Does living by the coast improve health and wellbeing?

Benedict W. Wheeler[a]*, Mathew White[a],Will Stahl-Timmins[a], Michael H. Depledge[a]

Affiliation

[a] European Centre for Environment & Human Health, Peninsula College of Medicine & Dentistry, University of Exeter, Knowledge Spa, Royal Cornwall Hospital, Truro TR1 3HD, UK.

Email addresses: benedict.wheeler@pcmd.ac.uk; mathew.white@pcmd.ac.uk; will.stahl-timmins@pms.ac.uk; michael.depledge@pms.ac.uk

*Corresponding author:

Email: benedict.wheeler@pcmd.ac.uk

Tel: +44-(0)-1872-258130

Fax: +44-(0)-1872-258134

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

Does living by the coast improve health and wellbeing?

Abstract

It is often assumed that spending time by the coast leads to better health and wellbeing, but there is strikingly little evidence regarding specific effects or mechanisms to support such a view. We analysed small-area census data for the population of England, which indicate that good health is more prevalent the closer one lives to the coast. We also found that, consistent with similar analyses of greenspace accessibility, the positive effects of coastal proximity may be greater amongst more socio-economically deprived communities. We hypothesise that these effects may be due to opportunities for stress reduction and increased physical activity.

Keywords: coast; health; wellbeing; greenspace; blue space

Introduction

Twenty-three of the world's 30 largest cities are on the coast. Whether from necessity or preference, over a third of the world's population choose to live along a "narrow fringe of coastal land" (UNEP, 2007). As well as socio-economic advantages, marine and coastal ecosystems contribute to human health and wellbeing. For example, they provide nutrient-rich seafood, novel pharmaceuticals and ecosystem services that foster outdoor leisure activities (Millennium Ecosystem Assessment, 2005). There is also a long history of the coast being used to facilitate health improvements and to aid convalescence (Fortescue Fox and Lloyd, 1938). Nonetheless, robust evidence of direct, environmentally-induced salutogenic

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

(health promoting) effects is scarce. We know that people who live near parks, woodland and other greenspaces tend to be healthier, and live longer, than those who do not (Mitchell and Popham, 2008), and there are some suggestions of a positive effect of aquatic environments or 'blue space' (de Vries et al., 2003). Multiple mechanisms are likely to be in play, including those proposed in attention restoration (Kaplan and Kaplan, 1989) and psycho-evolutionary (Ulrich et al., 1991) theories. Activity in the outdoors can generate positive mood states (Thompson Coon et al., 2011), reducing stress and improving physiological functioning (Hartig et al., 2003; Steptoe et al., 2005). Whilst increased physical activity has also been associated with residence in proximity to the coast in Australia (Bauman et al., 1999), the relationship between spending time at the coast and consequent health and wellbeing benefits awaits thorough investigation. In order to investigate this issue at a broad, population health level, we set out to use secondary datasets (Park et al., 2011) to address the question: Do rates of good health improve with proximity to the coast?

Methods

Using 2001 census data for England (n= 48.2 million), we analysed the relationship between rates of self-reported "good" health and residential proximity to the coast. Data were obtained for England's 32,482 Lower-layer Super Output Areas (LSOAs, average population c.1,500), a standard statistical geography. 2001 Census data indicated the proportion of the population answering 'good' to the question *"Over the last 12 months would you say your health has on the whole been: Good; Fairly good; Not good?"* This type of single item self-report general health question has been used previously to examine the effects of greenspace (Maas et al., 2006; Mitchell and Popham, 2007) and is strongly correlated with objective measures of health status such as mortality (Kyffin et al., 2004). Further, people self-reporting good health on this single item tend to have substantially higher scores on all physical, mental and social

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

health domains of the SF-36 health survey (Mavaddat et al., 2011). To account for geographical variation in population age/sex structure, we calculated directly standardised rates of good health as the outcome measure.

To determine coastal proximity, we used a Geographic Information System to calculate the linear distance from each LSOA's population-weighted centroid to its nearest coastline. The boundary between 'coast' and 'riverside' along the length of an estuary is not clearly delineated, and we were unable to identify previous work stating a definition relevant to population access to the coast. We therefore used an arbitrary cut-off where any estuary narrowed to less than approximately 1 km to define the end of the coastline.

