



# IG

Irish Geography

MAY 2017

ISSN: 0075-0778 (Print) 1939-4055 (Online)

<http://www.irishgeography.ie>

## Towards a geography of health inequalities in Ireland

Jan Rigby, Mark Boyle, Christopher Brunsdon, Martin Charlton, Danny Dorling, Walter French, Simon Noone and Dennis Pringle.

**How to cite:** Rigby, J. E., Boyle, M. G., Brunsdon, C., Charlton, M., Dorling, D., French, W., Noone, S. and Pringle, D. (2017) Towards a geography of health inequalities in Ireland. *Irish Geography*, 50(1), 37-58, DOI: 10.2014/igj.v50i1.1263



Geographical  
Society of  
Ireland

An Cumann Tíreolaíochta na hÉireann

## Towards a geography of health inequalities in Ireland

**Janette E. Rigby<sup>a\*</sup>, Mark G. Boyle<sup>ad</sup>, Christopher Brunsdon<sup>a</sup>, Martin Charlton<sup>a</sup>, Danny Dorling<sup>b</sup>, Walter French<sup>c</sup>, Simon Noone<sup>a</sup>, Dennis Pringle<sup>a</sup>**

<sup>a</sup> Centre for Health Geoinformatics, National Centre for Geocomputation, Maynooth University, Ireland.

<sup>b</sup> School of Geography and the Environment, University of Oxford, South Parks Road, Oxford, OX1 3QY United Kingdom.

<sup>c</sup> Compass, Block 8, Blackrock Business Park, Carysfort Avenue, Blackrock, County Dublin.

<sup>d</sup> Department of Geography, Maynooth University, Ireland.

First received: 10 February 2016

Accepted for publication: 2 March 2017

**Abstract:** Relationships between social disadvantage and health outcomes in the advanced capitalist world are now well documented but less is known about the uneven development over space of mortality and morbidity. As one of the more unequal and socially stratified countries in the OECD, it is to be suspected that Ireland is burdened by particularly acute social and geographical health inequalities. Yet, remarkably little is known about the Irish case. This paper is one of the first to explore the nexus between Ireland's emergence as a neoliberalising, small but radically open economy and its attendant social and spatial inequalities, and the geographical structure of its mortality. Offered as a methodological and mapping intervention upon which future longitudinal and tracking studies might be built, this paper reports the findings of an analysis of mortality in Ireland between 2006 and 2011, using an innovative newly-produced set of 407 areas intermediate in size between counties and Electoral Divisions. Our preliminary findings show that there exists both: (a) urban, rural, and what we term 'isolated rural' variations in age standardised death rates; and (b) sharp health inequalities within Irish cities and, in particular, in Dublin. We conclude that, whilst further modelling will be required to establish the extent to which socio-economic inequalities are driving geographies of health in Ireland, progress might be made if attention is given to the relationships which exist between neoliberalism, boom, bust, austerity, and recovery and the workings of socio-economic constraints, lifestyle and behaviour, health selection, and the accessibility of health care facilities.

**Keywords:** *neoliberalism, health inequalities, mortality, Ireland, mapping, health policy, spatial scale, Intermediate Areas*

## Introduction

*'Where you live and what you work at has an impact on your health. If you work at an unskilled job and live in a deprived area, you are more likely to die earlier than a professional worker living in an affluent area' (Burke and Pentony, 2011, v).*

In this paper we seek to contribute to international efforts to chronicle and measure the impacts of widening socio-economic and socio-spatial inequalities in advanced western capitalist nations which have been propagated by the combined workings of neoliberal reform and austerity budgets, by placing under scrutiny the question of health inequalities in the Republic of Ireland.

International research suggests that as neoliberalism has entrenched itself throughout the advanced capitalist world, and notwithstanding much furore and some policy intervention, income and wealth inequalities have persisted and at times widened since the 1970s (Machenbach *et al.*, 2015, 2016). Health inequalities of course exist (at least in part) as one of the most lamentable manifestations of income and wealth inequalities. The Republic of Ireland provides for a fascinating case study of health inequalities in so far as its emergence (from the 1960s but especially from the 1990s with the rise of the Celtic Tiger economy) as a neoliberalising, small but radically open economy has precipitated particularly extreme socio-economic inequalities and spatial injustices by any standards (Savage *et al.*, 2015, Kirby, 2016). And yet, to date, in contrast to research on health inequalities in many other OECD (Organisation for Economic Co-operation and Development) countries, scholarship within the geographies of health tradition, inequalities' literatures, research on particular neoliberalisms and associated austerity programmes, and Irish Studies, has failed to take seriously enough the conjoining in Ireland of acute socio-economic inequalities and health outcomes and has failed to attend sufficiently to the question of uneven morbidity and mortality over space and spatial injustices in health outcomes.

This paper is one of the first to explore the nexus between social and spatial inequalities, which have been exacerbated by neoliberalism and Ireland's radical openness to the forces of globalisation, and the detailed geographical structure of its mortality. The paper aims to measure and benchmark, at a particular historical time (2006-2011), the extent and nature of spatial variations in mortality as a health outcome in Ireland. As such, we hope it will serve as a methodological and mapping intervention upon which future longitudinal studies might be built. We also begin the task here of explaining the early and tentative patterns we detect and ruminate on possible forms of causality. We conclude that whilst further modelling will be required to establish the extent to which socio-economic inequalities are driving geographies of health in Ireland, progress might be made if attention is given to the relationships which exist between neoliberalism, austerity, and the mechanisms of socio-economic constraint, lifestyle and behaviours, health selection, and the accessibility of health care facilities.

The remainder of the paper is structured around four sections. In the first section, we review recent literature on socio-economic inequalities and health inequalities and explain in greater detail why Ireland presents a particularly important case study. In the second section, in part because we hope our research will provide a benchmark for future studies, we outline in detail the methodology which underpins our investigation. In the third section, we use our method to provide the first rigorous mapping of health inequalities in Ireland and offer an overview of some of the early but key findings. In the final section, whilst noting that the patterns we discern will need further data over time to confirm and affirm, we conclude by ruminating on potential causes of the principal socio-spatial health inequalities which we believe exist in Ireland.

## Inequalities and Health Inequalities in Ireland

### *Ireland's neoliberalised economy and the rise of social and spatial inequalities*

After more than forty years of neoliberal reform and aggressive entrepreneurial capitalism and after almost a decade of biting austerity, it comes as little surprise that socio-economic inequalities within advanced capitalist (OECD) countries have forced themselves onto the political and intellectual scene with heightened force and vigour (Harvey, 2005, OECD, 2015). Inequalities not only exist and persist but over time it seems they have widened and become more impactful. Embodied in the popularity of works such as Joseph E. Stiglitz' (2013) *The Price of Inequality: How Today's Divided Society Endangers Our Future* and Thomas Picketty's (2014) *Capital In The Twenty First Century*, it is clear that the question of the causes, extent, chronological development, consequences of, and potential remedies for, income and wealth inequalities within and between societies now excites acute interest and controversy. For his part, in books such as *Injustice: Why Social Inequality Still Persists* (Dorling, 2015), Danny Dorling (see also Dorling, 2016) has contributed a geographical lens to these debates, insisting that socio-economic inequalities are simultaneously spatial inequalities and that socio-spatial processes both serve as progenitors of inequalities and in turn are mediated by these inequalities.

The Republic of Ireland presents a fascinating case study not only because of the severity of its socio-economic inequalities but in addition because these inequalities have been long in the making and owe their existence to a unique set of historical processes. For much of its history, and up to as late as the early 1990s, Ireland languished as a poor country on the periphery of the European economy. Ireland's revolution leading to independence in the early 1920s was in the end a conservative one and the enduring effects of civil war politics on the Irish political establishment has ensured that the country has been governed by successive rightist political parties and has lacked a meaningful left politics and a politics of redistributive justice. It is in this milieu that post-colonial social and spatial inequalities first emerged and fermented, marked first and foremost by a distinctive urban and rural and, in particular, an economic core (Dublin and surrounding areas) and periphery (border counties and the West) divide, but also by patterns of deep socio-spatial polarisation within Irish cities (in particular, Dublin, Cork, and Limerick).

