Preventive Medicine 69 (2014) 135–140

Contents lists available at ScienceDirect

Preventive Medicine

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

Coastal proximity and physical activity: Is the coast an under-appreciated public health resource?

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ARTICLE INFO

Available online 2 October 2014

Keywords:
Physical activity
Coastal proximity
Monitor of Engagement with the Natural Environment
England

ABSTRACT

Background: Recent findings suggest that individuals living near the coast are healthier than those living inland. Here we investigated whether this may be related to higher levels of physical activity among coastal dwellers in England, arising in part as a result of more visits to outdoor coastal settings.

Method: Participants (n = 183,755) were drawn from Natural England's Monitor of Engagement with the Natural Environment Survey (2009–2012). Analyses were based on self-reported physical activity for leisure and transport.

Results: A small, but significant coastal proximity gradient was seen for the likelihood of achieving recommended guidelines of physical activity a week after adjusting for relevant area and individual level controls. This effect was statistically mediated by the likelihood of having visited the coast in the last seven days. Stratification by region, however, suggested that while the main effect was relatively strong for west coast regions, it was not significant for those in the east.

Conclusions: In general, our findings replicate and extend work from Australia and New Zealand. Further work is needed to explain the marked regional differences in the relationship between coastal proximity and physical activity in England to better understand the coast's potential role as a public health resource.

Introduction

Populations living near the coast in England are healthier than those inland (Wheeler et al., 2012) and longitudinal data suggest that individuals are healthier during periods when they live closer to the coast (White et al., 2013a). One factor may be that living closer to the coast fosters higher levels of physical activity (PA) and consequent health benefits. Regular PA is associated with a reduced risk of obesity, diabetes, heart disease and depression (NICE, 2008, 2012) and can be just as effective as medication in reducing associated mortality (Naci and Ioannidis, 2013). Studies in Australia and New Zealand, mostly using relatively small samples, report a positive association between living near the coast and rates of self-reported PA (mostly walking; Ball et al., 2007; Bauman et al., 1999; Humpel et al., 2004; Witten et al., 2008). However, as far as we are aware this issue has not previously been investigated outside of Australasia and in countries, such as England, with different cultures and climates.

A further issue is the lack of direct evidence that any coastal proximity effect really is due to greater time spent being active at the coast. Evidence exists that people who live near the sea do spend more leisure time at the coast (White et al., 2013a; Schipperijn et al., 2010) but we know of no research that has explored the relationship between frequency of coastal leisure visits and PA. Establishing this relationship is necessary if visit frequency is to account for any association between coastal proximity and PA, rather than activity being conducted in other locations such as gyms. A similar approach has been taken in studying whether associations between residential neighbourhood green space and PA are mediated by time spent in green space (e.g. Coombes et al., 2010; Lachowycz and Jones, 2014; Ord et al., 2013) but this is yet to be extended to coastal analysis.

Finally, there has been little exploration of potential moderators of any coastal proximity–PA relationship, in part because the relatively small sample sizes of the few studies that have been conducted prevent such an analysis. However, moderators such as socio-economic status (SES, Ord et al., 2013; Jones et al., 2009) and gender (Wheeler et al., 2010) have been identified in studies of the relationship between local green space and PA. While findings from these studies are mixed, there is some evidence of effect modification, which may also be important for coastal proximity and PA. In previous research we found a stronger association between residential coastal proximity and population self-reported health in more deprived areas (Wheeler et al., 2012) and this may also be reflected in PA in these areas. Moreover, the Australian studies investigating coastal proximity and PA revealed

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http://dx.doi.org/10.1016/j.ypmed.2014.09.016
0091-7435/

relatively strong effects for women (Ball et al., 2007; Humpel et al., 2004) but not men (Humpel et al., 2004). Other potential demographic moderators such as age have not been explored previously, nor have issues such as season of data collection or geographical location. Season and location, especially latitude, may play a role due to higher temperatures encouraging more interaction with the coast at some times of the year or in some places.

The current research addressed these underexplored issues using a large nationally representative English survey, the Monitor of Engagement with the Natural Environment (MENE, Natural England, 2011a). Specifically, we asked three key questions: 1) Is greater residential coastal proximity associated with increased PA in England?; 2) If there is an association, is it mediated by visits to the coast (i.e. due to time actually spent in this environment)?; and 3) Is there any evidence of moderation of the association by age, sex, SES, season or region?

