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Demographic and health time-series analysis of small areas in GB: the development of area measures and population estimates

Paul Norman. School of Geography, University of Leeds, p.d.norman@leeds.ac.uk

To date:

My involvement in this type of work started with my PhD (Norman 2002) and in subsequent publications which produced a set of subnational population related resources for GB and the UK through the development of methods: for geographical harmonisation when small area boundaries change (Norman et al. 2003; Norman 2006); of populations by age and sex in terms of the estimation of the past (Rees et al. 2004; 2005; Norman et al. 2008; Lomax & Norman 2016) and projection of the future (Norman et al. 2010; Rees et al. 2010, 2011 & 2012); of the calculation of changing area deprivation (Norman, 2010a); and of the analysis of demographic change (Tromans et al. 2008; Norman 2010b; Norman 2011). The resources relate to the period 1981 to 2001 with very full detail (relevant to the purposes) though with less detail from 1971 to 1981 and after 2001. Various datasets have been deposited at the UK Data Archive (study numbers 5850, 6045 & 6777). The same methods have been used to analyse changing deprivation for small areas in Australia (Norman et al. 2016).

In applied work, I have mainly used the resources for health related research of; infant mortality (Norman et al. 2008), all cause mortality (Rees et al. 2003; Norman et al. 2011), cause specific mortality (Exeter et al. 2011); limiting long-term illness and incapacity benefit (Bambra and Norman 2006; Norman & Bambra 2007; Ajebon & Norman 2016) and of children with life limiting conditions (Fraser et al. 2012; Norman & Fraser 2014). Further topics include small area analyses of local democracy (Norman et al. 2007), environmental equity (Mitchell & Norman 2012), traffic accidents (Lyons et al. 2009) and fire risk (Corcoran et al. 2007).

The examples above are *area* based; about whether aspects for small populations vary over space and time. Parallel to this, I have been involved in research which seeks to determine whether for *individuals*, there are different experiences for people who live in different kinds of places over time. As above, the focus is on health, particularly for persons: who move between levels of deprivation (Boyle et al. 2002; Norman et al. 2005) at different ages (Norman & Boyle 2014) or between urban and rural areas (Riva et al. 2011); in different countries from where they were born (Norman 2008; Popham et al. 2010); who do not move residence (Boyle et al. 2004); or who are socially mobile (Boyle et al. 2009); and where linkages to residential areas need estimation when specific locations are unclear or names of places have changed (Norman & Riva 2012). Analogous situations for cardiovascular disease have been researched in New Zealand (Darlington-Pollack et al. 2016).

As my academic profile developed and knowledge of the availability of the demographic resources have become more widely known, I have received requests to supply and manipulate data and collaborate in

ongoing research. These collaborations includes studies of general cancer (e.g. van Laar et al. 2010, 2012& 2013); specific cancers (Basta et al. 2014; Blakey et al. 2014; McNally et al. 2012, 2014 & 2015), coronary heart disease (Bajekal et al. 2013a&b; Scholes et al. 2013); coronary intervention treatment (Dondo et al. 2016; Hall et al. 2016), diabetes (Harron et al. 2010 & 2011), asthma (Hoskins et al. 2011 & 2012), hearing and visual impairment (Dawes et al. 2014a&b; Dawes et al. 2015), muscular dystrophy (Pierotti 2015) and neuromuscular disease (Woodcock et al. 2016).

To update:

More recent data are now available (both census and demographic births and deaths events) but with the inevitable boundary and data definitional changes which were resolved in the previous work. There was therefore a need to update, to redefine and to ensure the resources were fit for purpose for long run time-series analysis from 1971 to 2011 and by contemporary geographies (2011 definitions). The latter ensures that interpretations are relevant to current applications. Demand was building from various directions for the resources to be revised and made available.

Initially, a partial solution was needed for the Government's Foresight Future Cities initiative (work with Rees & Durham) and a proposal for future work was made to Joseph Rowntree (with Birkin, Malleson & Clarke). Previous collaborators at Leeds (Mitchell; Feltbower & Parslow), York (Fraser) and at Newcastle (McNally & colleagues) needed updated information and fuller resources for ongoing research. I also have new opportunities with researchers at Leeds (Connor), UCL (Jivraj & Murray), Manchester (Dawes and Becares), Nottingham (Edmondson-Jones) and Kings (Polling; Woodhead) all of whom want to link individual data to area characteristics for studies: of health and well-being through the life course; of visual and hearing impairment; of self harm and mental health using: longitudinal and cohort studies, hospital episode (in & out patients, A&E), the UK Biobank, etc. Public Health England (via Edwards in Birmingham) are keen to have annual population estimates for use as denominators in cancer rates.