These inequalities were further reworked and sedimented in the 1960s when under the leadership of Taoiseach Seán Lemass, Ireland positioned itself as a small but radically open economy, fully engaged with the global economy and subject to wild swings in fortune as global economic trends waxed and waned. It was during this period that Ireland first attempted a regional policy to divert in particular development from the comparatively more affluent core East centred on Dublin to the more impoverished Northern and Western periphery, although in the end this policy proved ineffectual. Whilst the economically and fiscally disastrous 1980s troubled Ireland's globalising ambitions they served only to aggravate and deepen socio-economic inequalities and existing spatial injustices. From the 1990s onwards, Ireland's volatile embroilment in the global economic system has conspired to further rework existing socio-economic divisions and spatial inequalities in income and wealth and to sharpen them. Co-ordinated by a pragmatic neoliberal consensus and catalysed by a fortuitous alignment of happenstance global and domestic conditions, from 1993 Ireland emerged as a thriving Celtic Tiger and by 2007 presented itself as one of Europe's most prosperous economic cores. Of course, not all ships rose equally and notwithstanding expanding state expenditure, area-based urban regeneration schemes targeting so called sink estates and deprived neighbourhoods, and a new National Spatial Strategy, inequalities only served to widen across occupation classes and at all geographical scales (Kirby, 2016).

The Global Financial Crisis from 2007, combined with reckless domestic political, banking, and planning practices, conspired to burst a runaway property bubble and the Irish economy was plunged into deep recession and the Irish state into unmanageable debt. The total government spend in 2009 was €78.4bn; the deficit on the current account in 2009 was €27.5bn; the deficit to GDP in 2010 amounted to 30%, whilst the total government debt to GDP rose in 2012 to 120% (all data taken from Central Statistics Office). There followed eight 'Troika' (European Union/European Central Bank/International Monetary Fund) led, Irish government imposed, austerity budgets comprising €18.5bn in public-spending cuts and €12bn in revenue/tax-raising/new charges measures. During this period the Irish state paid €64 billion bailing out the banks. Crucially, the pain of austerity was shared unequally, visiting the poor, the vulnerable, the ill, and the marginalised disproportionately. Prior inequalities became entrenched and in some cases deepened (O'Connor and Staunton, 2015).

The combined effects of the longevity of civil war politics, Ireland's decision to position itself as a small but radically open economy subject to the vicissitudes of the global economy from the early 1960s, and from the 1990s an epic neoliberal boom, bust, austerity programme and uneven recovery, have been to consolidate and deepen social and spatial inequalities in Ireland (Whelan *et al.*, 2016). Today, Ireland suffers the ignominy of being among the more unequal societies in the OECD world (Kirby, 2016, Savage *et al.*, 2015). Long established urban and rural and east and west divides, and intra-urban socio-spatial polarisation have proved to be enduring and intractable to policy. It is in this context that the question of health inequalities must be located. In comparison with many other OECD countries, little is known about the extent to

which the Irish economic model and the social and spatial injustices it has created in its wake have etched themselves onto the stratigraphic record of the health of the Irish population. Of course disentangling potential causal pathways is tricky; it can take time for socio-economic and socio-spatial processes to work their way through to create health outcomes and these processes often combine and overlap. It is towards addressing this problematique that the next section turns.

### ***Health Inequalities: Ireland as a research lacunae***

That there exist relationships between socio-economic inequalities and health has been extensively researched in many other countries. The considerable body of evidence which has accumulated (for example, Benzeval, Judge and Whitehead, 1995, Davey Smith, 2003, Kawachi and Kennedy, 2002, Marmot, 2015, Shaw *et al.*, 1999, Townsend *et al.*, 1988) has demonstrated convincingly that those in the lower socio-economic groups and those living in the most deprived communities endure appreciably greater levels of illness and die earlier. The impacts of the social determinants of health in more affluent countries are now well-established (Marmot, 2015, Marmot and Wilkinson, 2006, Marmot Review Team, 2010).

The international literature on health inequalities shows a health divide in western capitalist societies which has not been narrowing over the past twenty years. Mackenbach *et al.* (2015) explored trends in inequalities in premature mortality (defined as those aged 30-74) in 13 European countries, concluding that relative inequalities continued to rise in the North, West and East of Europe (Ireland was not one of the countries studied, but England and Wales were part of the dataset). For political, ethical and fiscal reasons, health inequalities have become a key policy concern, although the nature of the policy instruments which may be used varies. A particular challenge is that it can take many years before an intervention can be seen to have affected health outcomes, and the lifespan of policy instruments tends to be substantially shorter.

Farrell *et al.* (2008), and more recently Burke and Pentony (2011) have very clearly positioned this research agenda in an Irish context. These arguments need to be supported by an evidence base of health outcomes for effective, targeted, policy interventions. 'Prevention requires policymakers to focus on reducing the gaps between the highest and lowest occupational classes, and between the wealthiest and most deprived areas, in order to eliminate health inequalities' (Burke and Pentony, 2011, v).

There is a corresponding literature reporting spatial inequalities in health, demonstrating that health outcomes vary geographically (e.g. Pearce *et al.*, 2006, Shaw *et al.*, 1999). Social inequalities express themselves spatially and because there is a place effect, or a neighbourhood effect, place can act to amplify differences supporting the concept that one's health and life expectancy may depend upon where one lives (Macintyre, Ellaway and Cummins, 2002). The linkages between place and health outcome are not always straightforward to examine, not least because of population mobility. Health inequalities between places may be a function of both contextual factors (i.e. characteristics of the areas as such) and compositional factors (features associated

with the individuals who live in those areas). For example, an area of poor health may be characterised by poor housing (contextual) or a high percentage of elderly people who are more at risk (compositional). Compositional factors may in turn be either structural (e.g. deprivation) or behavioural (e.g. smoking), but these in turn may be influenced by contextual factors. For example, people may be disadvantaged in the job market because they live in an area tarnished by a bad reputation, whilst most forms of health-related behaviours reflect the social norms in an individual's local area. Disentangling the causal pathways may prove intractable. For example, Mitchell *et al.* (2009) focused their research on areas which did not demonstrate the expected association: the areas were relatively poor but with low mortality rates. In exploring the resilience of these areas, there were clear linkages to processes of social cohesion, but no consistent explanation was identified.

As one of the more unequal and stratified societies in the OECD, it is likely that health inequalities in Ireland are a significant issue (OECD, 2015). Barrington (2004) sounded a positive note summarising initiatives which identify inequalities and placed them firmly on the public health agenda, but concluded that there was much work to be done, and this was hindered by poor health information systems. Socio-economic inequalities in health have been reported in Ireland (Barry *et al.*, 2001, Nolan, 1990, O'Shea, 1997, 2003), whilst Balanda and Wilde (2001) produced a very persuasive report identifying inequalities from mortality data across socio-economic groups for a wide range of causes for all Ireland, and comparatively for Northern Ireland and the Republic. O'Shea (1997), focusing on males, found that the gap in the years of potential life lost by socio-economic group had widened between 1981 and 1991. Most recently Layte *et al.* (2015) established a significant gradient in mortality rates across socio-economic groups noting that the differences between professional and manual occupational groups increased between the 1980s and the 2000s.

Although there are also studies of spatial disparities in mortality in Ireland (e.g. Pringle, 1982, 1986a, 1986b) such studies, with few exceptions (Pringle, 1987, Barry *et al.*, 2001), have been confined to inter-county comparisons. More recently, Smyth (2009) demonstrated that socio-economic inequalities in mortality increased significantly during the period 2000-2006, but again the analysis was restricted to county level. Such a level of aggregation hides smaller areas of very poor health which may exist, even in a county which overall may have generally favourable outcomes. For a more complete picture, and in particular to monitor the outcome of policy changes, it is necessary to analyse the outcomes at a more sensitive scale (i.e. using 'smaller' areas). This approach is particularly difficult in countries where there is no postcode system for accurately geocoding residential addresses from mortality records; until recently Ireland was one such country.

Within Ireland, the last ten years have seen a number of initiatives to produce measures which relate to health inequalities (e.g. Irish Health Poverty Index (2008), Health Atlas Ireland (2016), Pobal (2008) and Small Area Health Research Unit (SAHRU) (Kelly and Teljeur, 2007) deprivation indices). Deprivation indices can be useful for indicating where

health and well-being may be poor, but the relationship is not consistent in that areas that can be identified as the most deprived do not necessarily have the worst health outcomes (Sridharan *et al.*, 2007). In many cases, an area may be disadvantaged by factors other than social inequalities (e.g. environmental factors, access to services, local cultures). Therefore, effective policy formulation needs to be evidence-based, taking account of all the factors that may impact upon health.

