Long-term exposure to residential green and blue spaces and anxiety and depression in adults: A cross-sectional study

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ABSTRACT

Keywords: Green spaces, Blue spaces, Air pollution, Physical activity, Social support, Depression, Anxiety, Mental health

Background: Although exposure to natural outdoor environments has been consistently associated with improved perceived general health, available evidence on a protective association between this exposure and specific mental health disorders such as depression and anxiety is still limited.

Objective: The aim of this study was to evaluate the effects of long-term exposure to residential green and blue spaces on anxiety and depression and intake of related medication. Additionally, we aimed to explore potential mediators and effect modifiers of this association.

Methods: The study was based on an existing adult cohort (ALFA – Alzheimer and Families) and includes 958 adult participants from Barcelona recruited in 2013–2014. For each participant residential green and blue exposure indicators [surrounding greenness (NDVI), amount of green (land-cover) and access to major green spaces and blue spaces] were generated for different buffers (100 m, 300 m and 500 m). Participants reported their history of doctor-diagnosed anxiety and depressive disorders and intake of related medication. Logistic regression models were applied to assess the corresponding associations.

Results: Increasing surrounding greenness was associated with reduced odds of self-reported history of benzodiazepines [e.g. Odds ratio - OR (95%CI) = 0.62 (0.43, 0.89) for 1-interquartile range (IQR) increase in NDVI in a 300 m buffer] and access to major green spaces was associated with self-reported history of depression [OR (95%CI) = 0.18 (0.06, 0.58)]. No statistically significant associations were observed with blue spaces. Air pollution (between 0.8% and 29.6%) and noise (between 2.2% and 5.3%) mediated a proportion of the associations observed, whereas physical activity and social support played a minor role.

Conclusion: Our findings suggest a potential protective role of green spaces on mental health (depression and anxiety) in adults, but further studies, especially longitudinal studies, are needed to provide further evidence of these benefits and of the mediation role of exposures like air pollution and noise.

1. Introduction

Over the last decade a growing body of literature has provided evidence of the links between natural outdoor environments and improved health and well-being (WHO Regional Office for Europe, 2016). Proposed mechanisms of these health benefits are diverse: a main hypothesis is that the direct contact or viewing of these environments increases stress recovery and attention (restoring capacities). However, previous research also suggests that the presence of green and/or blue spaces reduces exposure to harmful environmental exposures (e.g. air pollution, noise, extreme temperatures) and may contribute to building capacities (e.g. encouraging physical activity and facilitating social cohesion) thereby providing the health benefits observed in many studies (Burkart et al., 2016; Grellier et al., 2017; Hartig et al., 2014;...
The reason to exclude subjects with active major psychiatric disorders from the baseline recruitment was because those could affect cognition and mask results regarding the development of AD, which was the main objective of the ALFA parent cohort study (Molinuevo et al., 2016). As described in Molinuevo et al. (2016), from the 3102 volunteers assessed, 2743 subjects met the selection criteria or decided to remain in the study. Out of these, 958 resided in the city of Barcelona and had reliable geocoded data to allow allocating an exposure to them based on the address of residence and were therefore included in this study (Vert et al., 2017). The local Ethics Committee approved the ALFA study, and all subjects and their accompanying close relative signed an informed consent form (Molinuevo et al., 2016).

2.2. Residential exposure to green and blue spaces assessment

We used different indicators of exposure to residential green and blue spaces.

2.2.1. Surrounding greenness

We used the normalized difference vegetation index (NDVI) to define surrounding greenness. The NDVI is an indicator of greenness and is based on land surface reflectance of visible (red) and near-infrared parts of the spectrum (Weier and Herring, 2000). Its values range from −1 to 1, with higher positive numbers indicating more greenness (i.e. photosynthetically active vegetation). The index was derived from the Landsat 4–5 TM data at 30 m × 30 m resolution. The Landsat 5 imagery data atmospherically corrected was acquired for 26/07/2009 covering Barcelona city area. As we wanted to treat separately the effect of green and blue spaces, and as water bodies are characterized for having NDVI values below 0, we excluded water bodies from the NDVI assessment for surrounding greenness. Since we have observed that other artificial surfaces may also have negative values, we used a land use layer (Urban Atlas) to remove water bodies from the NDVI imagery by means of a “mask”. Afterwards, surrounding greenness was defined based on the NDVI average within 100 m, 300 m, and 500 m buffers around participant’s residences.

2.2.2. Amount of green and access to green and blue spaces

We used “Map of Land Covers of Catalonia (2009)” (Centre de Recerca Ecològica i Aplicacions Forestals (CREAF), 2013), which is based on orthophotos with a minimum map unit of 500 m² (0.5 ha). The map contains a total of 241 simple covers, which can be hierarchically grouped into different levels. To conduct this study, three green spaces categories were created: agricultural green, which included arboreal and herbaceous crops, forest green, which included sclerophyllous, deciduous and conifer forests, and urban green, which included artificial green areas and urban woodland. Blue spaces included continental waters (natural course, lakes, natural and artificial ponds, rivers, reservoir, coastal lagoons) and beaches. Using residential address of the participants, which was reported by them at recruitment (2013–2014), we calculated the hectares of green and blue spaces using buffers typically used in previous studies (Gascon et al., 2015). Based on this information we created the following exposure variables: 1) amount of green, which included all the hectares of any green space type within specific buffers (buffers 100 m, 300 m and 500 m), 2) access to major green spaces, defined in previous literature as having access to green spaces of at least 0.5 ha in a buffer of 300 m (WHO Regional Office for Europe, 2016) – all three categories of green spaces were included –, 3) access to blue spaces, defined as the presence of blue spaces of any type and size represented in the map around the residential address (buffers of 100, 300 m and 500 m). We also created the exposure variables of amount of green and access to major green spaces by type of green space (agricultural, forest and urban green).
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