Method

Participants

Participants were 183,755 individuals who took part in the MENE survey during the years 2009–2012 and for whom local area data were available (97.3% of 188,774). The MENE is commissioned by Natural England, a government body promoting public understanding, conservation and enjoyment of the natural environment. It is part of a face-to-face nationally representative omnibus survey conducted across the whole of England and throughout the year to reduce potential geographical and seasonal biases (Natural England, 2011b).

Physical activity

The primary outcome variable was self-reported physical activity in the last week. Responses were derived from the question: "In the past week, on how many days have you done a total of 30 minutes or more physical activity which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job" (q21, p.39, Natural England, 2011b). Due to the exclusion of work and housework we refer to responses as a measure of self-reported 'leisure and travel-related physical activity' (LTPA). As UK guidelines are for a minimum of 150 minutes of moderate PA a week which can be achieved by ≥5 days of 30 minutes (Bull and the Expert Working Group, 2010), our key outcome variable was whether or not the individual reported engaging in ≥5 days of LTPA, thus achieving their recommended PA with leisure and travel alone. Additionally, we explored reports of 1–4 vs. zero days of PA to examine if coastal proximity encourages at least some activity.

Coastal proximity

The approximate distance an individual lived from the coast was derived from the Lower-layer Super Output Area (LSOA) in which they lived. LSOAs are a geographical unit used to report small area statistics and there are 32,482 in England, each containing approximately 1500 people. As populations within LSOAs may not be uniformly distributed, coastal proximity was defined as the linear distance (in km) to the coast from the population-weighted centroid of the LSOA (Wheeler et al., 2012) and was categorised into four distances: a) <1 km; b) 1–5 km; c) >5–20 km; and d) >20 km.

Coastal visits in the last week

At the start of the survey respondents were informed that they were going to be asked about occasions in the last week when they had spent time out of doors. They were instructed, "by out of doors we mean open spaces in and around towns and cities, including parks, canals and nature areas; the coast and beaches; and the countryside including farmland, woodland, hills and rivers. This could be anything from a few minutes to all day. It may include time spent close to your home or workplace, further afield or while on holiday in England. However, this does not include routine shopping trips or time spent in your own garden" (Natural England, 2011b, p. 27). For each visit mentioned in the last week they were asked:"Which of the following best describes where you spent most of your time?: In a town or city; in a seaside resort or town; other seaside coastline (including beaches & cliffs); in the countryside (including areas around towns and cities)" (q2, p.28, Natural England, 2011b). Of the total sample, 7511 (4.1%) reported visiting an outdoors destination in a seaside resort, 3490 (1.9%) reported visiting the open coast, and 824 (0.8%) reported visiting both. Preliminary analysis using these separate groupings suggested that individuals reporting any of these visits all had a significantly greater likelihood of physical activity (than individuals who reported no coastal visit) and that the patterns of visit type were broadly similar across regions (Supplementary Table A). Given also that most seaside resorts are linked directly to open coast and we are not sure which part people visited we collapsed all three categories of coastal visitor into a single group, i.e. coastal visitors, n = 11,825 (6.4%). Using a single grouping did not affect the main results (contact the authors for further details).

Area level control variables

Area level controls were also derived from LSOA data. Perhaps the most important, given previous work, was the amount of green space present. This was calculated as the percentage of LSOA land cover (assessed at the resolution of 10 m^2) accounted for by 'green space' and 'gardens' combined (White et al., 2013b) using data from the Generalised Land Use Database (ODPM, 2005). Green space quintiles based on the distribution of green space across all LSOAs in the sample were derived. Mean percentage green space was 89.96% (SD = 5.14) in the highest quintile and 10.50% (SD = 5.61) in the lowest quintile.

LSOAs were also used to identify local area deprivation (based on factors such as unemployment and crime) with data extracted and imported from the 2004 English Indices of Deprivation (DCLG, 2008). Total Indices of Deprivation (IMD) scores were structured into quintiles (most deprived M = 49.54 (SD = 9.74), least deprived M = 6.22 (SD = 2.10)). England is also categorised into nine Government Office Regions (GORs, Fig. 1). It was not possible to control directly for GOR, because two regions (London and West Midlands) had no coastline, and a third (East Midlands) had no participants in the MENE survey who lived within 1 km of the coast. Analyses were therefore stratified separately by the six regions with an immediate coastal population in the MENE to examine the effects of North–South, East–West coastal locations.

Individual level controls

Individual level controls included: gender, age (categorised as 16–34, 35–64, 65+), occupational social grade (AB, C1, C2, DE) as a proxy for SES, employment status (full-time, part-time, in education, not working, retired), marital

Fig. 1. A map of England showing the Government Office Regions (GORs).