Until now, there has been a dearth of health outcome measures in Ireland at a suitable sub-national scale (Barrington, 2004). This paper addresses this gap and reports on the production and derivation of a series of datasets which classify areas according to standardised mortality rates, showing the extent of the inequalities in mortality and premature mortality rates from the years 2006 to 2011. (2006 is the first year for which individual mortality records in digital form became available nationally in Ireland.) The rates have been calculated for a specially-designed geography termed 'Intermediate Areas'. Age standardised rates were calculated by the direct method for all deaths and for premature deaths, defined here as deaths under 75 years of age. The paper also identifies and explores issues associated with visualising the outcomes, and presents a preliminary analysis of the results. A subsequent paper will explore potential explanations of the substantial inequalities which have emerged.

It has been known since the early 1930s that there is an interaction between spatial scale and the outcome of statistical computations for spatial data (Gehlke and Biehl, 1934). The phenomenon is usually referred to as the 'modifiable areal unit problem' (MAUP). Openshaw and Taylor (1979) demonstrated that values of the correlation coefficient between republican voters and older residents ranging from -0.99 and 0.99 could be obtained for re-aggregations of voting districts in Iowa, USA. More recently, Flowerdew (2011) observed 'How serious is the MAUP? Most of the time, not very – but there are occasions when it can make a great deal of difference. Unfortunately it remains difficult to predict these occasions' (p.113).

It is that unpredictability which has led a number of authors to examine the influence of the MAUP on health analyses. Schuurman and colleagues (2007) have considered the effect of spatial scale on deprivation indices, concluding that the MAUP 'continues to have a policy significance when assessing relative social and material deprivation in urban populations' (p 601). Parenteau and Sawada (2011) examined the relationship between NO<sub>2</sub> and respiratory health at three spatial scales and noted that Ordinary Least Squares regression results are conditioned on the spatial scale of the data. They conclude that 'more research on the role of spatial representation in health studies' (p 1) is required. Swift *et al.* (2014) observed ecological bias introduced by spatial data aggregation in the correlation between pathogen exposure and illness rates.

In the face of MAUP issues, how does the analyst proceed? Cockings and Martin (2004) have considered the creation of bespoke zoning systems using automated methods; they observe that 'the selection of building blocks and design criteria should be driven by the nature of the phenomena being represented and the purpose of the analysis' (p S201). Haynes *et al.* (2007) examined the relationship between zone design and residents'



perceptions using automated zone design methods, concluding that this might help to 'illuminate the mechanisms of place effects on health' (p 824). In a more recent study, Sabel and colleagues (2013) used automated zone design techniques to create synthetic areas for the analysis of the relationship between deprivation and asthma levels in a French city.

In the light of these, we follow the prescription of Cockings and Martin (2004) and some of the methodological approach of Sabel *et al.* (2013) in our analysis of the spatial variation in mortality. Our approach is intended to enable a stable basis for the production of mortality rates over future years.

## Charting the uneven development of mortality over space in Ireland: A new Methodology

The generation of mortality data at a suitable geographical scale requires the following objectives to be achieved:

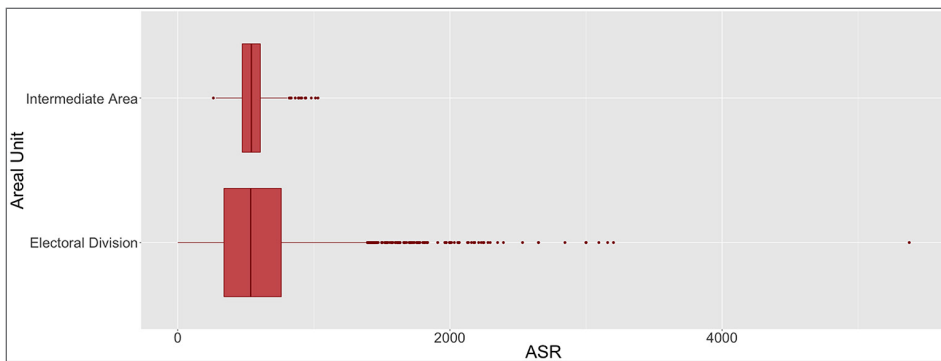
- (i) the creation of appropriate geographical areas, noting that it must be possible to derive population data for these areas to use as denominators in the calculation of rates;
- (ii) the identification of the geographical location of the residential address on each mortality record, so that counts of deaths can be determined for each of the areas created in meeting the first objective;
- (iii) the generation of directly standardised mortality rates to determine the extent of the inequalities and to facilitate comparison between areas.

With a view to introducing the methodology upon which our project is based, let us address each objective in turn.

- (i) Within Ireland a case can be made for collecting mortality and other health outcome data for commonly used administrative units called Electoral Divisions (EDs). However, we argue that EDs are not suitable here for analytical purposes as their populations are too variable: in 2006, ED populations ranged from 76 to 32,288. Hence, rates calculated for the smaller EDs will tend to be unstable because one death more or one death fewer will make a large percentage difference, whereas significant local variations within the larger EDs will tend to be averaged out. Further, for the process of age-standardisation, some of the population age-group totals for small EDs are zero: as these are denominators, errors result and a manual adjustment is required. For 2011, a new set of 18,488 small areas were constructed by the Central Statistics Office (CSO) for improved census dissemination (CSO 2014), but the populations of these areas are too small for present purposes, each area containing approximately 120 households. Therefore, what is required is a set of spatial units intermediate in size between EDs and counties. We took an innovative approach and devised a new set of areas that are sufficiently large to overcome the small numbers problem whilst also being approximately equal in population size.

Our new Intermediate Area (IA) geography, consists of areas with approximately equal-sized populations of about 10,000 people.

Figure 1 below illustrates the ‘small numbers’ issue when working with Electoral Divisions as the areal unit for computing the Age Standardised Mortality Rates (ASRs). The spread in values is notably larger than with Intermediate Areas, due to the very small numbers of deaths involved. When the population at risk is very low, the variance of the recorded ASR increases – leading to a more variable estimation of risk. This is one source of error. Working with larger units, such as IAs, reduces this problem. The cost associated with this is that any areas of higher risk at a smaller geographical scale may be ‘averaged out’ – and a biased estimate of risk is obtained. Thus, the two sources of error in risk estimation are bias and variance, and the least error is obtained when the bias/variance trade-off is optimal.



**Figure 1** Comparison of 2011 mortality rates for Electoral Divisions and Intermediate Areas

Figure 1 suggests that while variance is notably reduced for IAs, the overall mean level does not change greatly, so that while bias increase is fairly minimal, variance is greatly reduced, suggesting IAs are, if not strictly optimal, a superior areal unit to EDs in this context. Clearly an optimisation constraint here is the availability of base populations from census data. The Intermediate Areas were produced from smaller spatial ‘building blocks’ by aggregating EDs, or by dividing them using aggregations of the new small areas produced for 2011 census dissemination.

A methodology developed by Openshaw (1977a, 1977b) and subsequently enhanced (Martin, 1998, Martin, Nolan and Tranmer, 2001) was used to create a geography for the reporting of Census of Population data in the United Kingdom. Martin and his colleagues have created software which allows analysts to use the method for a wide range of aggregation exercises (Cockings *et al.*, 2011, Martin, 2003). This AZTool programme is available from the GeoData Institute at the University of Southampton (AZTool 2011). The software allows the user to aggregate a set of polygons into a smaller number of polygons, known as ‘tracts’, according to specified design criteria. The criteria include: (a) target population;

(b) maximum and minimum population thresholds; (c) shape constraints; (d) social homogeneity constraints; and (e) containment constraints. For the intermediate geographies produced for Ireland, the target was set at 10,000, the output zones should be optimised on a shape constraint to prevent the formation of pathological shapes, and social homogeneity used household tenure and building type as a proxy. The zones were constrained not to cross county (or in some cases ED) boundaries. Manual manipulation was needed to resolve some aggregation problems; the final dataset can be downloaded from [www.chg.ie](http://www.chg.ie).

