of exposure, besides that of purposeful visits to green spaces. A possible explanation is that visual exposure to greenness from, for example, windows at home or during commuting or other ways of unintentional use of green space may provide (micro-)restorative experiences (Hartig et al., 2014; Kaplan, 1995). Overall, there could be important differences between greenness indicators, which links to different way of exposure to or contact with greenness. Especially, the importance of indirect pathways of exposure is not yet clear: do people have to visit green space on purpose for obtaining mental health benefits from greenness in their immediate residential environment? The aim of the present study was to explore whether time spent visiting green space near home mediates the greenness – mental health association.

1.1. Time spent on visiting green space

Few studies have focussed on the association between the frequency and duration of visits to green space and mental health. These studies have reported that visiting green space more frequently and spending more time in green space was associated with lower perceived stress levels (Grahn and Stigsdotter, 2003; Nielsen and Hansen, 2007; Stigsdotter et al., 2010) and better mental health and vitality (van den Berg et al., 2016). A Danish study found that the number of visits to green space decreased with greater distance and that the number of visits partly explained the negative association between distance to green space and stress levels (Nielsen and Hansen, 2007), suggesting that purposeful visits to green space near home might be an important exposure pathway. To date, there is evidence linking self-reported distance to green space with visit frequency, and visit frequency and time spent in green space with better mental health. No studies have investigated whether time spent visiting green space near home, i.e. in the immediate residential environment, mediates the association between level of residential greenness, objectively measured by the Normalized Difference Vegetation Index (NDVI), and mental health.

Several individual and socio-cultural factors may influence time people spent on visiting green space, such as opportunity and motivation, perceptions of green space, perceived quality and safety (Lachowycz and Jones, 2013). Climatic factors may influence the time people spent visiting green space in different seasons. Socio-cultural factors that influence perceptions of green space and attitudes to visit green space, and towards nature in general, might even more important than having green spaces available and easily accessible (Lin et al., 2014). Therefore, it is expected that the importance of time spent on visiting green space as a mediator may differ between cities in European countries with different cultural and climatic contexts.

The present study builds on previous analyses by van den Berg et al. (2016) and is part of the EU-FP7-funded 'Positive Health Effects of the Natural Outdoor Environment in Typical Populations in Different Regions in Europe (PHENOTYPE) project. The main objective of the present study is to investigate whether time spent on visits to green space near home mediates the association between objectively measured level of residential greenness and mental health, and whether this association differs across cities.

2. Methods

2.1. Study background and data collection

Data for this study were derived from a questionnaire administered as part of the PHENOTYPE project. The study protocol has been described elsewhere (Nieuwenhuijsen et al., 2014). All procedures have been approved by ethical committees of the respective research institutes.

Data were collected from 3947 adult residents from 124 neighbourhoods across four European cities: Barcelona (Spain); Kaunas (Lithuania); Doetinchem (the Netherlands) and Stoke-on-Trent (UK). In Doetinchem, Barcelona and Stoke-on-Trent the questionnaire data were collected with face-to-face interviews, while in Kaunas postal questionnaires were conducted. A summary of the spatial units that were used for area selection can be seen in Supplementary Table 1. The spatial units in Barcelona are much smaller in physical size than the other cities. However, the population density of Barcelona is much higher. Furthermore, Doetinchem is the smallest city, both in size and in study population. Approximately 30 spatial units with sufficient variability in proximity to green space and in socioeconomic status (SES) were selected, in each city. A random sample of 30–35 adults was drawn from the general population aged 18–75 years, in each spatial unit. For further details on the area and population selection collection see van den Berg et al. (2016).

2.2. Questionnaire

Most questions were derived from existing and validated measures, and some were developed for the specific objectives of PHENOTYPE. Where new questions were developed, they were drafted in English and translated (and back translated) into Dutch, Spanish and Lithuanian.

The following subset of questions was used for this study:

Mental health: A subscale from The Medical Outcome Study Short Form (SF-36) general health survey was used to measure perceived mental health (Ware and Sherbourne 1992). The 5-items mental health subscale, also known as MHI-5, assesses nervousness and feelings of depression in the last month. All items were scored on a 6-point scale and sum scores were transformed into a scale from 0 to 100, where a higher score reflects better mental health.

Frequency and duration of visits to green space near home: Visit frequency was measured by asking "how often did you visit in the last 4 weeks on purpose the green/blue environment near home your home (i.e. at less than 15 min by foot/bike). This item was scored on a 5-point scale (never; 1 time or less in past month; 2–3 times in past month; 1–4 times weekly to (almost) daily). Visit duration was assessed by asking "how much time did you spend in green or blue environments near home in the last 4 weeks (per visit)". This was scored on a 4-point scale (< 1 h, 1–2 h, 3–5 h, 6–10 h). A new variable was constructed to obtain the total hours spent in green space near home in the last 4 weeks. The mid-points for each response category was used for visit frequency and duration and they were then multiplied to provide total hours spent in green space near home in the last 4 weeks (e.g. less than 1 times/month was coded as 0.5 times/month and less than 1 h/month was coded as 0.5 h/month). "Never" and "not applicable" answers for visit frequency were recoded as zero hours in the past month. Because of its skewed distribution, the variable time spent on visits to green space near home was dichotomized around the median (4 h for pooled data, specific median values for the city data, see Table 1). Although the questions included visits to both green and blue space, the analyses only assessed

Table 1
Characteristics of the study population: pooled data and data for the cities separately.