Outputs

The aim was to produce for small area subnational areas in England, Wales and Scotland various datasets which comprise:

- 1971-2001 annual time-series of populations by five year age-groups and sex;
- Population density for the census years, 1971, 1981, 1991, 2001 and 2011;
- Deprivation scores and quantiles for the census years, 1971, 1981, 1991, 2001 and 2011;
- Sociodemographic variables (the inputs to deprivation measures).

To create the above requires data to be converted from their original geographies of dissemination (different at least once per decade) to the small area geographies for which the 2011 Census data were

released: i.e. Super Output Areas in England and Wales and Datazones in Scotland. A lack of data over this time-frame precludes widening out the (vector) geographical coverage to include Northern Ireland but equivalent data will be made available for 1991, 2001 and 2011. See Lloyd (2017) for a solution using population surfaces across the UK.

The development of the resources and initial analyses are reported in Norman (2016) and Norman & Darlington-Pollock (2017) and have been used in studies of accessibility to sports facilities (Higgs et al. 2015) and of inequities in improvements in air quality (Mitchell et al. 2015). The time-series of GB deprivation and density measures have been attached to the 1958 and 1970 British Birth Cohorts for a study at UCL (Jivraj et al.) and an equivalent dataset for England and Wales for attachment to the ONS Longitudinal Study (via Dennett at Celsius).

References

- Ajebon M & Norman P (2016) Beyond the census: a spatial analysis of health and deprivation in England. *GeoJournal* 81(3): 395-410 DOI:10.1007/s10708-015-9624-8
- Bajekal M, Scholes S, O'Flaherty M, Raine R, Norman P & Capewell S (2013a) Implications of using a fixed IMD quintile allocation for small areas in England from 1981 to 2007. *PLOS ONE* 8(3): e59608. doi:10.1371/journal.pone.0059608.S003
- Bajekal M, Scholes S, O'Flaherty M, Raine R, Norman P & Capewell S (2013b) Unequal trends in coronary heart disease mortality by socioeconomic circumstances, England 1982-2006: analytical study. *PLOS ONE* 8(3): e59608. doi:10.1371/journal.pone.0059608
- Bambra C & Norman P (2006) What is the association between sickness absence, morbidity and mortality? *Health & Place* 12: 728-733
- Basta NO, James PW, Gomez-Pozo B, Craft AW, Norman PD, McNally RJQ (2014) Survival from teenage and young adult cancer in northern England, 1968-2008. *Pediatric Blood & Cancer* DOI 10.1002/pbc.24939
- Blakey K, Feltbower RG, Parslow RC, James PW, Pozo BG, Stiller C, Vincent TJ, Norman PD, McKinney PA, Murphy MF, Craft AW, McNally RJQ (2014) Is fluoride a risk factor for bone cancer? Small area analysis of osteosarcoma and Ewing sarcoma diagnosed among 0-49 year olds in Great Britain, 1980-2005. *International Journal of Epidemiology* 43(1): 224-234 doi: 10.1093/ije/dyt259
- Boyle P, Norman P & Popham F (2009) Social mobility: evidence that it can widen health inequalities. *Social Science & Medicine* 68(10): 1835-1842
- Boyle P, Norman P & Rees P (2002) Does migration exaggerate the relationship between deprivation and limiting long-term illness? A Scottish analysis. *Social Science & Medicine* 55: 21-31
- Boyle P, Norman P & Rees P (2004) Changing places: do changes in the relative deprivation of areas influence limiting long-term illness and mortality among non-migrant people living in non-deprived households? *Social Science & Medicine* 58: 2459-2471
- Corcoran J, Higgs G, Brunsdon C, Ware A & Norman P (2007) The use of spatial analytical techniques to explore patterns of fire incidence: a South Wales case study. *Computers, Environment and Urban Systems* 31: 623-647
- Darlington-Pollock, F, Norman, P, Lee, A, Grey, C, Mehta, S & Exeter D (2016) To move or not to move? Exploring the relationship between residential mobility, risk of CVD and ethnicity in New Zealand. *Social Science & Medicine* 165: 128-140 doi:10.1016/j.socscimed.2016.07.041

