

South Yorkshire Health Inequalities Atlas

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ABSTRACT

The *South Yorkshire Health Inequalities Atlas* was produced through collaboration of public health teams across the four former health authorities in South Yorkshire, foreshadowing the new South Yorkshire Public Health Network, formed in April 2002.

Spatial smoothing techniques were employed in order to provide, in one document, both an overview of health inequalities across South Yorkshire and a resource that can be used to inform detailed local planning. Previous reports have used choropleth maps to present data at electoral ward level, but this hides local variations, for example where a ward contains both deprived towns and affluent commuter villages.

The report presented deprivation indicators, mortality rates and cancer registration rates, amongst others, built up from enumeration districts but smoothed to counter the effects of very small numbers of events. Surface maps were presented using colours graded from red, through yellow and green to blue to indicate the underlying rate in the locality. This very clearly identified 'hotspots', which can be investigated in more detail and provide justification for local investment or initiatives.

The project did not break any new ground in terms of analytical GIS techniques. However, through combining rigorous analysis with imaginative presentation, and good timing, it can be claimed to be very advanced in terms of the use of public health information for strategic and local planning. The Atlas is being widely used by primary care trusts and the South Yorkshire Strategic Health Authority as a basis for tackling inequalities.

Keywords and phrases: health inequalities, public health, spatial moving average, natural neighbour.

1.0 INTRODUCTION

1.1 Policy Context

One of the very highest priorities for public health departments in Strategic Health Authorities and Primary Care Trusts in the UK is to reduce inequalities within their populations. Following the publication of Sir Donald Acheson's *Independent Inquiry into Inequalities in Health* (1998), this priority is emphasised in almost every national health policy document from the current Labour government (Department of Health 1999, 2000, 2001a, 2001b, 2001c, 2002; Secretary of State for Health 1998, 1999; Social Exclusion Unit 1999). This health policy theme is also mirrored by similar emphasis on reducing inequalities through neighbourhood renewal in other areas of government policy (Social Exclusion Unit 2000, 2001; Chief Secretary to the Treasury 2002) with the

requirement to work in partnership with local government to achieve sustainable development (Department of the Environment, Transport and the Regions 2001; Department for Environment, Food and Rural Affairs 2002). Hence initiatives such as Health Action Zones (NHS Executive 1997), Sure Start (Glass 1999) and New Deal for Communities (Department of the Environment, Transport and the Regions 1999) require these local strategic partnerships to tackle together the issues of socio-economic deprivation, low educational attainment, poor housing and environment, crime and poor health outcomes.

1.2 “The Stainforth Problem”

This emphasis in health and in other sectors in the UK on reducing inequalities means that there are frequent decisions to be made around the targeting of projects on deprived communities. Hence the method by which these ‘deprived communities’ are defined is a very important, and sometimes emotive, issue.

Decisions should be based on the best available information, and this is where limitations in the specificity of routine information become telling. In the UK, there is a wealth of information available at electoral ward level (for example on the Office for National Statistics *Neighbourhood Statistics* web site¹), and from a national perspective, this feels like a very fine level of information – there are 8,414 wards in England, average population around 5,800. These data have frequently been presented very clearly using choropleth maps. However, in South Yorkshire, the average size of wards is nearly 14,000 and the majority of these wards are highly heterogeneous.

Stainforth is a small town some 6 miles (10km) north of Doncaster. It is, like many others in South Yorkshire, a former mining community, with the problems of long-term unemployment and consequent socio-economic deprivation all-too-frequently associated with these communities since the mass pit-closures in the 1980s (Department of the Environment, Transport and the Regions 2000a). Coal mining is not the only industry to have folded within these communities across South Yorkshire, and the county is amongst the most deprived parts of Europe, a fact reflected in its receipt of European Objective 1 regeneration money. However, Stainforth has frequently missed out on funding for local initiatives. One reason for this is that Stainforth ward includes the deprived town of Stainforth, but also several villages which are not so deprived, often commuter villages. The ward of Stainforth is not one of the most deprived in Doncaster – it is ‘average’.

The first aim of the *South Yorkshire Health Inequalities Atlas* was to use routinely available information in a more discriminating way, to identify deprivation and needs in communities, whether or not they are surrounded by places with fewer problems. The second, and absolutely crucial, aim was to present this information in a way that was attractive and understandable to those responsible for planning and commissioning, so that the report would not remain as a purely academic exercise, ‘gathering dust’.