	All cities pooled	Barcelona, Spain	Stoke-on-Trent, UK	Doetinchem, Netherlands	Kaunas, Lithuania
Total N	3765	1030	1002	837	896
Age (18–75 years), Mean (SD)	51.2 (16.2)	44.9 (15.5)	45.8 (16.1)	56.3 (12.2)	59.3(14.3)
Missing, n	*53*	*9*	*43*	*0*	*1*
Male (=1), n (%)	1674 (44.5)	483(46.9)	529 (52.8)	364(43.5)	354(39.5)
Missing, n	*0*	*0*	*0*	*0*	*1*
Level of education, n (%)					
Low	271 (7.2)	148 (14.4)	96 (9.8)	10 (1.2)	17 (1.9)
Medium	1655 (44.0)	398 (38.8)	635 (64.8)	394 (47.1)	228 (25.4)
High	1813 (48.2)	481 (46.8)	249 (24.9)	432 (51.7)	651 (72.7)
Missing, n	*26*	*3*	*20*	*1*	*0*
Employed (vs. not), n (%)	2315 (61.5)	700 (68.0)	653 (65.2)	510 (60.9)	452 (50.4)
Missing, n	*0*	*0*	*0*	*0*	*0*
Perceived income situation, n (%)					
Cannot make ends meet	379 (10.1)	124 (12.6)	73 (8.2)	144 (17.4)	38 (4.7)
Enough to get along	1755 (46.6)	490 (49.6)	431 (48.6)	250 (30.2)	584 (72.1)
Comfortable	1377 (36.6)	373 (37.8)	382 (43.1)	4304 (52.4)	188 (23.2)
Missing, n	*254*	*43*	*116*	*9*	*86*
Household composition, n (%)					
children < 12	564 (15.0)	191 (18.6)	203 (20.5)	126 (15.1)	44 (4.9)
no children < 12	3177 (84.4)	834 (81.4)	785 (79.5)	711 (84.9)	847 (95.1)
Missing, n	*24*	*5*	*14*	*0*	*5*
Transformed mental health (sum score scale 0–100), Mean (SD)	73.5 (16.2)	70.9 (15.9)	73.3 (16.5)	80.1 (13.5)	70.6 (17.0)
Missing, n	0	*0*	*0*	*0*	*0*
Time spent in green spaces near home (hours/month) Median [IQR]	4 [0.3–12]	3.8 [0.0–12]	1 [0.0–10]	10 [1.4–12]	4 [0.3–12]
Missings, n	*157*	*10*	*34*	*12*	*101*
Residential greenness (NDVI 300 m straight-line buffer) Median [IQR]	0.38 [0.16–0.55]	0.19 [0.16–0.25]	0.47 [0.42–0.52]	0.53 [0.48–0.60]	0.54 [0.49–0.59]
Missings, n	*0*	*0*	*0*	*0*	*0*

Note: SD = Standard Deviation; N/n = number of respondents; IQR = Interquartile range.

mediation in the associations with the level of residential greenness.

Socio-demographic characteristics: To adjust for the socio-economic status of the respondent, level of education (primary school or no education; secondary school/further education; university degree or higher), perceived income situation (cannot make ends meet; just have enough to get along; being comfortable) and work status (employed/unemployed) were included as key confounders. Furthermore, the models were controlled for gender, age (in years) and household composition (with children younger than 12 years/other) and, only for the pooled data analyses, also for city.

Level of residential greenness: The normalized difference vegetation index (NDVI) was used to represent the level of vegetation or greenness around the participants' residence on a 300 m Euclidean (straight-line) buffer. The NDVI is based on the land surface reflectance of visible (red) and near-infrared wavelength of light indicating the density of healthy (i.e. photosynthetically active) green leaf vegetation. Values range from −1 to +1, with values below zero corresponding to water bodies, and values between zero and 0.1 corresponding to barren areas of rock, sand or snow. Moderate values (0.2–0.3) refer to shrub and grassland, while high values (0.6–0.8) represent temperate and tropical rain forests (Weier and Herring, 2011). It is assumed that the 300 m straight-line buffer captures the immediate residential area that includes most of the nearby green spaces. The NDVI measure has shown to be highly correlated with expert ratings of neighbourhood greenness in both low and high-density areas (Rhew et al., 2011). Another justification for using NDVI as a measure of overall level of vegetation is that previous findings of associations with mental health often were stronger and more consistent using surrounding greenness measures such as amount of green space and NDVI compared to green space access measures such as number of green spaces or presence of a nearby green space (Gascon et al., 2015). Furthermore, previous studies have shown that the frequency of green space visits declines sharply after 300–400 m of distance (Giles-Corti et al., 2005; Grahn and Stigsdotter, 2003; Nielsen and Hansen, 2007). NDVI values were derived from Landsat 8 satellite images provided at 30 m × 30 m spatial resolution. Four cloud-free images were obtained which covered the entire study region for each city and were representative of the greenest season within the relevant study period on the following dates: 16th April, 2013 for Barcelona area, 21st April, 2011 for Stoke-on-Trent, 21st July, 2013 for the Netherlands East, and 8th June, 2011 for Kaunas. Cells with large water bodies were excluded and mean NDVI values (scores 0–1) were calculated as estimations of greenness in a circular buffer around the geocoded address of the residence of each participant.

2.3. Statistical analyses

Multilevel linear and logistic regression analyses were performed to investigate the associations between the residential greenness and mental health, and to assess mediation. The multilevel analyses account for the dependency of data collected within neighbourhoods. Therefore, two levels were included: individual and neighbourhood. Including a random intercept significantly improved the regression model. The models were also tested with addition of a random slope, but this did not improve the models and therefore was not included. City was not included as a third level in the pooled data analyses, because the number of cities was too low. Instead, to adjust for the dependency of data collected within cities the variable "city" was added to the model as a potential confounder. All models were adjusted for the following potential confounders: gender, age, level of education, perceived income, employment status, household composition with/without children younger than 12 years.

