



Original article

Do perceived walking distance to and use of urban blue spaces affect self-reported physical and mental health?



Sebastian Völker^{a,*}, Angela Heiler^b, Thorsten Pollmann^c, Thomas Claßen^b, Claudia Hornberg^b, Thomas Kistemann^a

^a Institute for Hygiene and Public Health, GeoHealth Centre, University of Bonn, Sigmund-Freud-Str. 25, 53105 Bonn, Germany

^b School of Public Health, Department 7 Environment and Health, University of Bielefeld, Universitätsstr. 25, 33615 Bielefeld, Germany

^c School of Public Health, Department 2 Public Health Medicine, University of Bielefeld, Universitätsstr. 25, 33615 Bielefeld, Germany

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ABSTRACT

A cross-sectional analysis among 1041 urban residents was done to examine associations between self-reported walking distance to and use of freshwater urban blue space and health-related quality of life in two German cities: a city with “poor” urban blue space supply (Bielefeld; 0.8% blue space) and one with “better” urban blue space supply (Gelsenkirchen; 3.0% blue space). Health-related quality of life was assessed with the SF-12v2, which measures residents’ self-reported mental and physical health. Results showed a significant association between use frequency and perceived walking distance to blue space. Blue space use was a better indicator of health outcomes than perceived walking distance. After controlling for green space, socio-economic and demographic variables, use frequency was associated with higher mental health in Gelsenkirchen. These cross-sectional findings suggest that blue space use increases the probability of being healthier in highly urbanised areas in cities with an appropriate amount of blue space.

1. Introduction

The disease burden resulting from non-communicable diseases (NCDs) like type 2 diabetes and cardiovascular conditions, and mental disorders like depression and burnout syndrome, has become a major challenge to contemporary public health (W.H.O. European Mental Health Action Plan, 2017). Urban living has been suggested to be an important part of the growth in incidence of NCDs (Farrington et al., 2015). Urbanisation has direct and indirect impacts on human health and quality of life. Urban environments are associated with many health threatening environmental factors such as noise, particulate matter, extreme temperatures, accidents and violence, as well as barriers against healthy forms of transport like walking and cycling (Frumkin, 2003; Mytton et al., 2012). As a result, living in urban places can result in an increased burden on health care systems (Beaglehole et al., 2011). However, urban environments also contain health promoting structures that may help to mitigate negative health consequences of urban living. In particular, the last two decades have witnessed a growing interest in ecological, nature-oriented health promoting strategies in both research and practice (Hartig et al., 2014). The aims of this new strategy are the creation, protection, maintenance and development of green and blue urban open spaces.

There is a lack of consensus in definition of urban open space within the broader built environment and health literature. In our study we use the definition of the National Heart Foundation Australia (National Heart Foundation Australia, 2017): “a variety of spaces within the urban environment that are readily and freely accessible to the wider community, regardless of size, design or physical features and which is intended primarily for amenity or recreation purposes – whether active or passive”. Blue urban open spaces encompass “large-scale, normally natural waterbodies connected to the ocean, such as seas, bays, gulfs, lagoons or estuaries, flowing inland waterbodies like rivers, streams or canals of different sizes, flow rates, turbulence and transported sediments, stagnant inland waterbodies like lakes, ponds, pools or basins of different size and turbidity and other urban blue elements which are not waterbodies, such as geysers or waterfalls” (Völker et al., 2016).

A growing body of literature can be found on the positive health effects of green space (Hartig et al., 2014; Lee and Maheswaran, 2011; Tzoulas et al., 2007). Evidence for the importance of blue space for human health is also growing, but remains limited in comparison with green space research (Foley and Kistemann, 2015; Völker and Kistemann, 2011). Quantitative studies analysing blue space proximity

* Corresponding author.

E-mail addresses: sebastian.voelker@kvwl.de (S. Völker), angela.heiler@uni-bielefeld.de (A. Heiler), thorsten.pollmann@uni-bielefeld.de (T. Pollmann), thomas.classen@uni-bielefeld.de (T. Claßen), claudia.hornberg@uni-bielefeld.de (C. Hornberg), thomas.kistemann@ukbonn.de (T. Kistemann).

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and health have not consistently found positive associations. Generally, evidence for a causal relationship between availability of blue space and health has been limited and inconclusive (Gascon et al., 2015). Using population census data from England, Wheeler et al. (2012) showed that people were more likely to be in good health when living near the seashore. Using English panel data, White et al. (2013a) identified that living less than 5 km from the coast promoted general and mental health as compared to living further away. However, both studies excluded inland surface waters. In other studies including surface waters alongside coastal waters, no associations between mental health and the proportion of blue space or its ease of access could be found (De Vries et al., 2003; Triguero-Mas et al., 2015).

Nevertheless, quantitative and qualitative studies suggest that blue space use has a positive effect on both physical and mental health in urban areas. Although most of the research has focussed on coastal settings, a growing body of literature engages with the impact of inland surface waters. White et al. (2010) detected higher levels of restorativeness for people viewing urban blue scenes compared to other environments. In a study on voluntary visits to different types of natural environments, White et al. (2013b) did not find significant stress reducing capacities of inland surface waters (rivers, canals etc.) in the UK. According to qualitative results from case studies in Copenhagen, Cologne and Dusseldorf, urban blue spaces provide an environment for improved physical activity, social interaction and recreation (Thomas, 2015; Völker and Kistemann, 2015). In addition to direct health impacts associated with proximity and use of blue space, several studies have also indicated more indirect health impacts of blue space: especially turbulent water bodies can protect and promote health by masking traffic noise (Jeon et al., 2010; You et al., 2010) and mitigate summertime temperatures (Völker et al., 2013).