In common with previous greenspace analyses (Maas et al., 2006; Mitchell and Popham, 2007), linear regression models were constructed separately for urban, town/fringe and rural areas as defined by the Office for National Statistics (Office for National Statistics, 2004). Predictor variables including coastal proximity, % land area classified as greenspace (Generalised Land Use Database (Department for Communities and Local Government, 2007)), and five indices of socio-economic deprivation (Noble et al., 2004): income, employment, education and skills, crime, and environmental deprivation. The environment deprivation domain only includes measures of housing condition, outdoor air quality, and road traffic collisions, and therefore does not cause problems through overlap with our primary environmental measures (coastal proximity and greenspace density). Coastal proximity was divided into bands chosen to represent comparative geographical accessibility and inferring from this potential frequency/intensity of 'exposure' to coastal environments: 0-1 km; >1-5 km; >5-20 km; >20-50km; >50 km. Given suggestions that proximity to greenspace may provide resilience against health inequalities (Mitchell and Popham, 2008), we tested whether the association between coastal proximity and good health was modified

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

by income deprivation. All analyses were conducted using Stata 12 (StataCorp, College Station, TX).

Results

We tested for modification of the association between coastal proximity and good health by urban/rural category using a likelihood ratio test. This produced a p-value=0.02, indicating evidence of an interaction, and therefore that analyses stratified by urban/rural category were appropriate. Regression coefficients for stratified, adjusted models are presented in Table 1. 'Distance to coast' coefficients represent the difference in the age/sex standardised prevalence (percentage) of people reporting good health relative to that in the category of LSOAs furthest from the coast (>50km). For example, compared to urban communities living further than 50 km from the sea, the proportion of those reporting "good health" in urban coastal LSOAs (<1 km) was 1.13 percentage points higher (95% Confidence Interval 0.99-1.27) after adjustment for potential confounders. The effect was similar amongst urban and town/fringe areas, but appeared to be weaker across rural areas. Associations with other area characteristics were in the expected directions, with increasing greenspace and decreasing deprivation associated with higher rates of good health. Although the amount of greenspace is associated with good health, its effect as measured here appears smaller than that of coastal proximity.

A likelihood ratio test was used to test for interaction between coastal proximity and income deprivation within urban LSOAs (with adjustment for all other variables as per Table 1), and produced a p-value<0.001, again indicating strong statistical evidence of an interaction. Therefore, we repeated the main regression analysis for urban areas stratified by income deprivation quintile. The association between good health rates and coastal proximity in urban areas, in total and by income deprivation quintile is depicted in Figure 1. The 'All

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

urban areas' graph illustrates the overall results for urban areas as given in Table 1. The five sub-graphs depict results of regression models stratified by deprivation quintile. These indicate that the association between good health and coastal proximity is strongest in the most deprived areas (Q1), with the strength of association diminishing with decreasing deprivation. For Q5 (the least deprived 20% of LSOAs), there is no clear association between coastal proximity and good health rates, although there is still some indication of a small positive effect for coastal areas (<1km) relative to those inland.

Discussion

After adjusting for age, sex, greenspace density and socio-economic confounders, there is an apparent gradient of increasing self-reported good health with proximity to the coast in England. The difference in the percentage of people reporting good health between urban inland areas and coastal zones was approximately equivalent to that between adjacent income deprivation quintiles. The positive health gradient appears to strengthen with increasing socio-economic deprivation, so as has been suggested with greenspace (Mitchell and Popham, 2008) it is possible that the benefits of living near the coast may mitigate some of the negative health effects of socio-economic deprivation.

This relationship between exposure to natural environments, socio-economic status and public health outcomes is an important facet of this research. The well-established and important literature on environmental justice has primarily focused on the negative aspects and consequences of unequal/inequitable exposures to environmental hazards by race, socio-economic status and so on (Kjellstrom et al., 2007; Mohai et al., 2009). However, our study and others (de Vries et al., 2003; Maas et al., 2006; Mitchell and Popham, 2008) indicate that access to 'good' environments may play a part in reducing health inequalities. Whilst the evidence base is still relatively limited, the issue has started to gain recognition in health

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

inequalities policy, such as the discussions and recommendations regarding greenspace in the 2010 Marmot Review for the UK Department of Health (Marmot, 2010).