Mediation analysis tests whether an independent variable influences the outcome variable directly or indirectly through a mediating variable (Hayes, 2013; MacKinnon, 2008). Mediation analysis consisted of the following three regression steps (Fig. 1): i) the association between the level of residential greenness and mental health, estimat-

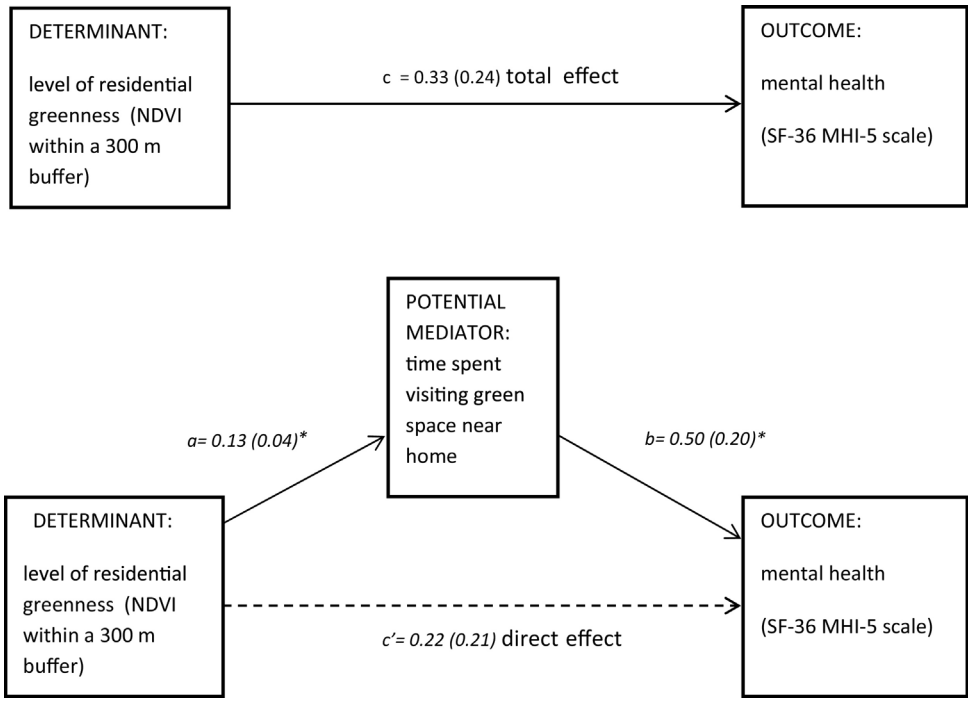

Fig. 1. Conceptual model of mediation of the study exploring mediation of time spent on visits to green space near home (hours per month; variable dichotomized around the median value) in the association between the residential greenness (NDVI within a straight-line buffer of 300 m) and mental health as a score on the 0–100 MHI-5 scale. The numbers are the comparable regression coefficients and standard errors presenting the results for **Doetinchem**, i.e. significant mediation indicated by the product of the a- and b-coefficients (0.13 × 0.50) = 0.07, 95% CI 0.00–0.13, p = 0.046 based on the Sobel test of significance of the mediated effect ($p < 0.05$). The models were adjusted for gender, age, level of education, perceived income, employment status and household with/without children < 12 years; a random intercept was included to account for neighbourhood clustering.

ing the unstandardized regression coefficient c (the total effect); ii) the association between the level of residential greenness and the potential mediator, estimating the unstandardized regression coefficient a (a-path); iii) the association between the level of residential greenness and mental health, while including the potential mediator (b-path), estimating the unstandardized regression coefficient b as a measure of the independent effect of the mediator on mental health and the unstandardized regression coefficient c' as a measure of the direct effect on mental health. The size of the indirect or mediated effect was represented by the product of a and b coefficients; i.e. the product-of-coefficients approach (see Fig. 1; (MacKinnon, 2008)). Because the potential mediator was transformed into a dichotomous variable (based on city-specific median values), the regression coefficients resulting from the logistic and linear regression steps were on different scales. To make them comparable, the coefficients were multiplied by the standard deviation (SD) of the independent variable (X) in the regression equation and then divided by the SD of the outcome variable. The spreadsheet tool created by Nathaniel Herr (version February 2006) was used to compute the comparable regression coefficients, and the indirect effect (ab) and its standard deviation. The Sobel test was used to test whether an intervening variable was a significant mediator. Significance was set at the $p < 0.05$ level. The percentage of the mediated effect was estimated as ab/(ab + c') × 100%. All regression analyses were conducted in MLwiN version 2.22.

3. Results

3.1. Study population

Supplementary Table 2 presents data on recruitment methods and response rates for each city.

The aim was to use similar recruitment methods, but there were some limitations in practice which resulted in differences in response rates between the four cities. In Barcelona, the response rate was 46.9%, in Stoke-on-Trent 36.9%, in Doetinchem 8.4% and Kaunas 21.3%. The response rate in the pooled dataset was 19.8%.

After cleaning the database and excluding cases with missing data on key variables (mental health, frequency and duration of visits to green space near home), the pooled database consisted of 3765 participants. Table 1 shows the number of participants for each city and the characteristics of the study populations. It shows that some of the personal characteristics varied significantly between the four cities. The Kaunas study population was on average the oldest and most educated, while the employment rate was lowest compared to the other study populations. Furthermore, the mean mental health score was significantly lower in Kaunas and Barcelona compared to Doetinchem. The median value of time spent visiting green space near home was lowest in Stoke-on-Trent and highest in Doetinchem, while the level of residential greenness, measured as the mean NDVI value, was lowest in Barcelona and highest in Doetinchem and Kaunas. Additional information collected in the current study showed that the percentage of respondents that was dissatisfied with the safety and quality of green space differed significantly between the cities (see Supplementary Table 3). Also having a dog differed between the four cities: in Kaunas more than half of the respondents had a dog, while in Doetinchem and Barcelona, this was less than a quarter.