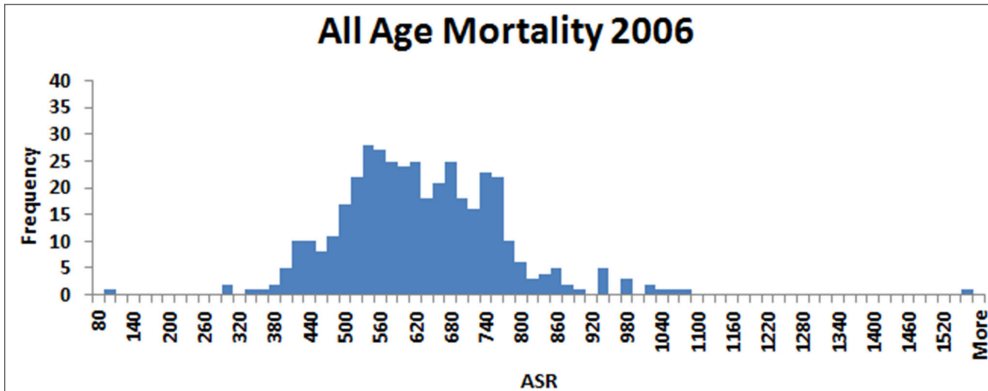
Further processing was required along boundaries, as occasionally the process of line generalisation, used to smooth complex boundary lines, could result in a location 'moving' across a boundary, and these required manual adjustment. Population totals for 5-year age bands in 2006 were generated for each IA in conjunction with the Central Statistics Office (CSO) and Pobal, and for 2011 directly from the Census of Population produced by the CSO.

- (ii) Mortality records for 2006 (the first year that computer-based records were available) were obtained from the CSO in conjunction with the General Records Office. Records of deaths of visitors to Ireland, deaths in hospitals where there was no other locational information, deaths which were otherwise incomplete (no address information), or deaths which were duplicated in the file were removed, leaving 27,681 deaths in 2006. The deceased persons' home addresses were then georeferenced using a geocoder developed in-house as part of this research project. The georeferences produced were the centroids of the buildings, given to a precision of 1m<sup>1</sup>. Again, manual intervention was required to resolve non-unique addresses, and there were further issues where addresses were in the Irish language. Manual validation checks were conducted on the results.
- (iii) The counts of deaths were then grouped into 5-year age bands for each Intermediate Area. Death rates were calculated by the direct method, standardising to the European Standard Population, for both (a) all ages and (b) under-75s (representing 'premature' mortality). Using the European Standard Population will permit direct comparisons with similar rates calculated subsequently for other years. Mortality rates were also produced for four main causes of death, averaged over the years 2009-11. These were for cancers, ischaemic heart disease, respiratory disease and cerebrovascular disease (stroke). These are coded by International Classification of Disease (ICD 10) codes C00-97, I20-25, J00-99, I60-69 respectively<sup>2</sup>.

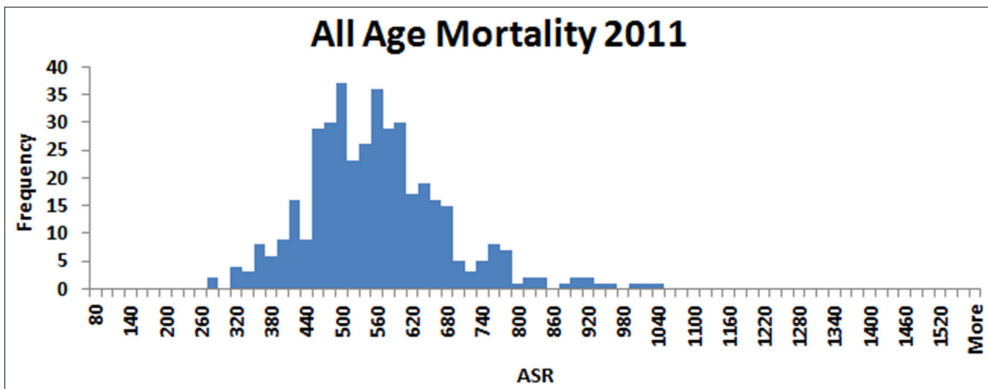
## Mapping Health Outcomes in Ireland: First Findings

The age-standardised mortality rates (per 100,000 population) for 2006 suggest there are substantial inequalities in health in Ireland. The all-age mortality rates range from 80.3 to 1489.4, whilst the rates for the under-75s range from 81.9 to 655.0. However, the ranges for 2006 include a single extreme value at each end of the distribution (Figure 2a below) and it must be stressed that the rates are based on deaths in a single year. Given

the relatively small number of deaths in a few areas, despite the precautions taken by creating Intermediate Areas, the estimated rates will tend to be more extreme than they would be over a longer period. By 2011 the all-age mortality rates are more concentrated, ranging from 261.8 to 1030.3 (Figure 2b).

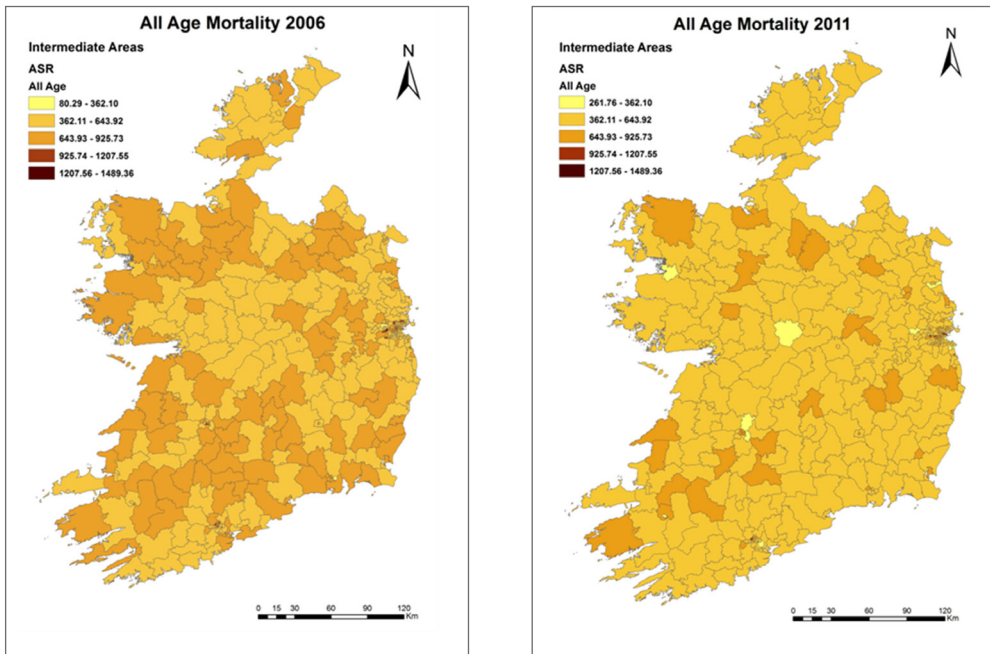


**Figure 2a** Distribution of all age mortality rates, 2006, for 407 Intermediate Areas



**Figure 2b** Distribution of all age mortality rates, 2011, for 407 Intermediate Areas

These differences are mapped as Figure 3 below. It might appear at first glance that there are no clear spatial patterns in evidence. Nevertheless, tentatively, we might point to two key observations. Firstly, there appears to be grounds to draw a distinction between rates of mortality in urban, rural, and what we term isolated rural areas. Secondly, the sharpest health outcomes can be discerned at the intra-urban scale, and, in particular, within the city of Dublin. Let us now unpack both provisional findings.



**Figure 3** The spatial distribution of rates for all-age mortality in 2006 and 2011

The maps show a visualisation issue common to many aspects of human geography: much of the map is dominated by rural areas, which are larger in area than the more densely populated urban areas. For Ireland, it becomes clear that the extremes of the mortality rates are to be found in the cities. Of particular interest is the fact that notwithstanding the core-periphery dynamic at work between the more prosperous and developed Dublin city region and the poorer, more rural, and peripheral North and West of the country, rates of mortality are higher in Dublin. Perhaps, it should be noted that areas of very high mortality in Dublin (and in other cities) are in some cases directly adjacent to areas with very low mortality, complicating aggregate analyses of relationships between higher performing urban economies and the health of their populations. Hence, Dublin has higher rates of mortality than other regions of Ireland, even though it serves at the nation's economic core.