The study is subject to limitations and strengths typical of the ecological epidemiology research design (Savitz, 2012). Whilst these findings are based on very large, robust samples (census data), alternative explanations are possible. The cross-sectional nature of the analysis means that it cannot account for migration. Particularly, the results may to some extent be caused by a 'healthy migrant effect', whereby the healthiest (and wealthiest) are more mobile and potentially more able (physically and financially) to move towards desirable environments, including the coast. However, the finding that that coast-health association is strongest in the most deprived areas perhaps indicates that the healthy migrant effect is not wholly responsible for the observed association. It is also possible that the association could be due to residual confounding by one or more unmeasured area/population characteristics associated with both the coast and good health.

Despite these limitations, there are plausible mechanisms for a 'healthy coast' effect. As previously stated, it has been suggested that the coast may be associated with increased opportunities for increased physical activity (Bauman et al., 1999). Additionally, data from two waves of a large nationally representative survey of leisure visits in England during 2009-2011 suggests that restoration/stress-reduction may be a potential mechanism (Natural England, 2010, 2011). These Natural England data indicate that everyday visits to the coast were associated with higher levels of stress-reducing, positive emotions (e.g. calmness, relaxation, revitalisation) than visits to urban parks or open countryside. As over two-thirds of all coastal visits were found to be made by people who live within 5 miles of the coast, coastal communities may attain better physical health due to the stress-reducing value of greater leisure time spent near the sea.

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

Our findings indicate that the health effects of living near to, and spending time at, the coast warrant further investigation. Future research into this issue could make valuable use of more sophisticated, longitudinal secondary datasets as argued by Park et al. (2011), in conjunction with more detailed environmental datasets that would permit differentiation of types and qualities of coastal environment. Primary research eliciting relevant aspects of good health and wellbeing using standardised and validated scales, and with good geographical referencing, would also be beneficial. Whilst it is not feasible for everyone to live at the coast, many people do, and some health promoting characteristics of coastal environments may be transferable to other situations (e.g. virtual environments). New policy initiatives would need to balance potential benefits of coastal access and lifestyles against threats from extreme events, climate change impacts, and overdevelopment of coastal residential and recreational locations. However, if sensible precautions are taken, significant health improvements may be achievable.

Acknowledgments

ECEHH is supported by investment from the European Regional Development Fund and the European Social Fund Convergence Programme for Cornwall and the Isles of Scilly. Census data source: ESRC/JISC Census Programme, Census Dissemination Unit, Mimas (University of Manchester). Thanks to Terry Hartig and Sabine Pahl for comments on earlier drafts.

References

Bauman, A., Smith, B., Stoker, L., Bellew, B., Booth, M., 1999. Geographical influences upon physical activity participation: evidence of a 'coastal effect'. Australian and New Zealand Journal of Public Health 23, 322-324.

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

de Vries, S., Verheij, R.A., Groenewegen, P.P., Spreeuwenberg, P., 2003. Natural environments - healthy environments? An exploratory analysis of the relationship between greenspace and health. Environment and Planning A 35, 1717-1731.

Department for Communities and Local Government, 2007. Generalised Land Use Database Statistics for England 2005 (Enhanced Basemap). DCLG, London.

Fortescue Fox, R., Lloyd, W.B., 1938. Convalescence on the coast. The Lancet 232, 37-39.

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, 109-123.

Kaplan, R., Kaplan, S., 1989. The experience of nature: A psychological perspective. Cambridge University Press, Cambridge.

Kjellstrom, T., Friel, S., Dixon, J., Corvalan, C., Rehfuess, E., Campbell-Lendrum, D., Gore, F., Bartram, J., 2007. Urban environmental health hazards and health equity. Journal of Urban Health 84, i86-97.