3.2. Association between the level of residential greenness and mental health (c-path)

The first step in the mediation analysis was to assess the association between the level of residential greenness and mental health. Table 2 shows the results of the crude and the adjusted multilevel linear regression models (step 1). The level of residential greenness was not significantly associated with mental health, neither in the pooled data nor in the data of the four cities separately. Conducting mediation analysis is still justified because the overall association might be cancelled out by multiple mediators and opposing mechanisms. As advocated by several authors in the technical literature on mediation: there is no need for a statistical significant c-path to establish mediation

Table 2
Multilevel linear regression of residential greenness (X; NDVI 300 m straight-line buffer) on mental health (Y; 0–100 scale; higher is better mental health), step 1(c-path) and 3 (b-path) of testing mediation for time spent on visiting green space near home (M): unstandardized regression coefficients, standard error and 95% confidence intervals.

	Crude model[a]	Adjusted model step 1 (c-path, X → Y)[b]	Adjusted model step 3 (b-path X, M → Y)[c]	
	c (se) 95% CI	c (se) 95% CI	c' (se) 95% CI	b1 (se) 95% CI
Pooled data, n = 3765				
Residential greenness	10.65 (2.80) 5.16–16.13	3.28 (3.77) −4.10 to 10.66	2.46 (3.76) −4.91 to 9.83	
Visits to green space close to home, M 1 = more than 4.00 h/month				1.77 (0.54) 0.72–2.82*
Barcelona (Spain) n = 1030				
Residential greenness	2.81 (8.63) −14.10 to 19.72	4.40 (7.47) −10.23 to 19.03	2.58 (7.53) −12.18 to 17.34	
Visits to green space close to home, M 1 = more than 3.8 h/month				2.59 (0.99) 0.65–4.53*
Stoke-on-Trent (UK), n = 1002				
Residential greenness	13.10 (9.76) −6.03 to 32.24	4.16 (10.02) −15.49 to 23.80	5.32 (9.84) −13.97 to 24.61	
Visits to green space close to home, M 1 = more than 1.00 h/month				3.42 (1.14) 1.19−5.65*
Doetinchem (Netherlands), n = 837				
Residential greenness	12.09 (5.59) 0.11–2.30	7.29 (5.30) −3.10 to 17.68	5.72 (5.30) −4.67 to 16.11	
Visits to green space close to home, M 1 = more than 10.00 h/month				2.23 (0.90) 0.47–3.99*
Kaunas (Lithuanian), n = 896				
Residential greenness	−10.03 (7.95) −25.61 to 5.55	−6.74 (8.19) −22.79 to 9.31	−7.20 (8.17) −23.21 to 8.81	
Visits to green space close to home, M				1.88 (1.21) −0.49 to 4.25

* $p < 0.05$.
[a] Including random intercept.
[b] Adjusted for gender, age, level of education, perceived income, employment, household with/without children < 12 years and city.
[c] Adjusted for gender, age, level of education, perceived income, employment, household with/without children < 12 years and time spent on visiting green space close to home (potential mediator M); pooled data also adjusted for city.

or an indirect effect, which can be demonstrated by testing whether the product of the a- and b-coefficients is statistically significant (Hayes, 2009; Shrout and Bolger, 2002; Zhao et al., 2010).

3.3. Association between the level of residential greenness and time spent visiting green space as mediator (a-path)

The second step in the mediation analysis was to assess the association between the level of residential greenness and the potential mediator, i.e. time spent visiting green space near home. Table 3 shows the results of the crude and the adjusted multilevel logistic regression models. The analysis with the pooled data showed that a 0.1 increment in NDVI was significantly associated with a 22% higher odds of spending 4 h or more (i.e. the median value of pooled data) visiting green space near home in the last 4 weeks. The analyses per city showed that the associations between the level of residential greenness and time spent visiting green space near home were only significant in Barcelona and Doetinchem: a 0.1 increment in NDVI was associated with 41% and 32% (respectively) higher odds of spending time visiting green space near home in the last 4 weeks based on the city specific median values of 3.8 h (Barcelona) and 10 h (Doetinchem).

3.4. Association between level of residential greenness and mental health controlling for time spent visiting green space near home (b-path)

For the third step in the mediation analysis, the association between the level of residential greenness and mental health was controlled for the potential mediator, i.e. time spent visiting green space near home. The resulting regression coefficients (b and c') are presented in Table 2 (adjusted model step 3). Time spent visiting green space near home was

Table 3
Multilevel logistic regression of the level of residential greenness (NDVI 300 m circular buffer) on time spend visiting green space close to home (M), step 2 (a-path): unstandardized regression coefficients with standard error, Odds Ratio's (for additional 0.1 NDVI) with 95% confidence intervals for adjusted model only.

	Crude model[a]	Adjusted model step 2: Time spend visiting green spaces, M1 (a-path, X → M)[b]	
	a (se)	a (se)	OR (95% CI)
Pooled data n = 3765			
Residential greenness	1.70(0.39)	2.00 (0.54)	1.22 (1.10–1.36)*
Barcelona (Spain) n = 1030			
Residential greenness	3.51 (1.38)	3.43 (1.39)	1.41 (1.07–1.85)*
Stoke-on-Trent (UK) n = 1002			
Residential greenness	−0.48 (1.48)	−1.11 (1.46)	0.89 (0.67–1.19)
Doetinchem (Netherlands) n = 837			
Residential greenness	2.82 (0.81)	2.08 (0.83)	1.32 (1.05–1.45)*
Kaunas (Lithuanian) n = 986			
Residential greenness	1.84 (0.95)	0.89 (1.02)	1.09 (0.90–1.33)

* $p < 0.05$.
[a] Including random intercept.
[b] Adjusted for gender, age, level of education, perceived income, employment status, household with/without children < 12 years; pooled data also adjusted for city.