To summarise, research on blue space and health has thus far mostly focused on coastal waters. As yet, few studies have examined the health impacts of inland surface waters. Findings of these studies provide some preliminary support for the idea that urban blue space can positively contribute to residents' health. However, published studies relating urban blue space to health mostly (i) are in cities with large amounts of blue space, (ii) consist of qualitative studies among users of blue space, (iii) do not take non-users into account, (iv) do not regard potential different health impacts, and (v) do not consider the influence of residential or perceived walking distance to blue space.

In times of rising awareness of public health challenges and costs, the focus of health planners shifts to developing strategies for ill-health prevention and health promotion. Detailed knowledge about specific health impacts of urban blue spaces is essential for sustainable, health promoting urban development as part of an urban health strategy.

The use of urban open spaces is essential for benefitting from their health promoting potential. A key determinant for use of urban open spaces is their accessibility. A number of studies have shown an association between open space proximity, accessibility and physical activity (Powell et al., 2011). Both, accessibility and use, are fundamentally intertwined. However, uncertainty exists regarding the relationship between access, frequency of e.g. green space use and health (Hartig et al., 2014). Use of urban open spaces may affect health via multiple pathways. We follow Hartig's et al. (Hartig et al., 2014) theory that contact with nature involves air quality, physical activity, social cohesion, and stress reduction. In our study we address different aspects of nature: as setting for behavior, resulting in physical health benefits, and as experience, resulting in mental health benefits, but also as physical environment. However, we hypothesize that multiple pathways may be intertwined and affect one another, because use of urban open space involves all these aspects. These pathways cannot be separated effectively.

In this study we test if there is a quantifiable association between blue space perceived walking distance, blue space use and self-reported health-related quality of life, measured on two scales representing physical and mental health, after controlling for potential confounding

factors among a random sample in highly urbanised areas. In the study, two cities in Germany were chosen, one with a very low amount of blue space (Bielefeld) and one with a higher amount of blue space (Gelsenkirchen). First, we examined the association between frequency of use and perceived walking distance. Secondly, we modelled (1) perceived walking distance to blue spaces and (2) frequency of blue space use and self-reported health-related quality of life. We included possible confounders in the models, such as socio-demographic data and the amount of green space. Against this background we addressed the following research questions:

- (1) Does blue space frequency of use increase with lower perceived walking distances?
- (2) Do the cities differ with respect to self-reported health effects attributable to blue space use and perceived walking distance?
- (3) Are higher frequency of blue space use and lower perceived walking distances to blue space associated with better self-reported physical and mental health outcomes in the city with a higher amount of blue space?

2. Methods

2.1. Data sources

Data for this study were combined from individual (person based) and area level sources (control variable "green space"). As the literature showed that cities with a good supply of blue space may have positive health benefits, we decided to choose one city with a very low amount of urban blue space, and one city with a higher amount.

Compared to all German cities with more than 100,000 inhabitants (median = 2.7%) Bielefeld has a very low percentage of blue space in the total city area (0.8%). In Gelsenkirchen the percentage is about four times higher (3.0%).

The cities are different in other ways like different industrial heritage or community socio-economic status. Bielefeld is a regional centre (inhabitants 2014 = 329,327) in western Germany with a slightly increasing population and a diversified economy, and no other bigger cities nearby. The city has a differentiated network of green space and offers very good accessibility in terms of Euclidian distances from residents' homes to green spaces and walkability of these structures. On the other hand, Bielefeld has very few blue spaces. There are some naturally occurring surface waters like creeks running through the city, and in the north of the city the "Obersee" lake is situated, whose surroundings are used as a recreational area with paths around the lake. In the city centre, there are some fountains and ponds. The city of Gelsenkirchen is approximately comparable regarding the number of inhabitants (inhabitants 2014 = 259,006). It is located in the Ruhr area between the bigger cities of Essen and Bochum. The city faces a relatively high deprivation with high unemployment rates and stagnating population growth. Because of its history, Gelsenkirchen possesses many different industrial wastelands (former hard coal mining industry, heavy industry), which have recently been in part converted into industrial forests or landscape parks. In comparison to Bielefeld, Gelsenkirchen possesses larger urban blue space structures. These include the "Rhein-Herne-Kanal" Canal and the "Emscher" River, which both cross the city area and are equipped with paths for activities like walking, running or cycling, and lakes and ponds within parks in the inner city.

The individual level data were sourced from a questionnaire mailed in November 2012 to a sample of 6243 adults aged 18–93 in highly urbanised statistical districts in Bielefeld ($n = 3145$) and Gelsenkirchen ($n = 3098$). Highly urbanised districts were identified by intersecting built-up areas, circulation areas, farm land (inverse criterion) and population density in each statistical district (Fig. 1). The sample was drawn randomly from the central register of persons in each city. 1041 persons or 17% of the original sample answered the questionnaire

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