ELSEVIER

Health & Place 13 (2007) 812–825

HEALTH & PLACE

www.elsevier.com/locate/healthplace

Modifiable neighbourhood units, zone design and residents' perceptions

Robin Haynes[a,*], Konstantinos Daras[a], Richard Reading[b], Andrew Jones[a]

[a]*School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK*
[b]*School of Medicine, Health Policy and Practice, University of East Anglia, Norwich NR4 7TJ, UK*

Received 10 July 2006; received in revised form 29 January 2007; accepted 30 January 2007

Abstract

Neighbourhood effects on health are partly determined by the way the neighbourhoods are defined (the modifiable areal unit problem), but few studies of place effects have incorporated alternative sets of areal units. This study compared computer-generated zones with areal units identified subjectively by local government officers as communities in the city of Bristol, UK. Automated zone design came close to replicating the subjective communities when the balance of objectives and boundary constraints was adjusted. The set of subjective community areas was compared with automated zone designs, which maximized the homogeneity of a social factor (deprivation) and an environmental factor (housing type), at three different geographical scales, with average populations of 2500, 3700 and 7500. All sets of areas were then matched against the neighbourhood perceptions and social behaviour reported by residents, measured as part of the Avon Longitudinal Study of Parents and Children (ALSPAC). Neighbourhood perceptions and social behaviour varied mostly between individuals, but there were significant small differences between all sets of areas. The neighbourhood perceptions of residents were found to match the areas identified by automated zone design as well as they matched the subjectively defined communities, suggesting that the neighbourhoods identified by experts were not more real to residents than synthetic areas. Differences in perceptions could be explained by variations in social and housing conditions at the very local scale of enumeration districts, with populations of about 500. The neighbourhoods with meaning for residents therefore appeared to be much smaller areas than those typically investigated in geographical studies of health.

Keywords: ALSPAC; Neighbourhood; Perceptions; Place effects; MAUP; Zone design

Introduction

Many research studies over recent years have concluded that health inequalities between populations are partly the result of neighbourhood effects (Pickett and Pearl, 2001; Diez-Roux, 2001; Macintyre et al., 2002). Although everybody seems to accept that they live in a neighbourhood, the immediate environment that has the potential to influence residents' health is difficult to define precisely. There are several competing definitions of neighbourhood, none of which has achieved universal acceptability, but most concentrate either on small geographical areas with similar attributes or areas whose residents interact with each other (Galster, 2001). Boundaries between

*Corresponding author. Tel.: +44 1603 592554; fax: +44 1603 507719.
E-mail address: r.haynes@uea.ac.uk (R. Haynes).

1353-8292/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.healthplace.2007.01.002

neighbourhoods might coincide with administrative divisions, changes in physical environment, differences in residents' characteristics or peoples' perceptions (Diez-Roux, 2001). Some researchers have avoided the term neighbourhood, preferring "community" or "place effects", but the problem of boundary delineation remains. Any study area can be divided into alternative plausible sets of small geographical units.

Most studies of local place effects on health have used administrative or census areas as the geographical units for convenience, because population data are available for them. Whether or not these areas are appropriate depends on the research question (Diez-Roux, 2001; Pickett and Pearl, 2001), but only a small number of studies so far have defined custom-made neighbourhoods to suit a particular investigation. Examples include the use of socially homogeneous areas (Reading et al., 1999; Law et al., 2005) and areas based on the local knowledge of key professionals (Ross et al., 2004).

The size of neighbourhoods designed to detect local place effects on health has varied enormously. Studies using administrative areas, such as census tracts in the US and wards in the UK, have worked with geographical units with populations mostly in the range 4000–5500 (Pickett and Pearl, 2001). Larger units with populations between 8000 and 40,000 have also been popular (Ellaway et al., 2001; Martikainen et al., 2003; Ross et al., 2004; Law et al., 2005; Subramanian et al., 2003; Shenassa et al., 2004). Few studies have investigated smaller areas (Coulton et al., 2001 is an exception). Although reviewers have called for comparisons of alternative neighbourhood schemes to achieve a better understanding of the underlying processes (Diez-Roux, 2001; Martikainen et al., 2003), most of the published studies of the effects of neighbourhoods on health have been based on a single set of area units. Some attempts to compare place effects on health at different geographical scales have been made (Haynes et al., 2003; Ross et al., 2004; Pampalon, 2005), but only one systematic comparison of alternative sets of areal units incorporating both boundary and scale changes has been reported, to our knowledge (Cockings and Martin, 2005).

Many authors (e.g. Openshaw, 1984) have demonstrated the modifiable areal unit problem (MAUP), whereby different definitions of areas—either in terms of average population size (scale) or choice of boundary (zoning)—will lead to different results for analyses based on those areas, such as area-level correlations. Therefore, careful consideration must be given to the definition and choice of areal unit for the analysis. Modifiable areal units are a problem only if they are arbitrary. If there is a hypothesis about the mechanism of the link between neighbourhood and health, then the set of areal units should be defined accordingly. When mechanisms are unclear, as they often are at an early stage of research, then it is important to test the sensitivity of relationships to the definition of the underlying areas.

A range of alternative areal units can be created using automated zone design procedures (Cockings and Martin, 2005) which group a set of basic areal units into a smaller number of zones which are in some sense optimal. The criteria used in the grouping process might include combinations of the number of zones required, constraints on the population size of each zone, the compactness of zone shape and a requirement to maximize the homogeneity of specified variables within each zone. Cockings and Martin used the technique to define zones with approximately equal populations at different scales and were able to demonstrate that these synthetic zones produced stronger relationships between morbidity and deprivation than census units, and that larger areas produced stronger relationships. They made no attempt in this exploratory study to design zones that were internally homogeneous in terms of environmental or social characteristics. Others have suggested that areas based on homogeneous characteristics produce stronger relationships than heterogeneous areas (Carstairs, 1981; Morgenstern, 1982; Haynes et al., 1999), so this might be a promising line of inquiry. Such procedures were used in the 2001 England and Wales census to define homogeneous census output areas (Martin et al., 2001).

Another issue is whether zones identified by automated programmes have any meaning for residents. After an accumulation of substantial evidence that neighbourhoods affect the health of residents in a variety of ways, we still need to understand how, and why some people are particularly affected, in some settings more than in others (Macintyre et al., 2002). Much attention has been given to the theory that a breakdown of social cohesion might be responsible for the link between general levels of health and income inequality within communities (Wilkinson, 1996; Kawachi and Kennedy, 1997). Associations have been found between levels of health and residents' perceptions