Table 4
Mediation effects of time spent on visiting green space close to home (M; variable dichotomized around the median value) on the association between the level of residential greenness measured as NDVI within a straight-line buffer of 300 m and mental health.

Mediator	comp c (se)[a]	comp a(se)[b]	comp b(se)[c]	comp a* comp b (se)[d]	95%CI of comp a*comp b	comp c'(se)[e]	% mediated effect[f]
Pooled data							
Time spend visiting green space close to home *Median 4.00 h*	0.33 (0.25)	0.17 (0.05)	0.43 (0.13)	0.08 (0.03)	**0.02–0.13***	0.19 (0.29)	**28**
Barcelona (Spain)							
Time spend visiting green space close to home *Median 3.8 h*	0.23 (0.40)	0.18 (0.07)	0.57 (0.22)	0.10 (0.06)	−0.01 to 0.22 p = 0.07	0.11 (0.33)	48
Stoke-on-Trent (UK)							
Time spend visiting green space close to home *Median 1.00*	0.18 (0.42)	*−0.05 (0.06)*	*0.67 (0.22)*	*−0.03 (0.04)*	*-0.12 to 0.05*	*0.16 (0.30)*	inconsistent mediation
Doetinchem (Netherlands)							
Time spend visiting green space close to home *Median 10.00*	0.33 (0.24)	*0.13 (0.04)*	*0.50 (0.20)*	*0.07 (0.03)*	***0.00–0.13**** ***p = 0.046***	*0.22 (0.21)*	**23**
Kaunas (Lithuanian)							
Time spend visiting green space close to home *Median 4.00 h*	−0.26 (0.32)	0.04 (0.04)	0.45 (0.29)	0.02 (0.02)	−0.03 to 0.06	−0.25 (0.29)	inconsistent mediation

All models were adjusted for gender, age, level of education, perceived income, employment status and household with/without children < 12 years; pooled data also for city; a random intercept was included to account for neighbourhood clustering.

[a] Estimate of the comparable total effect of level of residential greenness (X) on the outcome (y').
[b] Estimate of the comparable effect of residential greenness (X) on the mediator (M').
[c] Estimate of the comparable effect of the mediator (M) on the outcome (Y") when adjusted for level of residential greenness (X).
[d] The product of comparable a and b estimates the indirect or mediated effect; * Sobel test of significance of the mediated effect ($p < 0.05$).
[e] Estimate of the comparable direct effect of residential greenness (X) on the outcome (Y"), adjusted for the mediator (M).
[f] Percentage of the mediated effect is estimated by ab/(ab + c') × 100%.

significantly associated with mental health, independent of surrounding greenness, in the pooled data as well as in Barcelona, Stoke-on-Trent and Doetinchem (using city specific median values for visiting time), but not in Kaunas. The strongest association was found for Stoke-on-Trent (a = 3.42). In the pooled data and in the city specific data of Barcelona and Doetinchem, the c'- coefficients indicating direct effects were substantially smaller than the c- coefficients indicating total effects This suggests that mediation occurred.

3.5. Mediation (ab-path)

Table 4 shows the calculated comparable coefficients of the c-, a- and b-paths. The mediated effect, indicated as comp a*comp b, was significant for the pooled data (comp a* comp b 0.08, 95% CI 0.02–0.13; p = 0.014) and in Doetinchem (comp a*comp b 0.07, 95% CI 0.00–0.13; p = 0.046). Time spent visiting green space near home was a significant mediator.in the pooled data, the proportion of the total effect mediated was 28 percent, while, in Doetinchem, this was 23 percent. Fig. 1 presents the results for Doetinchem in the conceptual model of mediation. In Barcelona, the mediated effect seemed stronger (comp a *comp b 0.10, 95% CI −0.01 to 0.2) than in Doetinchem (the proportion of the total effect mediated by time spent visiting green spaces was 48%), although this was not statistically significant (p = 0.072). The results for Stoke-on-Trent and Kaunas showed that the direction of the indirect effect (a × b) was different from that of the total effect pointing to inconsistent mediation. This means that the indirect and direct effect tend to cancel each other out, indicating that the mediator acts as a suppressor variable (MacKinnon, 2008; Zhao et al., 2010).

4. Discussion

4.1. Main findings

The objective of the present study was to explore whether time spent visiting green space near home, as a proxy of exposure, mediated the association between the level of residential greenness (300 m straight-line circular buffer) and mental health. Results showed that, despite a lack of an overall association between the level of greenness in the immediate environment and mental health, time spent visiting green space near home was a statistically significant mediator in the pooled data as well as in the Dutch city (Doetinchem). However, the mediation effect (i.e. indirect effect) was small and was not demonstrated in the other three cities. This suggests that whether there is a mediation effect of time spent visiting green space near home differs between cities. For Barcelona, there was a trend for a mediating effect, but this was not significant, while a statistically significant association was found between the level of residential greenness and the hypothesized mediator (a-path). For Stoke-on-Trent, an association was found between the mediator and mental health (b-path), but no association was found between the level of residential greenness and the tested mediator (a-path). For Kaunas, both a- and b-paths were not statistically significant.

4.1.1. Explaining the null findings (c-path)

The lack of a significant overall association between the level of residential greenness and mental health in the pooled data and in the separate cities contradicts findings of previous studies that have shown associations (Gascon et al., 2015; McEachan et al., 2015; van den Berg et al., 2015). The context in the four cities is so different that other mediators, especially those that might act in a certain context as a suppressor, overshadow the mere role of time spent in green space. A plausible candidate for such a mediator might be perceived safety

(Hartig et al., 2014). Several studies have found that type of green space influences perceived safety (Jansson et al., 2013). For example, Maas et al. (2009a,b) found that the level of residential greenness was in general positively associated with higher perceived safety, except in highly urbanized areas where a higher percentage of enclosed green space was associated with lower perceived safety.