- Dawes P, Dickinson C, Emsley R, Bishop P, Cruickshanks K, Edmondson-Jones M, McCormack A, Fortnum H, Moore DR, Norman P & Munro K (2014) Vision impairment and dual sensory problems in middle age. *Ophthalmic and Physiological Optics* 34(4):479-488 doi/10.1111/opo.12138
- Dawes P, Dickinson C, Emsley R, Bishop P, Cruickshanks K, Edmondson-Jones M, McCormack A, Fortnum H, Moore DR, Norman P & Munro K (2015) Understanding visual impairment in UK Biobank – Authors' Reply. *Ophthalmic and Physiological Optics* 35(1):107-108 DOI:10.1111/opo.12178
- Dawes P, Fortnum H, Moore DR, Emsley R, Norman P, Cruickshanks K, Davis A, Edmondson-Jones M, McCormack A, Lutman M, Munro K (2014) Hearing in middle age: a population snapshot of 40- to 69-year olds in the United Kingdom. *Ear and Hearing* doi: 10.1097/AUD.0000000000000010
- Dondo T.B., Hall M., Timmis A.D., Batin P.D., Oliver G., Alabas O.A., Norman P., Deanfield J.E., Bloor K., Hemingway H. & Gale C.P. (2016) Geographic variation in the treatment of non ST-segment myocardial infarction in the English National Health Service: a cohort study. *BMJ Open* doi:10.1136/bmjopen-2016-011600
- Exeter D J, Boyle P J & Norman P (2011) Deprivation (im)mobility and cause-specific premature mortality in Scotland. *Social Science & Medicine* 72: 389-397
- Fraser L K, Miller M, Hain R, Norman P, Aldridge J, McKinney P A & Parslow R C (2012) Rising national prevalence of Life Limiting Conditions in Children in England. *Paediatrics* DOI: 10.1542/peds.2011-2846
- Hall, M, Laut, K, Dondo, T, Alabas, O, Brogan, R, Gutacker, N, Cookson, R, Norman, P, Timmis, A, de Belder, M, Ludman, P, Gale, C (2016) Patient and hospital determinants of primary percutaneous coronary intervention in England, 2003-13. *Heart* doi:10.1136/heartjnl-2015-308616
- Harron K, McKinney PA, Feltbower RG, Stephenson CR, Bodansky HJ, Norman PD, Chhokar G & Parslow RC (2011) Incidence rate trends in childhood Type 1 diabetes in Yorkshire, UK 1978-2007: effects of deprivation and age at diagnosis in the south Asian and non-south Asian populations. *Diabetic Medicine* 28, 1508–1513 doi:10.1111/j.1464-5491.2011.03413.x
- Harron K, McKinney PA, Feltbower RG, Stephenson CR, Norman PD, Bodansky HJ, Chhokar G & Parslow RC (2010) Ethnic differences in incidence rates of childhood Type 1 diabetes in Yorkshire 1978-2007. *Diabetologia* 53: S143-S143
- Higgs G, Langford M & Norman P (2015) Accessibility to sports facilities in Wales: a GIS-based analysis of socio-economic variations in provision. *Geoforum* 62: 105-120
<http://dx.doi.org/10.1016/j.geoforum.2015.04.010>
- Hoskins G, Williams B, Jackson C, Norman P D & Donnan P T (2011) Assessing Asthma Control in UK Primary Care: Use of routinely collected prospective observational consultation data to determine appropriateness of a variety of control assessment models. *BMC Family Practice*, 12: 105
doi:10.1186/1471-2296-12-105
- Hoskins G, Williams B, Jackson C, Norman P D & Donnan P T (2012) Patient, practice and organizational influences on asthma control. Observational data from a national study on primary care in the United Kingdom. *International Journal of Nursing Studies* 49(5) 596-609 doi:10.1016/j.ijnurstu.2011.10.017
- Lloyd C D (2017) Creating Population Surfaces for the Analysis of Small Area Change. In *The Frontiers of Applied Demography*. Springer International Publishing: 431-448
- Lomax N & Norman P (2016) Estimating population attribute values in a table: 'get me started in' Iterative Proportional Fitting (IPF) *Professional Geographer* 68(3): 451-461 DOI: 10.1080/00330124.2015.1099449
- Lyons R A, Ward H, Christie N, Macey S, Norman P & Griffiths S (2009) Road traffic injury and disadvantage: people and areas. In *Behavioural Research in Road Safety 2007*. Department for Transport. www.dft.gov.uk/pgr/roadsafety/research/behavioural/ 77-93