Kyffin, R.G., Goldacre, M.J., Gill, M., 2004. Mortality rates and self reported health: database analysis by English local authority area. BMJ (Clinical Research Ed.) 329, 887-888.

Maas, J., Verheij, R.A., Groenewegen, P.P., de Vries, S., Spreeuwenberg, P., 2006. Green space, urbanity, and health: how strong is the relation? Journal of Epidemiology and Community Health 60, 587-592.

Marmot, M., 2010. Fair Society, Healthy Lives: The Marmot Review. http://www.marmotreview.org/ Accessed: 19/6/2012.

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

Mavaddat, N., Kinmonth, A.L., Sanderson, S., Surtees, P., Bingham, S., Khaw, K.T., 2011. What determines Self-Rated Health (SRH)? A cross-sectional study of SF-36 health domains in the EPIC-Norfolk cohort. Journal of Epidemiology and Community Health 65, 800-806.

Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Mitchell, R., Popham, F., 2007. Greenspace, urbanity and health: relationships in England. Journal of Epidemiology and Community Health 61, 681-683.

Mitchell, R., Popham, F., 2008. Effect of exposure to natural environment on health inequalities: an observational population study. Lancet 372, 1655-1660.

Mohai, P., Pellow, D., Roberts, J.T., 2009. Environmental Justice. Annual Review of Environment and Resources 34, 405-430.

Natural England, 2010. Monitor of Engagement with the Natural Environment. Annual Report from the 2009-10 survey. Natural England, Sheffield.

Natural England, 2011. Monitor of Engagement with the Natural Environment. Annual Report from the 2010-11 survey. Natural England, Sheffield.

Noble, M., Wright, G., Dibben, C., Smith, G.A.N., McLennan, D., Anttila, C., Barnes, H., Mokhtar, C., Noble, S., Avenell, D., Gardner, J., Covizzi, I., Lloyd, M., 2004. The English Indices of Deprivation 2004. Office of the Deputy Prime Minister, London.

Office for National Statistics, 2004. Rural/Urban Definition (England and Wales).http://www.ons.gov.uk/about-statistics/geography/products/area-classifications/rural-urban-definition-and-la-classification/rural-urban-definition/index.html Accessed: 22/11/2010

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

Park, J.J., O'Brien, L., Roe, J., Ward Thompson, C., Mitchell, R., 2011. The natural outdoors and health: Assessing the value and potential contribution of secondary public data sets in the UK to current and future knowledge. Health and Place 17, 269-279.

Savitz, D.A., 2012. Commentary: A niche for ecologic studies in environmental epidemiology. Epidemiology 23, 53-54.

Steptoe, A., Wardle, J., Marmot, M., 2005. Positive affect and health-related neuroendocrine, cardiovascular, and inflammatory processes. Proceedings of the National Academy of Sciences of the United States of America 102, 6508-6512.

Thompson Coon, J., Boddy, K., Stein, K., Whear, R., Barton, J., Depledge, M.H., 2011. Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A systematic review. Environmental Science and Technology 45, 1761-1772.

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. Journal of Environmental Psychology 11, 201-230.

UNEP, 2007. United Nations Environment Programme Annual Report: 2006. UNEP, Nairobi.