In terms of rural Ireland, for 2006 there would appear to be a cluster of generally low mortality areas (represented by the lighter shading) extending from east Galway across the midlands as far as Westmeath and Laois. But in addition, there also appears to be a band of generally high mortality in more isolated and in some cases peripheral coastal and border rural areas, extending from Mayo eastwards as far as east Cavan, plus a cluster of generally high mortality rates towards the south west. The 2006 rates were divided into quintiles for mapping, and the class intervals were retained for 2011 to enable comparability. Whilst these patterns are less pronounced in 2011, the data do suggest a need to differentiate rural Ireland and to treat as a separate category more isolated remote and peripheral rural areas.

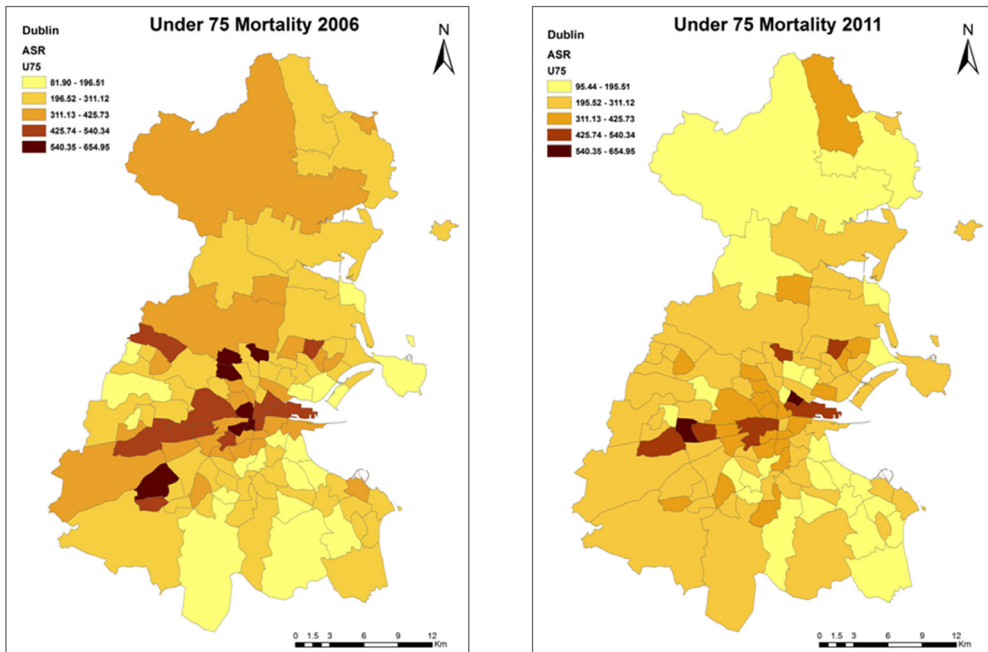


Figure 4 Premature Mortality in the Dublin region, 2006 and 2011

Figure 4 shows, for example, the under-75 mortality rates for Dublin for 2006 and 2011, generally showing higher rates in the city centre, north of the River Liffey. This very clearly brings out the northside/southside social divide in the city (which in reality tends to be more a northwest/southeast divide with relatively affluent areas such as Clontarf and Howth in the east, north of the Liffey, and mostly working class areas in the west of the city south of the river, plus their extensions in parts of Tallaght, Clondalkin and Blanchardstown). These sharp intra-urban asymmetries are replicated in Ireland's other cities, notably in Cork and Limerick, though not to the same extent.

It is difficult to investigate a single, traditional map as the relatively large land areas of the rural midlands dominate. To bring these two observations to the foreground an alternative approach is to use a cartogram, where the population size of the area is used instead of the land area. Figure 5 below shows this approach for 2011 all-age mortality, which can be compared with Figure 3 for 2011. The higher rates in the inner-city areas of Dublin and Cork are much more distinct, and the overall proportions in the city centres are again more obvious. However, it can be argued that the distortion of place necessary to produce and interpret such maps may compromise their adoption by policy-makers.



**Figure 5** Cartogram of all cause mortality rates, 2011

*Produced using Gastner-Newman algorithm, instructions available from <https://github.com/chrisbrunsdon/getcart>*

The findings here demonstrate that the extent of geographical inequalities in mortality rates across Ireland are substantial. Significant variations are discernible between cities and rural areas and within both cities and rural areas. Perhaps surprisingly, the Eastern economic core heartland centred upon the Dublin region suffers from particular high rates of mortality but this is a reflection of steep intra-urban health inequalities within this city region. Moreover, whilst the data are far from definitive, there would appear to be grounds to conclude that more remote, peripheral, border, and coastal rural areas in the West and the North in particular show a tendency towards higher rates of mortality. This study has produced rates at a finer geographical scale than heretofore. Further, the Intermediate Areas developed here should remain suitable for comparisons for the next decade or two, enabling temporal trends in the absolute rates for each area and the widening or narrowing of the disparities between areas to be identified<sup>3</sup>. Inevitably there will be some changes to the boundaries of small areas for future census dissemination, so the IAs will potentially need to be partially reconstructed for each Census period.

## In Search of Causality: Drivers of Uneven Health Outcomes in Ireland

The supposition behind this paper is that it is Ireland's economic and political history, including its emergence as a small but neoliberalising open economy from the early 1960s and its experience of boom, bust, austerity, and fragmented recovery since the early 1990s, which provides the broad canvas upon which health inequalities have emerged. Our hypothesis is that it is deep, historical, structural, and fundamental socio-economic drivers centred upon uneven standards of living which are primarily responsible for

the spatial disparities in mortality. But, the relationship between uneven geographical development and health inequalities is far from simple. A substantial amount of interpretive work remains to be completed to unravel the variegated and multi-dimensional factors at play. We attempted a first pass to explain the results by undertaking a simple linear regression of the all-age mortality rates for 2006 with a deprivation index used in Ireland (Pobal 2008, Trutz Haase personal communication, 2011). This only produced an  $r^2$  of 0.25, and there was little evidence of spatial patterning. Therefore, it seems apparent that any geographical patterns depicted in the maps do not reflect in any simple way the geography of social disadvantage as measured by this index.

We should not assume *a priori* that similar processes apply to each of the major causes of death. To explore the variation across the four major causes of death groupings, a parallel-coordinates plot was produced (Figure 6). This shows all the rates for 2011 in quintiles. For the under-75 all cause mortality rates axis (2nd from the left) the top 20% of rates are in red, and the subsequent 20% bands are in orange, yellow, pale and dark blue. Each line represents one Intermediate Area, and so links to the relative position of the rates on each of the axes. A much greater range of rates is apparent for cancer than for ischaemic heart disease or respiratory disease, with cerebrovascular deaths showing the smallest variation in rates. Although three years of data (2009-11) were aggregated for the causes of death, some small numbers may persist in these data, warranting further investigation.

Using socio-economic variables to explain mortality does produce inconsistencies. Figure 7 is a heatmap showing the variation in correlation between the mortality datasets and commonly used socio-economic indicators from the census. As shown in the accompanying legend, the colour palette is spectral where violet represents -0.56 through to red +0.60,

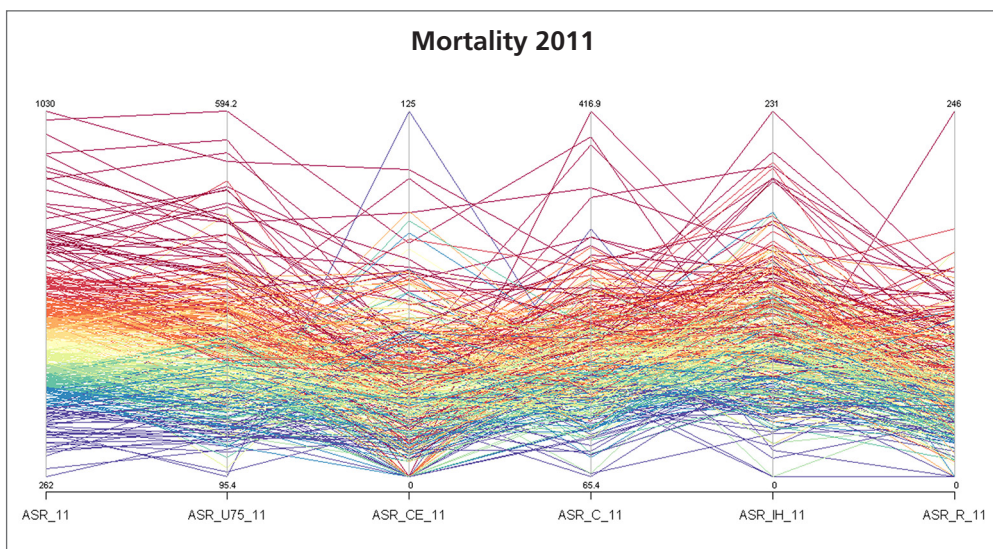


Figure 6 Parallel coordinates plot for major causes of death 2009-11



with yellow around zero. More detail on indicator definitions can be found at <https://rpubs.com/chrisbrunsdon/14998>. Of note, the four indicators at the top of the plot are the individual indicators which are combined in the Small Area Health Research Unit (SAHRU) index of deprivation (Kelly and Teljeur, 2007): LA: the proportion of private households which are not owner occupied; NC: the proportion of private households which do not possess a car; SC: the proportion of private households with more than one person per room; UE: the proportion of the economically active who are unemployed. The following variables are seen to be quite strongly correlated: Separated/Divorced, Single Person Households, Lone Parent Households, Public Rental Households, Two Car Households, and Long term Ill/Unemployed.