- McNally RJ, Basta NO, Errington S, James PW, Norman, PD, Hale JP & Pearce MS (2015) Socio-economic patterning in the incidence and survival of boys and young men diagnosed with testicular cancer in northern England. *Urologic Oncology: Seminars and Original Investigations* 33(12) 506.E9-505.E14 <http://dx.doi.org/10.1016/j.urolonc.2015.07.014>
- McNally RJQ, Blakey K, Parslow RC, James PW, Pozo BG, Stiller C, Vincent TJ, Norman P, McKinney PA, Murphy MF, Craft AW & Feltbower RG (2012) Small area analyses of bone cancer diagnosed in Great Britain provide clues to aetiology. *BMC Cancer* 12: 270 doi:10.1186/1471-2407-12-270
- McNally RJQ, James PW, Ducker S, Norman PD, James OFW (2014) No rise in incidence but geographical heterogeneity in the occurrence of Primary Biliary Cirrhosis in northeast England. *American Journal of Epidemiology* 179(4):492-498 DOI: 10.1093/aje/kwt308
- Mitchell G & Norman P (2012) Longitudinal environmental justice analysis: Co-evolution of environmental quality and deprivation in England, 1960-2007. *Geoforum* 43: 44-57 doi:10.1016/j.geoforum.2011.08.005
- Mitchell G, Norman P & Mullin K (2015) Who benefits from environmental policy? An environmental justice analysis of air quality change in Britain, 2001-2011. *Environmental Research Letters* doi:10.1088/1748-9326/10/10/105009
- Norman P & Bambra C (2007) Unemployment or incapacity? The utility of medically certified sickness absence data as an updatable indicator of population health. *Population, Space & Place* 13(5): 333-352
- Norman P & Boyle P (2014) Are health inequalities between differently deprived areas evident at different ages? A longitudinal study of census records in England & Wales, 1991-2001. *Health & Place* 26: 88-93 <http://dx.doi.org/10.1016/j.healthplace.2013.12.010>
- Norman P & Darlington-Pollock F (2017) The Changing Geography of Deprivation in Great Britain: Exploiting Small Area Census Data, 1971 to 2011. Chapter 30 in Stillwell, J & Duke-Williams O. *Unlocking the UK 2011 Census: Handbook of Census Resources, Methods and Applications* Routledge
- Norman P & Fraser L (2014) Prevalence of life-limiting and life-threatening illness in children and young people in England: time trends by area type. *Health & Place* 26: 171-179 <http://dx.doi.org/10.1016/j.healthplace.2014.01.002>
- Norman P & Riva M (2012) Population health across space and time: the geographical harmonisation of the ONS Longitudinal Study for England and Wales. *Population, Space & Place* 18: 483-502 DOI: 10.1002/psp.1705
- Norman P (2002) Estimating small area populations for use in medical studies: Accounting for population migration. University of Leeds
- Norman P (2006) Sociodemographic spatial change in the UK: data and computational issues and solutions. *GIS Development* 10(12): 30-34
- Norman P (2008) Country of birth and country of residence influences on self-reported health: a British analysis using individual-level data. Working Paper 08/05, School of Geography, University of Leeds, Leeds <http://eprints.whiterose.ac.uk/76681/>
- Norman P (2010a) Identifying change over time in small area socio-economic deprivation. *Applied Spatial Analysis and Policy* 3(2-3) 107-138
- Norman P (2010b) Demographic and deprivation change in the UK, 1991-2001. In *Understanding Population Trends and Processes Volume 2: Spatial and Social Disparities* (eds.) John Stillwell, Paul Norman, Claudia Thomas & Paula Surridge. Springer: Dordrecht: 17-35
- Norman P (2011) Relationships between UK subnational trends in infant mortality and fertility. In *Population Dynamics and Projection Methods*, UPTAP Volume 4, (eds.) John Stillwell & Martin Clarke. Springer: Dordrecht: 99-114

- Norman P (2016) The Changing Geography of Deprivation in Britain: 1971 to 2011 and Beyond. Chapter 11 in Champion T and Falkingham J (eds.) *Population change in the United Kingdom*: Rowman & Littlefield: London: 193-214
- Norman P, Boyle P & Rees P (2005) Selective migration, health and deprivation: a longitudinal analysis. *Social Science & Medicine* 60(12): 2755-2771
- Norman P, Boyle P, Exeter D, Feng Z & Popham F (2011) Rising premature mortality in the UK's persistently deprived areas: Only a Scottish phenomenon? *Social Science & Medicine* 73 1575-1584 doi:10.1016/j.socscimed.2011.09.034
- Norman P, Charles-Edwards E & Wilson T (2016) Relationships between population change, deprivation change and health change at small area level: Australia 2001-2011. In *Demography for Planning and Policy: Australian Case Studies* (eds) Tom Wilson, Elin Charles-Edwards and Martin Bell: Springer: 197-214
- