



Developing an openly accessible multi-dimensional small area index of ‘Access to Healthy Assets and Hazards’ for Great Britain, 2016



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ABSTRACT

Health geographers have been long concerned with understanding how the accessibility of individuals to certain environmental features may influence health and wellbeing. Such insights are increasingly being adopted by policy makers for designing healthy neighbourhoods. To support and inform decision making, there is a need for small area national level data. This paper details the creation of a suite of open access health indicators, including a novel multidimensional index summarising 14 health-related features of neighbourhoods for Great Britain. We find no association of our overall index with physical health measures, but a significant association to mental wellbeing.

1. Introduction

1.1. Accessibility and the geographical determinants of health

Geographical accessibility most commonly relates to the “distance” of an object (or individual) to a feature of interest (although see [Brennan and Martin, 2012](#)). It is one of the core underpinning concepts of health geography since it makes the spatial explicit. In the pursuit of understanding about *how* and *why* geographical determinants of health operate, it can be important to demonstrate how living close to a feature or having greater exposure to it will influence the risk of disease and ill health.

The role of access to and utilisation of health services forms one of the classical studies into the geographical determinants of health. Studies have sought to understand whether living far from a health service may discourage individuals from using them ([Lovett et al., 2002](#); [Haynes et al., 2003](#); [Jordan et al., 2004](#); [Macintyre et al., 2008](#); [Jones et al., 2010](#)). Understanding which populations have access to different types of health care has led to researchers considering whether access is equitable. [Tudor Hart \(1971\)](#) proposed the ‘Inverse Care Law’, whereby health services are hypothesised to be located in areas with less need for them, with considerable evidence to support the inequitable distribution of services ([Furler et al., 2002](#); [Shaw and Dorling, 2004](#); [Mercer and Watt, 2007](#)). The implications of promoting universal and equitable access to health care remains prominent among policy

discussions ([Ware and Mawby, 2015](#); [NHS England, 2017](#)).

Within the wider accessibility and health geography literature, there has also been consideration of broader geographical determinants of health beyond service provision and use. The location of different types of retail outlets has formed one area of interest across health geography, motivated by the rationale that the sources of services and goods we have access to may shape our behaviours. For example, research has demonstrated that individuals who have a greater number of fast food outlets within their vicinity can be associated with risk of obesity ([Fraser and Edwards, 2010](#); [Hobbs et al., 2018](#)); the density of on- and off-trade alcohol-related outlets have been shown to be associated with acute and chronic alcohol-related harms ([Shrek et al., 2018](#)); and other studies have demonstrated similar associations related to tobacco outlets and risk of smoking ([Shortt et al., 2016](#)). Other work has explored how proximity to gambling outlets may affect the risk of problem gambling behaviours (which is independently associated with poorer mental wellbeing) ([Pearce et al., 2008](#)). The considerable evidence in favour of the health damaging aspects of retail outlet location has seen interest in restricting their location through planning restrictions among policy makers ([Public Health England, 2017a](#)).

It is also important to consider context as extending beyond the built environment, and there has been considerable investigation into how the natural environment may impact health. Air pollution has been extensively demonstrated to be associated with poorer respiratory health ([Wheeler and Ben-Shlomo, 2005](#); [Shah et al., 2015](#)), and has

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been a longstanding policy issue (DEFRA, 2015; Royal College of Physicians, 2016; NICE, 2017). Conversely, accessibility to green space (i.e. natural vegetation including parks, grasslands or woodlands) has also been shown to be positively associated with physical health and mental wellbeing (Mitchell and Popham, 2008; Cherrie et al., 2018). Although these issues are not traditional components of ‘access’, we argue that the nature of their exposure has an inherently spatial extent, and as such can be conceptualised alongside access (as we introduce in Section 2.1.1).

1.2. Measuring accessibility to health-related features of environments

The importance of the role that geographical determinants play on health and wellbeing are being given greater priority by policy makers when designing intervention strategies (Public Health England, 2017b). It is therefore a policy imperative to have access to open data and tools that can be used to measure aspects of the environment, and that can help support such decision-making processes; as well as for researchers wanting to evaluate the influence of these contexts within their domain of application.

Although there are increasing quantities of data that exist and can be used to measure a variety of environmental features, there are barriers which limit their potential usage. Data may be costly, and perhaps held by commercial organisations, thus limiting access for individuals without suitable funding. Processing of contextual data will often require heavy data manipulation skills that users may not have, and can be further complicated when the data have additional geographic characteristics. Data sources may have known or unknown bias, and may not be complete at the national level. For example, they may be stored by local governments with no mechanism for sharing data between institutions to create a single collective resource. Given such constraints, it is perhaps unsurprising that in many studies that have explored the role of geographic context on health or wellbeing, these have tended to focus on relatively small regions (e.g. Lovett et al., 2002; Macintyre et al., 2008; Fraser and Edwards, 2010). Although these studies provide great insight into these localities, they may not be representative at the national level at which many policy decisions are made at. Creating open source metrics of accessibility that are nationally extensive we argue can therefore address these barriers.