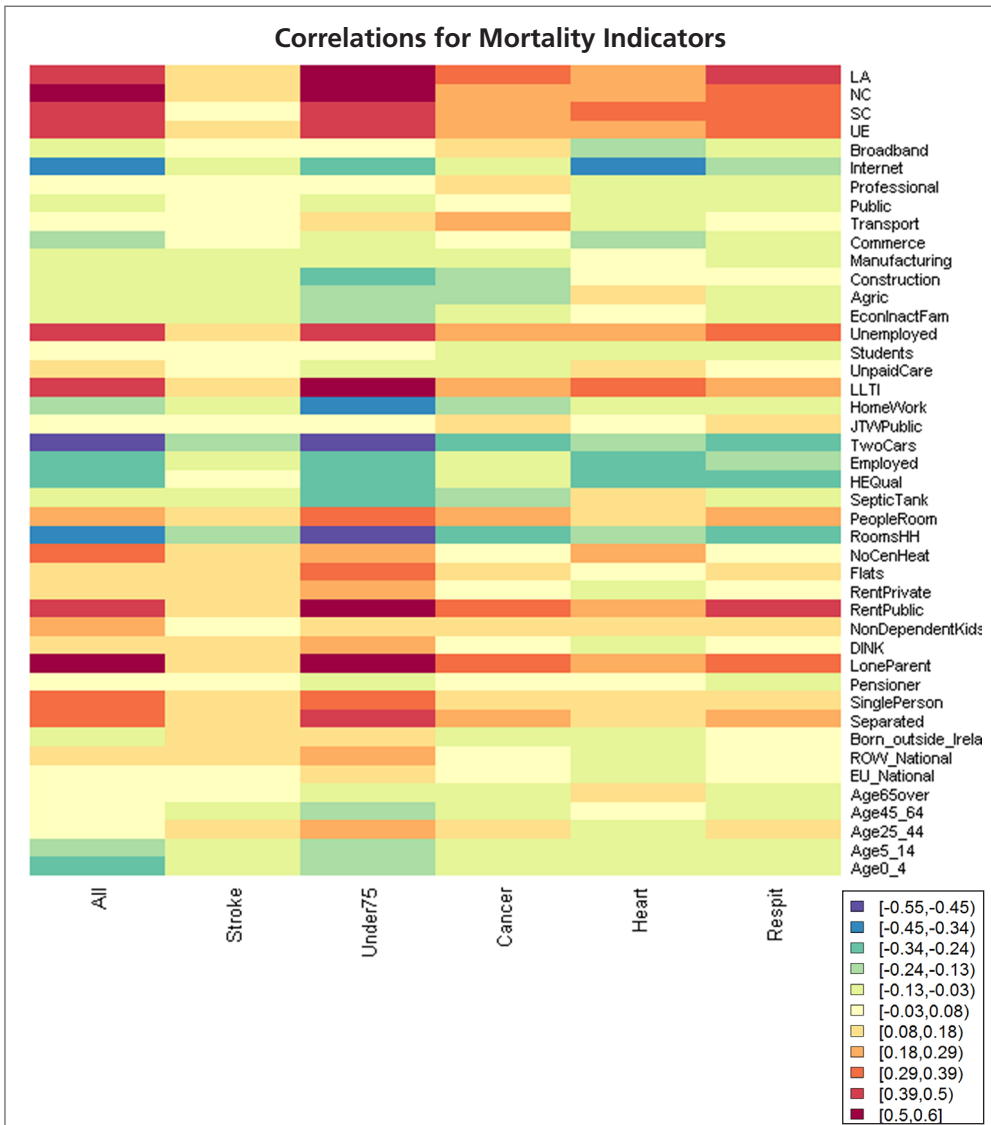


Figure 7 Heatmap of socioeconomic variables and mortality datasets

The heatmap demonstrates that there are striking differences between the correlates of the different mortality rates, and the associated census variables. In particular, the under-75 mortality rate (essentially an indicator of levels of premature death) correlates positively with a number of variables including lone parents, public renting, unemployment, and negatively with variables such as Higher Education qualifications, and owning two or more cars. To some extent, the pattern is also visible for respiratory illness and heart disease, although the correlations are less marked. Stroke seems less notably correlated to census-based indicators than the other measures.

So, the data reveal complexity and it would be wrong to over-interpret from our theoretical framing actual causal mechanisms at play here. A substantial amount of unbundling, unravelling, and untangling of multi-factorial processes remains necessary. In the interim, we speculate that neoliberalisation, boom, bust, austerity and uneven recovery, and socio-economic and socio-spatial inequalities might work in complex ways through four key proximate determinants of health to produce spatial variations in health outcomes: socio-economic constraint, lifestyle and behaviour, health selection, and access to and usage of health care resources (Karanikolos, 2013).

It is clear that Ireland's emergence as a neoliberalising, small but radically open economy has exacerbated a patchwork quilt of standards of living, including pockets of rural and urban deprivation. It remains to be established if poverty alone is resulting in increased morbidity and mortality, through, for example, increased exposure to occupational hazards, poor housing standards and conditions, food and fuel poverty, and the impact of precarity on mental and physical stress and ill health. Recently in the UK, Dorling (2016) suggested that the impact of austerity policies cutting funding from social care to the elderly is translating quickly into greater mortality in the older age groups. More usually we would expect the impacts of austerity to take time to translate into the mortality statistics.

However it seems likely, for example, that Ireland's housing crisis which has resulted in the surge of a new generation of 'family homelessness', the gravitas of the effects of austerity on low income families, and the rise of unemployment and austerity-induced suicide all relate in fundamental ways to heightened mortality and morbidity in Ireland's disadvantaged communities. Meanwhile, *pace* Wilkinson (1996), psychosocial processes deriving from relative inequalities – rooted in the iniquities which have derived the asymmetric allocation of Celtic Tiger wealth and differential austerity burdens – may also mean that even if standards of living are sufficient in absolute terms, the hidden existential injuries work to frustrate improved outcomes.

Of course, it remains the case that uneven lifestyles (related to physical activity, diet, addictive behaviours) exist as critical determinants of health and are related in complex ways to socio-economic and socio-spatial inequalities, disadvantage and exclusion and psycho-social interiorisations of feelings of comparative inadequacy and inferiority. This raises questions concerning the extent to which areas of high mortality in Ireland are areas characterised by particularly unhealthy lifestyles, perhaps caused by the inadequate provision of affordable recreational and leisure resources, their heightened exposure to

the drug trade, or inaccessible public health and education campaigns (Butler and Hope, 2015, Mercille, 2016).

The concept of health selection draws attention to the effects of health on upwards social and spatial mobility and the impacts of ill health on downward social and spatial mobility. This sifting and sorting of people into class groups and through the job and housing market into neighbourhoods with different levels of affluence and deprivation implies that it is health which in part determines socio-economic status rather than vice-versa. Studies elsewhere have shown that up to a third of all geographical variations in health outcomes can be explained with reference to the workings of health selective migration (Boyle *et al.*, 2004). In the Irish case then, we might ask the question to what extent is the rural depopulation and the relocation of the young and upwardly mobile from Western and Northern counties to the Dublin City Region, and more broadly to other countries, partly responsible for higher rates of mortality in isolated rural areas? At the intra-urban scale, it will be important to assess the extent to which movement through the housing market within particular cities is mediated by health status, so that healthier people in aggregate tend to drift to better neighbourhoods while those suffering from long term and acute illness work their ways into more deprived social housing estates and disadvantaged communities. We might also explore the extent to which both rural depopulation and health selective intra-urban migration conspire to decimate communities and deplete social capital, resulting in exaggerated health inequalities.