Another explanation for the null findings of an overall association in the pooled data is, that the associations found in the previous studies were weak (i.e. small effect estimate with large confidence intervals) and only statistically significant in large populations samples, mainly from one city or (part of) one country. Therefore, the power analysis that calculated the sample sizes of the current study might not have accounted sufficiently for the heterogeneity between the populations in the four cities. This is supported by the fact that a previous study in Barcelona, which used a sample of 4000 people residing from 10 districts in Barcelona, did find an association between mental health and surrounding greenness as measured by NDVI in three buffers (100 m, 250 and 500 m buffers) (Dadvand et al., 2016). The current study with a sample of 1000 people across 30 neighbourhoods in Barcelona did not find such an association. However, the studies used different indicators of mental health as outcome. The indicator of mental health used in the previous Barcelona study, and in many other previous studies on the association between residential greenness and mental health, was the General Health Questionnaire (GHQ-12), while in the current study the MHI-5 scale was used. A comparison of the performance of both indicators of mental health in a Dutch population showed that the performance of both instruments in prediction mental health problems is similar, but there are differences: the GHQ-12 predicts visits to the general practitioner better, while MHI-5 those to mental health care (Hoeymans et al., 2004). This confirms that the MHI-5 assesses more serious mental health problems such as anxiety and depression, while the GHQ-12 assesses general feelings of psychological distress (worry, stress, lack of concentration): complaints which might be more susceptive to the beneficial effect of exposure to residential greenness (Hartig et al., 2003).

4.1.2. Explaining city differences (a-path)

The current study builds on the study by van den Berg et al. (2016), which was based on the same data collected in the four cities, investigated the association between total time spent in green space and mental health, in which the sum of hours spent in green space in near home (in the immediate living home environment) as well as further away (in and around the city) was calculated. Contrary, the current study only focussed on greenness near home and time spent in green spaces near home. This different focus may explain the different results for Kaunas in both studies. Another explanation is that different models were used to assess the association between time spent visiting green space and mental health: in the current study, the model accounted for the level of greenness.

The differences in the associations between the level of residential greenness and time spent on visiting green space near home between the cities may be explained by neighbourhood level differences such as differences in types, spatial distribution and quality of green space and neighbourhood social economic status, despite that the multilevel models may partly account for those differences. In Barcelona and Doetinchem, the level of residential greenness was positively associated with time spent visiting green space, while no such associations were found for Stoke-on-Trent and Kaunas. It is not clear yet whether the associations differs for certain population subgroups in Stoke-on-Trent and Kaunas. Perceived safety and quality of green space and personal factors such as health status and having a dog may moderate the association between level of residential greenness and time spent on visits to green space (Lachowycz and Jones, 2013; Lee and Maheswaran, 2011; Schipperijn et al., 2010) and possibly influence mediation. Having a dog has shown to be an important predictor of green space use (Schipperijn et al., 2010). Stratified mediation analyses are needed to explore moderated mediation, but this was beyond the scope of the current study because of the limited sample sizes.

4.2. Strengths and limitations

This study was one of the first that conducted a mediation analysis to investigate whether time visiting green space mediates the association between the level of residential greenness and mental health. Residents from four different cities across Europe were sampled from neighbourhoods stratified by proximity to green space and which varied in socio-economic status to maximise variation of population and exposure within cities. Multilevel statistical models were used to adjust for a dependency of data sampled within neighbourhoods. Furthermore, the models were adjusted for a set of potential confounders to minimise selection effects. Pooled analyses were also adjusted for city to account for unmeasured city-specific population characteristics. Other strengths of the current study were the use of a standardized and validated questionnaire to assess perceived mental health and an objective measure of the level of residential greenness.

Several limitations of the study should be recognized. First, the cross-sectional study design precludes conclusions on causality and reverse causal order is possible. For example, people with a higher mental health score may spend more time visiting green space and may prefer to live in neighbourhoods with more green space. Despite the adjustment for potential confounding, residual confounding may have occurred. Second, the questionnaires to assess visit frequency and duration of visits to green space near home were based on self-reports, which were not tested for their reliability and validity. Moreover, because precise numbers of visits were not collected, the mid-point for each response category was used to construct the variable total hours spent visiting green space near home. As a consequence, at the lower end of the five-point scale for visit frequency half a visit in the last four weeks was used in the calculation. The alternative was to delete respondents with low scores on visit frequency, but this might have influenced the statistical power of the analyses. Third, the NDVI measure does not distinguish between different types of greenness, such as parks and forests, neither does it account for accessibility. A more specific weakness linked to the use of NDVI is the possibility of a temporal mismatch with the visit data. In Doetinchem, the questionnaire was conducted from April until December, while the NDVI was based on satellite data from April to September 2013. The models were not adjusted for season, but it is unlikely that this might have influenced the results because no other environmental changes were expected in the study periods except tree cover. Another reason for a possible mismatch between visit data and NDVI-data is that blue space is included in the visit frequency and duration questions, while not included in the NDVI measure. However, data showed that approximately 85–90% of the respondents in the four cities had no blue space near home. Therefore, this might not have influenced the results. Moreover, most blue spaces are embedded in greenness. A possible mismatch is the spatial mismatch between the neighbourhood boundary defined in the visits questions by a 15 min on bicycle range that goes beyond the 300 m (straight-line) buffer of the NDVI. This mismatch might be stronger for Doetinchem, which is the smallest city with a possibly higher percentage of bike users compared to the other cities. This may have led to an overestimation of the time spent visiting green space and of the association with the level of greenness for Doetinchem. Finally, the responses rates in the four cities were relatively low, especially in the Dutch city. The low response rate in Doetinchem was due to the approach of recruiting participants invited by mail, that turned out to be less efficient than those used in the other cities (Supplementary Table 2). With the exception of Stoke-on-Trent, study participants were higher educated than the general adult population in each of the four cities. In Doetinchem, the study population was relatively older and more often male compared to the general population in Doetinchem. Especially the underrepresentation

of people with low level of education might have led to an underestimation of associations because several studies have found stronger associations between greenness and health for lower SES-groups (de Vries et al., 2003; Maas et al., 2006). This could have biased the results, despite adjustment for the level of education in the statistical models. Furthermore, non-response analyses, which were only available for Doetinchem, revealed that responders found the green space more important for recreational activities than non-responders. This may also have biased the results related to the time spent in green spaces and limits generalizing to other cities.

4.3. Conclusion and further research

This study provides only weak support for the hypothesis that the level of residential greenness contributes indirectly to mental health through purposeful visits to green space. To understand the role of visiting green space with regard to the green space – mental health relationship, future research should focus on specific types and (perceived) safety and quality of green spaces in the immediate living environment. This could help to identify why people use (or do not use) green space (de Vries et al., 2013; Mitchell et al., 2011) and for whom and under what conditions time spent on visiting green space is a mediator. Besides visits to green spaces, access to street greenery and gardens should be investigated because they may providing opportunities for micro-restorative experiences (Kaplan, 1995) and may play a role in improving neighbourhood satisfaction (de Vries et al., 2013; Hartig et al., 2014; Kaplan, 1995). More advanced measures of contact with or use of green space should be developed which should measure both visual exposure and intentional as well as unintentional use of different green spaces. Global positioning systems (GPS) devices might be used to assess time spent visiting green spaces more precisely than self-report measures. Other study designs, such as longitudinal studies and natural experiments, are needed to provide evidence for causal relationships.

Conflict of interest

The authors have no conflict of interest to declare.

Acknowledgements

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP & /2007-2013) under grant agreement no 282996. Margarita Triguero-Mas is funded by a grant from the Catalan Government (AGAUR FI-DGR-2013). On behalf of the PHENOTYPE Consortium, all field workers who coordinated and administered the face-to-face interviews and the postal questionnaire, and checked and cleaned the data are gratefully acknowledged.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ufug.2017.04.010.

References

Bedimo-Rung, A.L., Mowen, A.J., Cohen, D.A., 2005. The significance of parks to physical activity and public health: a conceptual model. Am. J. Prev. Med. 28 (2 Suppl. 2), 159–168.

Bowler, D.E., Buyung-Ali, L.M., Knight, T.M., Pullin, A.S., 2010. A systematic review of evidence for the added benefits to health of exposure to natural environments. BMC Public Health 10, 456.

Bratman, G.N., Hamilton, J.P., Daily, G.C., 2012. The impacts of nature experience on human cognitive function and mental health. Ann. N. Y. Acad. Sci. 1249, 118–136.

Dadvand, P., Bartoll, X., Basagana, X., Dalmau-Bueno, A., Martinez, D., Ambros, A., Cirach, M., Triguero-Mas, M., Gascon, M., Borrell, C., Nieuwenhuijsen, M.J., 2016. Green spaces and General Health: roles of mental health status social support, and physical activity. Environ. Int. 91, 161–167.

de Vries, S., Verheij, R.A., Groenewegen, P.P., Spreeuwenberg, P., 2003. Natural environments – healthy environments? An exploratory analysis of the relationship between green space and health. Environ. Plann. A 35, 1717–1731.

de Vries, S., van Dillen, S.M.E., Groenewegen, P.P., Spreeuwenberg, P., 2013. Streetscape greenery and health: stress, social cohesion and physical activity as mediators. Soc. Sci. Med. 94, 26–33.

Gascon, M., Triguero-Mas, M., Martinez, D., Dadvand, P., Forns, J., Plasencia, A., Nieuwenhuijsen, M.J., 2015. Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review. Int. J. Environ. Res. Public Health 12 (4), 4354–4379.

Giles-Corti, B., Broomhall, M.H., Knuiman, M., Collins, C., Douglas, K., Ng, K., Lange, A., Donovan, R.J., 2005. Increasing walking: how important is distance to, attractiveness, and size of public open space? Am. J. Prev. Med. 28 (2 Suppl. 2), 169–176.

Grahn, P., Stigsdotter, U.A., 2003. Landscape planning and stress. Urban For. Urban Green. 2 (1), 1–18.

Hartig, T., Evans, G.W., Jamner, L.D., Davis, D.S., Garling, T., 2003. Tracking restoration in natural and urban field settings. J. Environ. Psychol. 23, 109–123.

Hartig, T., Mitchell, R., de Vries, S., Frumkin, H., 2014. Nature and health. Annu. Rev. Public Health 35, 207–228.

Hayes, A.F., 2009. Beyond Baron and Kenny: statistical mediation analysis in the new millennium. Commun. Monogr. 76 (4), 408–420.

Hayes, A.F., 2013. Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. Guilford Press.

Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning 2004, Nature and Health. The Influence of Nature on Social, Psychological and Physical Well-Being, Helth Council of the Netherladns, The Hague, 2004/09.

Hoeymans, N., Garssen, A.A., Westert, G.P., Verhaak, P.F., 2004. Measuring mental health of the Dutch population: a comparison of the GHQ-12 and the MHI-5. Health Qual. Life Outcomes 2, 23.

James, P., Banay, R.F., Hart, J.E., Laden, F., 2015. A review of the health benefits of greenness. Curr. Epidemiol. Rep. 1–12.

Jansson, M., Fors, H., Lindgren, T., Wiström, B., 2013. Perceived personal safety in relation to urban woodland vegetation—a review. Urban For. Urban Green. 12 (2), 127–133.