2.0 METHODOLOGY

2.1 Data

The project aimed to undertake an analysis of variations in a range of health indicators, including mortality rates, cancer incidence rates and hospital admission rates, and socio-economic factors such as deprivation indicators – the Index of Multiple Deprivation (Department of the Environment, Transport and the Regions 2000b) and Townsend Score (Townsend *et al* 1988) – and the proportions of population from ethnic minorities, or aged over 75. In all, 30 indicators were analysed.

Deaths² for the period 1996-2000 were analysed, a compromise between taking an extended period to reduce the impact of random variation within the small area populations and keeping the data as up-to-date and relevant as possible. Registrations of new cancer cases³ for the period 1997-99 were used. Deaths and cancer registrations represented the majority of the analyses undertaken – other data were similarly obtained from routine sources.

The smallest areas for which these routine health data can be produced are Census enumeration districts (EDs). The 1991 Census gave denominator populations for EDs, but the numerators (deaths, cancer registrations, hospital admissions etc.) originated much later and this mismatch was deemed intolerable. Using the NHS

¹ <http://www.neighbourhood.statistics.gov.uk/>

² *Annual Death Extracts*, supplied annually to health authorities by the Office for National Statistics.

³ Details of new cancer registrations supplied by the Trent Cancer Registry.

patient registers and mid-year population estimates at local authority and ward level (Office for National Statistics 1999; Penhale and Noble 2000), estimates of age-sex specific ED populations were produced for mid-1998 (Fryers 2001), the middle of the periods of analysis for mortality and cancer incidence rates. This was not a straightforward process, details of which are given in the report (Bentley *et al* 2002).

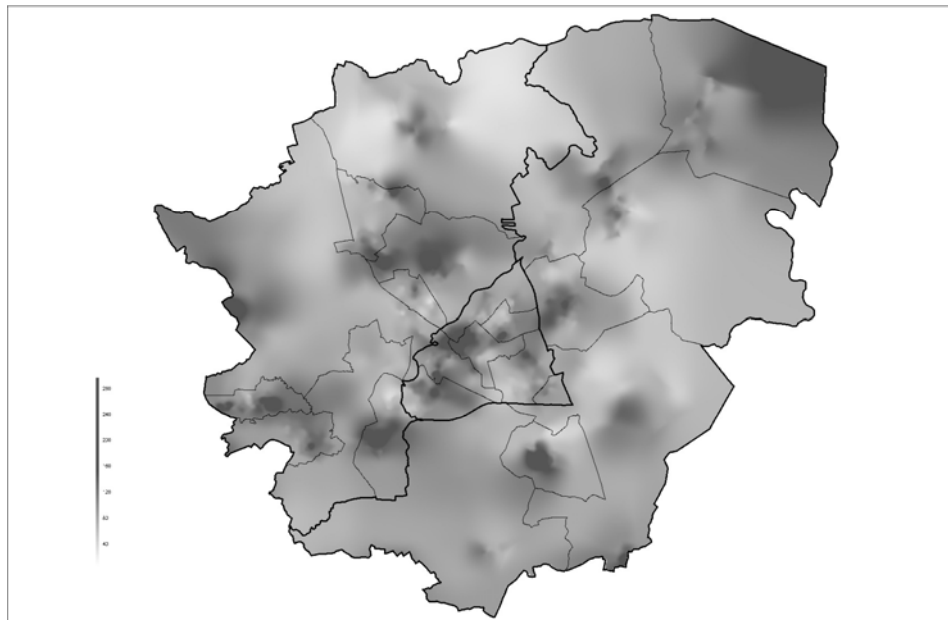
2.2 Analysis

In order to calculate directly standardised rates for the data described counts of deaths, registrations, etc were calculated by ED, gender and age groups 0-4, 5-9, ..., 79-80, 85+. Denominator populations were derived for the same strata.

The spatial analysis was based on work done at the Trent Public Health GIS Unit (Fryers *et al* 2000) which had demonstrated that spatial smoothing techniques could be used on health data to identify variations at small area level. The process consisted of two stages: first, spatial moving averages were calculated whereby each ED value was replaced by the (equally weighted) aggregates of that ED's value and all its neighbours, a neighbour defined as any ED that shares a boundary with the original ED. Directly standardised rates were then calculated from these aggregated ED data, standardising to the European Standard Population (Breslow and Day 1987).

The second stage of the analysis consisted of assigning the rates to the centroids of the EDs and creating a surface map using the natural neighbour algorithm (with linear interpolation) in the Vertical Mapper module of MapInfo (MapInfo Corporation 2002; Northwood Technologies Inc. 2001). This method leaves the values at the centroid points the same as the original observed spatial moving average values, with interpolated values in between, forming a grid of 20m squares covering the whole of South Yorkshire.

The grid squares were then assigned colours on a continuum from dark blue through cyan, green, yellow and orange to red. The colours were defined such that five colour bands equated approximately to population quintiles, so that areas at opposite ends of the county could be compared easily. An example (converted to grey scale and losing most of its meaning in the process) is shown in figure 1.



*Figure 1. Death rates for Coronary Heart Disease in Doncaster, UK, 1996-2000
Ages under 75; ICD-9 410-414
Directly standardised rates per 100,000 resident population: Spatial moving
averages smoothed with a natural neighbour algorithm*

In addition to the spatial analysis, each indicator was calculated at ward and primary care trust level as directly standardised rates with 95% confidence intervals, these being presented in bar charts. The ward level rates were also plotted against values of the Index of Multiple Deprivation (Department of the Environment, Transport and the Regions 2000b) to show the relationship with socio-economic deprivation.

2.3 Presentation

Despite complimentary comments at the time of publication, many statistical reports produced in health authorities have tended to be ignored by planners. They may be read with interest, but when the crucial decisions have to be made about prioritising investment, they are forgotten. The authors of the *South Yorkshire Health Inequalities Atlas* were determined that this should not happen with this report. Presenting data on maps has two inbuilt advantages: firstly simplicity – the coloured maps with red ‘hot spots’ can be very easily understood, and secondly attractiveness – an eye-catching and visually pleasing document is more likely to be read and to make a lasting impression.

It was felt desirable to present the information both in a printed document and electronically. The maps, charts and all the data were incorporated into an interactive web site, allowing widespread general access to the results⁴. However, this in itself would have been unlikely to have much impact on policy makers, unaccustomed as they are to surfing the web to ascertain information on which to base decisions!

A printed report was designed, including only ten of the 30 indicators, but including a credit card sized CD-ROM containing the web site along with a copy of the full report in portable document format. The report was innovative in the way it used maps which folded out to A3 size (necessary to view the whole of South Yorkshire) alongside relevant commentary and definitions, with a key map which folded out on the opposite side to be viewed with any of the data maps. The result was a public health professional’s equivalent of the pop-up books which entertain toddlers!

3.0 RESULTS

As the statistical methodology had been previously proven (Fryers *et al* 2000), it was not surprising that the maps clearly identified high and low areas, most being correlated strongly with deprivation. For example, to return to the example given earlier, Stainforth is revealed to have high levels of deprivation, high mortality rates for cancer and respiratory disease and a relatively high birth rate, a fact which helps the case for placing projects aimed at the very young, such as Sure Start (Glass 1999) in the town. However circulatory disease mortality rates, although strongly correlated with deprivation, are not particularly high in Stainforth.

This information has been used to back up bids for funding in Stainforth and other areas, but it has been necessary to undertake further analysis before giving out such information: a red area on a map does not necessarily constitute a statistically significant finding. By looking back at the original numbers of events in areas which appear to be hot spots on the map, an idea of the significance of the excess events can be obtained. This has been done crudely, as the number of significance tests required on standardised rates for groups of EDs makes a more rigorous approach unfeasible, although this could be done if required.

The surface maps have also been overlaid with topographical data⁵ within MapInfo, which allows two ‘solid’ layers to be viewed concurrently by setting a translucency percentage for the top layer. This allows people to relate very easily to the surface maps by seeing them as background colouring for familiar Ordnance Survey maps.

4.0 DISCUSSION

The report has attracted a lot of attention, and has been generally very well-received. It has also found its way into high level discussions about planning for tackling health inequalities between primary care trusts and the strategic health authority. There are several reasons for this apparent success. Firstly the information is useful and accessible. Secondly the document is attractive and memorable. Thirdly, the timing of the report was very fortunate: when the project was conceived and begun there were four health authorities in South Yorkshire, but by the time it was published, a single new Strategic Health Authority had been founded covering the whole of South Yorkshire. The existence of a brand new report for the exact area covered by the new authority was fortunate for the new organisation, and as a result it was widely cited and quoted.

⁴ The electronic report is available at <http://www.doncasterhealth.co.uk/syhlthineqatlas/index.html>.

⁵ Ordnance Survey 1:50,000 Raster.

The existence of the report has created a lot of work for public health staff in South Yorkshire, as it requires further investigation to determine the significance of apparent variations in rates. It is not clear how this can be avoided, and the fact that the work is being asked for is a positive sign that the information is seen as important.

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