Finally, attention will need to be given to the geography of health care provision in Ireland, and to the accessibility and availability of health care facilities and to the public's access to and usage of these facilities. Whilst the Irish state provides access to basic health care for those dependent upon social protection, access to speedy screening, treatment and quality health care is heavily mediated by the insurance industry and the ability of customers to pay increasing premiums. Ireland's public health service is widely regarded to be in crisis with long waiting lists and inadequate and antiquated facilities. It is clear that austerity has resulted in many leaving health insurance schemes out of necessity, placing further burdens on the system (Kiernan, 2014, Thomas *et al.*, 2014). Meanwhile, a centralisation agenda has sought to concentrate particular specialisms into a limited number of centres of excellence. Whilst championed as a better method of provision, it has resulted in a depletion of the range of services provided locally and longer commutes from more isolated parts of the country for specialist treatments. More broadly, it has affirmed the need to examine the working of Hart's inverse care law (1971) in an Irish context which implies that the geography of health care provision invariably bears an inverse relationship with the geography of need (Kentikelenis, 2015). There is much to be investigated.

## Conclusion

Against the backdrop of the foregrounding of socio-economic inequalities as a key malady within the advanced capitalist world and a progenitor of indefensible social and spatial injustices and alongside systemic precarity within the western political and economic system, this paper has sought to explore the specific question of health inequalities and their manifestations in the specific case of one OECD country which has hitherto received insufficient attention, the Republic of Ireland. We have drawn attention to the need to examine the impacts of Ireland's emergence as a neoliberalising, small but open economy, its exposure to the vagaries of the global economic system, its recent experience of boom, bust, austerity, and multi-speed recovery, and its (by OECD standards) marked social inequalities (O'Connor and Staunton, 2015) on the stratigraphic record of the nation's health. The research upon which this paper is based presents itself as the first attempt to produce a systematic evidence base, at an appropriate geographical scale, charting spatial variations in mortality rates in Ireland. Our results show persistent inequalities in Ireland, with higher rates of mortality in the major cities and in isolated rural areas, particularly in more coastal, peripheral, and border areas and particularly sharp health inequalities at a more local scale, within Irish cities and, in particular, within Dublin. Of particular concern are the inequalities relating to mortality in those aged under-75, below life expectancy.

We have noted the limits of the interpretive reading of the patterns we have offered, recognising that relationships between capitalist economies and neoliberal variants therein, social and spatial inequalities, and asymmetric health outcomes are complex and multifaceted. Our theoretical supposition and working hypothesis, that Ireland's peculiar and aggressive species of neoliberalism is responsible for especially sharp social and spatial inequalities and in turn these are likely to produce a particularly distinctive generation of health inequalities in the country, are partially advanced by the results. But clearly other readings of the same data are possible and much work remains to be done to render intelligible the particular causal pathways at work. We have presented then a data core around which we have woven an interpretive frame which we believe to be compelling. But our frame is provisional and conjectural and has a journey to travel before being deemed authoritative or commanding.

Our contribution is in part methodological. Our work has addressed head-on some of the data challenges which has frustrated work in this area to date, not least the absence of geocoded residential addresses. In July 2015, Ireland introduced a new system of 'eircodes'. Regrettably, these are not geographically cohesive, and early indications of errors and omissions strongly suggest these will not be in routine, accurate use for some years. Mortality records, particularly those of 2006 and 2007, featured numerous data quality errors (particularly of duplication and incompleteness). These were seen to improve greatly by 2011, but we would caution against their use without validation checks. Population data were much easier to derive for 2011 compared with 2006 where some small area data required derivation and back-coding. Populations need to be estimated for inter-censal years, and extrapolated to project beyond the most recent

census, though for Ireland the five-year census period allows for adjustment relatively rapidly. The unsuitability of existing administrative boundaries was overcome by the production of the new Intermediate Areas, which have been made publically available. These issues notwithstanding, we offer our methodology and data as a baseline upon which future longitudinal and tracking studies of spatial variations in health outcomes in Ireland might be based.

As ever, the point is to make things better. It is critical that such health outcomes are brought to the forefront of health policy debate in Ireland, as they are indicative of substantial and sustained under-funding in population health. Perhaps the public sphere is now ready to digest such a message. It is clear that social and spatial inequalities, and political projects which support bankers, developers, and speculators over the disenfranchised and impoverished majority with declining living standards, is no longer possible.

## Acknowledgements

This research was funded by the Health Research Board (award HRA\_PHS/2010/19). We gratefully acknowledge the assistance of Sandra Tobin of the CSO, Catherine Keane of GRO, Trutz Haase for assistance with 2006 population data provision, and Ordnance Survey Ireland for the provision of digital boundary data. We also acknowledge assistance with data preparation and validation by Damien Butler, Áine Rickard and Sandra Walsh. The paper benefited considerably from the comments of two anonymous referees.

## Endnotes

- <sup>1</sup> [www.geodirectory.ie](http://www.geodirectory.ie)
- <sup>2</sup> International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) –WHO Version for 2016
- <sup>3</sup> The datasets have all been made publically available on [www.chg.ie](http://www.chg.ie) as an interactive atlas, which allows the user to explore two maps simultaneously. Alternatively, datasets may be obtained from the corresponding author.

## References

- AZTool, 2011.** AZTool, URL: <http://www.geodata.soton.ac.uk/software/AZTool/>
- Balanda, K. and Wilde, J., 2001.** *Inequalities in Mortality 1989-1998: A Report on All Ireland Mortality Data*, Dublin/Belfast: Institute of Public Health in Ireland.
- Barrington, R., 2004.** *Poverty is Bad for Your Health*. Discussion Paper 5. Dublin: Crisis Poverty Agency.
- Barry, J., Sinclair, H., Kelly, A., O'Loughlin, R., Handy, D. and O'Dowd, T., 2001.** *Inequalities in Health in Ireland – Hard Facts*. Dublin: Department of Community Health and General Practice, Trinity College Dublin.
- Benzeval, M., Judge, K. and Whitehead, M., 1995.** *Tackling Inequalities in Health: An Agenda for Action*. London, Kings Fund.
- Boyle, P., Exeter, D. and Flowerdew, R., 2004.** The role of population change in widening the mortality gap in Scotland. *Area*, 36(2), 164-173
- Butler, S. and Hope, A., 2015.** Ireland's financial crisis and its influence on alcohol and drug issues. *Nordic Studies on Alcohol and Drugs*, 32(6), 623-628.
- Central Statistics Office (CSO), 2014.** <http://www.cso.ie/en/census/census2011boundaryfiles/>