Kaplan, S., 1995. The restorative benefits of nature toward an integral framework. J. Environ. Psychol. 15, 169–182.

Lachowycz, K., Jones, A.P., 2013. Towards a better understanding of the relationship between greenspace and health: development of a theoretical framework. Landsc. Urban Plann. 118, 62–69.

Lee, A.C.K., Maheswaran, R., 2011. The health benefits of urban green spaces. A review of the evidence. J. Public Health 33 (2), 212–222.

Lin, B.B., Fuller, R.A., Bush, R., Gaston, K.J., Shanahan, D.F., 2014. Opportunity or orientation? Who uses urban parks and why. PLoS One 9 (1), e87422.

Maas, J., Verheij, R.A., Groenewegen, P.P., de Vries, S., Spreeuwenberg, P., 2006. Green space, urbanity, and health: how strong is the relation? J. Epidemiol. Community Health 60 (7), 587–592.

Maas, J., van Dillen, S.M.E., Verheij, R.A., Groenewegen, P.P., 2009a. Social contacts as a possible mechanism behind the relation between green space and health. Health Place 15 (2), 586–595.

Maas, J., Verheij, R.A., de Vries, S., Spreeuwenberg, P., Schellevis, F.G., Groenewegen, P.P., 2009b. Morbidity is related to a green living environment. J. Epidemiol. Community Health 63 (12), 967–973.

MacKinnon, D.P., 2008. Introduction to Statistical Mediation Analysis. Taylor & Francis Group, New York.

McEachan, R.R.C., Prady, S.L., Smith, G., Fairley, L., Cabieses, B., Gidlow, C., Wright, J., Dadvand, P., van Gent, D., Nieuwenhuijsen, M.J., 2015. The association between green space and depressive symptoms in pregnant women: moderating roles of socioeconomic status and physical activity. J. Epidemiol. Community Health jech–2015.

Mitchell, R., stell-Burt, T., Richardson, E.A., 2011. A comparison of green space indicators for epidemiological research. J. Epidemiol. Community Health 65 (10), 853–858.

Nielsen, T.S., Hansen, K.B., 2007. Do green areas affect health? Results from a Danish survey on the use of green areas and health indicators. Health Place 13 (4), 839–850.

Nieuwenhuijsen, M.J., Kruize, H., Gidlow, C., Andrusaityte, S., Anto, J.M., Basagana, X., Cirach, M., Dadvand, P., Danileviciute, A., Donaire-Gonzalez, D., Garcia, J., Jerrett, M., Jones, M., Julvez, J., van Kempen, E., van Kamp, I., Maas, J., Seto, E., Smith, G., Triguero, M., Wendel-Vos, W., Wright, J., Zufferey, J., van den Hazel, P.J., Lawrence, R., Grazuleviciene, R., 2014. Positive health effects of the natural outdoor environment in typical populations in different regions in Europe (PHENOTYPE): a study programme protocol. BMJ Open 4 (4), e004951.

Rhew, I.C., Vander, S.A., Kearney, A., Smith, N.L., Dunbar, M.D., 2011. Validation of the normalized difference vegetation index as a measure of neighborhood greenness. Ann. Epidemiol. 21 (12), 946–952.

Schipperijn, J., Stigsdotter, U.K., Randrup, T.B., Troelsen, J., 2010. Influences on the use of urban green space. A case study in Odense, Denmark. Urban For. Urban Green. 9, 25–32.

Shrout, P.E., Bolger, N., 2002. Mediation in experimental and nonexperimental studies: new procedures and recommendations. Psychol. Methods 7 (4), 422–445.

Stigsdotter, U.K., Ekholm, O., Schipperijn, J., Toftager, M., Kamper-Jorgensen, F., Randrup, T.B., 2010. Health promoting outdoor environments-associations between green space, and health, health-related quality of life and stress based on a Danish national representative survey. Scand. J. Public Health 38 (4), 411–417.

Triguero-Mas, M., Dadvand, P., Cirach, M., Martinez, D., Medina, A., Mompart, A., Basagana, X., Grazuleviciene, R., Nieuwenhuijsen, M.J., 2015. Natural outdoor

environments and mental and physical health: relationships and mechanisms. Environ. Int. 77C, 35–41.
Ulrich, R.S., Simons, R.F., Losito, B.D., Fiorito, E., Miles, M.A., Zelson, M., 1991. Stress recovery during exposure to natural and urban environments. J. Environ. Psychol. 11, 201–203.
van Dillen, S.M., de Vries, S., Groenewegen, P.P., Spreeuwenberg, P., 2011. Greenspace in urban neighbourhoods and residents' health: adding quality to quantity. J. Epidemiol. Community Health.
van den Berg, M., Wendel-Vos, W., van Poppel, M., Kemper, H., van Mechelen, W., Maas, J., 2015. Health benefits of green spaces in the living environment: a systematic review of epidemiological studies. Urban For. Urban Green. 14, 806–816.
van den Berg, M., van Poppel, M., van Kamp, I., Andrusaityte, S., Balseviciene, B., Cirach, M., Danileviciute, A., Ellis, N., Hurst, G., Masterson, D., Smith, G., Triguero-Mas, M., Uzdanaviciute, I., de Wit, P., van Mechelen, W., Gidlow, C., Grazuleviciene, R., Nieuwenhuijsen, M.J., Kruize, H., Maas, J., 2016. Visiting green space is associated with mental health and vitality: a cross-sectional study in four european cities. Health Place 38, 8–15.
Ware Jr., J.E., Sherbourne, C.D., 1992. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med. Care 30 (6), 473–483.
Zhao, X., Lynch, J.G., Chen, Q., 2010. Reconsidering Baron and Kenny: myths and truths about mediation analysis. J. Consum. Res. 37 (2), 197–206.