One further limitation of developing univariate measures of accessibility are that they imply that different components of context are considered in isolation (Cummins et al., 2007). However, there is a lengthy history of how context within urban and social research can be more effectively represented as a complex series of different interacting influences; and that these contexts lead to particular “neighbourhood” effects that may substantially influence outcomes of measured social phenomena (Diez-Roux, 2001; Gatrell, 2005; Cummins et al., 2007; Sampson, 2012). There is therefore a need to develop multidimensional measures of the health-related features of neighbourhoods to help describe the inherent multiplicity of features.

Such composite indicators are commonly created within other policy-related fields, but perhaps most commonly in the study of deprivation which is considered as inherently complex, and comprised of multiple features of an individual's socioeconomic context (Townsend, 1987). The UK's Index of Multiple Deprivation (IMD) represents one attempt to capture these competing dimensions of deprivation and includes data on education, occupation, income, housing, health, crime and access to services (Noble et al., 2006; Smith et al., 2015). The power and relevance of the measure can be demonstrated through a plethora of studies showing its association with a multitude of health outcomes (Mitchell and Popham, 2008; Newton et al., 2015), and its wide policy appeal for identifying deprivation (Smith et al., 2015).

There are few examples that have applied such an approach to health-related features of environments, despite the pathways and resulting harms associated with the geographical determinants of health being multidimensional in nature. Richardson et al. (2010) provide an

exemplar index of the physical environment that included data on air quality, climate, green space, radiation etc, and was demonstrated to be predictive of mortality rates (Pearce et al., 2010). Green et al. (2014) explored the multidimensionality of mortality rates for Great Britain finding that diseases clustered in different areas suggesting that simple measures of mortality rates fail to capture the variation in experiences across cause of death. Hobbs et al. (2018) applied a similar approach focusing on features of the obesogenic environment only, demonstrating that the interactions between the food and physical activity environments produce differing harms relating to risk of obesity.

Developing open metrics of access may benefit policy officials in two ways: (1) in being able to identify areas to intervene at, (2) help identify pathways that interventions can be designed to address. Composite measures can enable the possibility to identify *if* geography may matter leading to further investigation of *why*. They are also useful descriptive tools that, like the IMD, may help feed into the comparison and targeting of areas.

1.3. Aim

The aim of the study is to develop an open-access multi-dimensional index of the accessibility to health-related features of the environment for small areas across Great Britain (2016). We will outline the development of the index, Access to Healthy Assets and Hazards (AHAH), as well as examine what the index reveals and whether it is associated with health and wellbeing at both the area- and individual-level.

2. Methodology

2.1. Creating the index ‘Access to Healthy Assets and Hazards’ (AHAH)

2.1.1. Data and indicators

The inclusion of variables was informed based on a scoping exercise to identify environment features that had been shown to be associated to health and/or wellbeing within the literature, and with a clear direction of association. We identified nationally extensive data that could be compiled into measures related to our framework of three domains of accessibility: health services, retail outlets, and environmental quality.

Data on retail outlets were acquired from the ‘Local Data Company’ (LDC) who provide a rolling and nationally extensive survey of retail outlets for Great Britain in 2016. The data are collected via a combination of administrative databases and continuous field work to validate and update outlets. They included the location of an outlet (full address) and a classification of the outlet type. Using the data, we identified all (i) fast food outlets, (ii) pubs, bars and nightclubs, (iii) off-licenses, (iv) tobacconists, (v) gambling outlets. For all postcodes in Great Britain, we calculated the road network distance (km) to the nearest of each service using the open source software ‘Routino’ (www.routino.org), which integrates with an extract of ‘OpenStreetMap’ that details the road network.

Data on the location of health services in 2016 were acquired from multiple sources. For England and Wales, the location of GP practices, hospitals with an accident and emergency (A&E) department, pharmacies and dentists were supplied by NHS Digital. The equivalent data for Scotland were acquired from the Information Services Division (ISD) in NHS Scotland. We also included data on the location of private leisure services (e.g. gym, sports hall) among these indicators. While not a traditional health service, it is a retail outlet that offers health promotion facilities. We calculated the road network distance of a postcode to the nearest of each service.

The final domain, environmental quality, included data from two sources. The location of green space was identified from ‘OpenStreetMap’ (2017). We extracted the location of all ‘accessible’ green space (i.e. that is open to the public) by utilising the following “tags”: cemetery, common, dog park, scrub, fell, forest, garden,

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