- Cockings, S. and Martin, D., 2004. Zone design for an environmental epidemiological study using individual level data. *Epidemiology*, 15(4), SS201-SS202.
- Cockings, S. and Martin, D., 2005. Zone design for environment and health studies using pre-aggregated data. *Social Science & Medicine*, 60, 2729-2742.
- Cockings, S., Harfoot, D., Martin, D. and Hornby, D., 2011. Maintaining existing zoning systems using automated zone design techniques: methods for creating the 2011 Census output geographies for England and Wales. *Environment and Planning A*, 43, 2399-2418. doi:10.1068/a43601
- Davey Smith, G. (ed.), 2003. *Health Inequalities*. Bristol, Policy Press.
- Dorling, D., 2015. *Injustice: Why social inequality still persists*. Bristol, Policy Press.
- Dorling, D., 2016. Brexit: the decision of a divided country, *BMJ* 2016; 354.
- Farrell, C., McAvoey, H., Wilde, J., 2008. *Tackling Health Inequalities*. Dublin: Combat Poverty Agency.
- Flowerdew, R., 2011. How serious is the modifiable areal unit problem for analysis of English Census data? *Population Trends*, 145, 102-14.
- Gehlke, C.E. and Biehl, K., 1934. Certain effects of grouping upon the size of the correlation coefficient in census tract material. *Journal of the American Statistical Association*, Supplement 29, 169-170.
- Hart, J.T., 1971. The inverse care law. *The Lancet*, 1, 405-412.
- Harvey D., 2005. *A Brief History of Neoliberalism*. Oxford, Oxford University Press.
- Haynes, R.M., Daras, K., Reading, R. and Jones, A.P., 2007. Modifiable neighbourhood units, zone design and residents' perceptions. *Health and Place*, 1(4), 812-825.
- Health Atlas Ireland, 2016. <https://www.healthatlasireland.ie/>
- International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) –WHO Version for 2016
- Irish Health Poverty Index (interim release), 2008. Dublin: Institute of Public Health in Ireland.
- Karanikolos, M., Mladovsky, P., Cylus, J., Thomson, S., Basu, S., Stuckler, D., Mackenbach, J.P. and McKee, M., 2013. Financial crisis, austerity, and health in Europe. *The Lancet*, 381 (9874), 1323-1331.
- Kawachi, I., Kennedy, B.P., 2002. *The Health of Nations*. New York: The New Press.
- Kelly, A. and Teljeur, C., 2007. *The National Deprivation Index for Health & Health Services Research*. Small Area Health Research Unit, Technical Report, Dublin: Trinity College Dublin.
- Kentikelenis, A., 2015. Bailouts, austerity and the erosion of health coverage in Southern Europe and Ireland. *The European Journal of Public Health*, 25(3), 365-366.
- Kiernan, F., 2014. What Price Austerity – A nation's health? The effect of austerity on access to health care in Ireland. *The European Journal of Public Health*, 24(suppl 2), 165-110.
- Kirby, P., 2016. *The Celtic tiger in distress: Growth with inequality in Ireland*. Amsterdam, Springer.
- Layte, R., Banks, J., Walsh, C., McKnight, G., 2015. Trends in socio-economic inequalities in mortality by sex in Ireland from the 1980s to the 2000s. *Ir J Med Sci*, 184, 613-621.
- Machenbach, J.P., Kulhánová, I., Artnik, B., et al., 2016. Changes in mortality inequalities over two decades: register based study of European countries. *BMJ*, 353, 11732.
- Machenbach, J.P., Kulhánová, I., Menvielle, G., et al., 2015. Trends in inequalities in premature mortality: a study of 3.2 million deaths in 13 European countries. *J Epidemiol Community Health* 69: 207-17.
- Macintyre, S., Ellaway, A., Cummins, S., 2002. Place effects on health: how can we conceptualise, operationalise and measure them? *Social Science and Medicine*, 55, 125-139.
- Marmot, M., 2015. *The Health Gap: the challenge of an unequal world*. London: Bloomsbury Press.
- Marmot, M., Wilkinson, R. (eds), 2006. *Social determinants of health (2<sup>nd</sup> edition)*. Oxford: Oxford University Press.
- Marmot Review Team, 2010. *Fair Society, Healthy Lives: Strategic Review of Health Inequalities in England post-2010*. London: Marmot Review.
- Martin, D., 1998. 2001. Census output areas: from concept to prototype. *Population Trends*, 94, 19-24.
- Martin, D., 2003. Extending the automated zoning procedure to reconcile incompatible zoning systems. *International Journal of Geographical Information Science*, 17, 181-196.
- Martin, D., Nolan, A. and Tranmer, M., 2001. The application of zone design methodology to the 2001 UK Census. *Environment and Planning A*, 33, 1949-1962.

- Mercille, J., 2016. Neoliberalism and the alcohol industry in Ireland. *Space and Polity*, 20(1), pp. 59-74.
- Mitchell, R., Gibbs, J., Tunstall, H., Platt, S. and Dorling, D., 2009. Factors which nurture geographical resilience in Britain: a mixed methods study. *J Epidemiol Community Health*, 63, 18-23.
- Nolan, B., 1990. Socio-economic mortality differentials in Ireland. *Economic and Social Review*, 21, 193-208.
- OECD, 2015. *In It Together: Why Less Inequality Benefits All*. Paris, OECD Publishing, doi: <http://dx.doi.org/10.1787/9789264235120-en>
- Openshaw, S., 1977a. A geographical solution to scale and aggregation problems in region-building, partitioning and spatial modelling. *Transactions of the Institute of British Geographers*, New Series 2, 459-472.
- Openshaw, S., 1977b. Algorithm 3: a procedure to generate pseudo-random aggregations of N zones into M zones, where M is less than N. *Environment and Planning A*, 9, 1423-1428.
- Openshaw, S. and Taylor, P., 1979. A million or so correlation coefficients: three experiments on the modifiable areal unit problem. In Wrigley, N. (ed.) *Statistical applications in the spatial sciences*. London, Pion, 127-144.
- O'Shea, E., 1997. Male mortality differentials by socio-economic group in Ireland. *Social Science & Medicine*, 45, 803-809.
- O'Shea, E., 2003. Social gradients in years of potential life lost in Ireland. *European Journal of Public Health*, 13, 327-333.
- Parenteau, M.-P. and Sawada, M.C., 2011. The modifiable areal unit problem (MAUP) in the relationship between exposure to NO<sub>2</sub> and respiratory health. *International Journal of Health Geographics*, 10(58), 1-15.
- Pearce, J., Dorling, D., Wheeler, B., Barnett, R., Rigby, J., 2006. Geographical inequalities in health in New Zealand, 1980-2001. *Australia and New Zealand Journal of Public Health*, 30, 461-466.
- Picketty, T., 2014. *Capital in the twenty first century*. Boston, Harvard University Press.
- Pobal HP Deprivation Index 2008 <https://www.pobal.ie/Pages/New-Measures.aspx>
- Pringle, D.G., 1982. Regional Disparities In The Quantity Of Life: The Republic Of Ireland, 1971-7. *Irish Geography*, 15, 22-3.
- Pringle, D.G., 1986a. Premature Mortality In The Republic Of Ireland, 1971-1981. *Irish Geography*, 19, 33-40.
- Pringle, D.G., 1986b. Disaggregating Regional Variations In Mortality By Cause Of Death: A Case Study Of The Republic Of Ireland. *Social Science and Medicine*, 23, 919-28.
- Pringle, D.G., 1987. Health inequalities in Dublin. In: A.A. Horner and A.J. Parker (eds.), *Geographical Perspectives On The Dublin Region*. Dublin: Geographical Society of Ireland.
- Sabel, C.E., Kihal, W., Bard, D. and Weber, C., 2013. Creation of synthetic homogeneous neighbourhoods using zone design algorithms to explore relationships between asthma and deprivation in Strasbourg, France. *Social Science and Medicine*, 91, 110-121.
- Savage, M., Callan, T., Nolan, B. and Colgan, B., 2015. *The Great Recession, austerity and inequality: evidence from Ireland*. Dublin, ESRI Working Paper 499.
- Schuurman, N., Bell, N., Dunn, J.R. and Oliver, L., 2007. Deprivation indices, population health and geography: an evaluation of the spatial effectiveness of indices at multiple scales. *Journal of Urban Health*, 84(4), 591-603.
- Shaw, M., Dorling, D., Gordon, D. and Davey Smith, G., 1999. *The Widening Gap*. Bristol: The Policy Press.
- Smyth, B., 2009. *Mortality Inequalities in Ireland 2000-2006*. Unpublished MD Thesis NUI Galway.
- Sridharan, S., Tunstall, H., Lawder, R. and Mitchell, R., 2007. An exploratory spatial data analysis approach to understanding the relationship between deprivation and mortality in Scotland. *Social Science & Medicine*, 65, 1942-1952.
- Stiglitz, J.E., 2012. *The price of inequality: How today's divided society endangers our future*. New York, WW Norton & Company.
- Swift, A., Liu, L. and Ueber, J., 2014. MAUP sensitivity analysis of ecological bias in health studies *GeoJournal*, 79(2), 137-153.
- Thomas, S., Burke, S. and Barry, S., 2014. The Irish health-care system and austerity: sharing the pain. *The Lancet*, 383(9928), 1545-1546.
- Townsend, P., Davidson, N. and Whitehead, M. (eds.), 1988. *Inequalities in health: The Black Report and The Health Divide*. London, Penguin Books.
- Wilkinson, R.G., 1996. *Unhealthy societies: The afflictions of inequality*. London, Routledge.