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

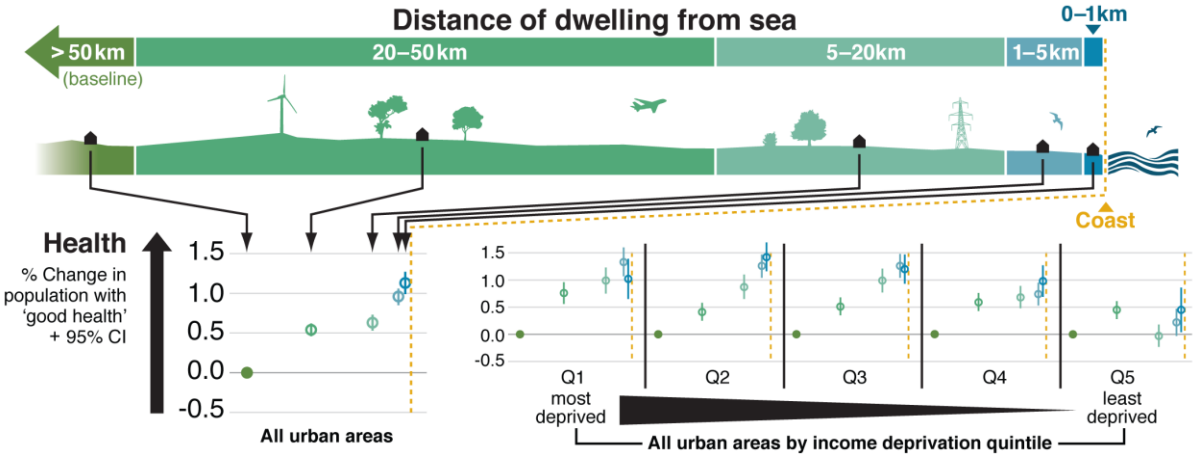
Table 1. Multivariate linear regression models predicting age/sex standardised rate of good general health, stratified by urban/rural status.

	URBAN (n=26455)			TOWN/FRINGE (n=3081)			RURAL (n=2946)		
	B	**95% CI**	**n**	**B**	**95% CI**	**n**	**B**	**95% CI**	**n**
Distance to coast									
>50km[a]	0	-	10098	0	-	1023	0	-	870
>20-50km	0.54	(0.46,0.62)	8096	0.04	(-0.20,0.28)	898	0.22	(0.01,0.42)	990
>5-20km	0.63	(0.53,0.73)	3571	0.43	(0.16,0.71)	620	0.41	(0.17,0.64)	705
>1-5km	0.96	(0.85,1.06)	3133	0.89	(0.54,1.25)	303	0.73	(0.41,1.05)	317
<1km	1.13	(0.99,1.27)	1557	1.19	(0.79,1.59)	237	-0.09	(-0.69,0.51)	64
% greenspace by area									
Quintile 1[a]	0	-	5291	0	-	617	0	-	590
Quintile 2	-0.02	(-0.13,0.08)	5291	0.13	(-0.17,0.43)	616	0.14	(-0.12,0.40)	589
Quintile 3	-0.01	(-0.11,0.10)	5291	0.15	(-0.14,0.45)	616	0.31	(0.04,0.57)	589
Quintile 4	0.23	(0.13,0.33)	5291	0.49	(0.19,0.79)	616	0.25	(-0.03,0.52)	589
Quintile 5	0.36	(0.26,0.47)	5291	0.69	(0.39,0.99)	616	0.59	(0.30,0.88)	589
Deprivation indices (B coefficient per quintile)[b]									
Income	1.61	(1.56,1.66)	26455	0.84	(0.71,0.96)	3081	0.42	(0.33,0.52)	2946
Employment	1.23	(1.19,1.28)	26455	1.19	(1.08,1.30)	3081	0.86	(0.77,0.95)	2946
Education	1.58	(1.54,1.61)	26455	1.52	(1.42,1.62)	3081	1.21	(1.13,1.29)	2946
Crime	0.07	(0.04,0.10)	26455	0.25	(0.17,0.32)	3081	0.07	(0.01,0.13)	2946
Environment	0.13	(0.10,0.16)	26455	-0.17	(-0.25,-0.10)	3081	-0.05	(-0.12,0.01)	2946
Constant	53.49	(53.38,53.61)		59.58	(59.20,59.96)		66.11	(65.71,66.50)	
R^2	0.84			0.75			0.66		

B: adjusted non-standardised regression coefficient
n: number of Lower-layer Super Output Areas (LSOAs) within urban/rural stratum
[a] Reference category
[b] Lowest quintile: most deprived 20% of LSOAs within stratum

Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015

Figure 1. The coast and good health in urban areas. Age standardised % of population stating 'good health' relative to those in areas furthest from the coast (>50km) - adjusted regression coefficients with 95% confidence intervals; total and by income deprivation quintile.



Author's copy of final accepted version.
Published in Health and Place 18 (5): 1198-1201 http://dx.doi.org/10.1016/j.healthplace.2012.06.015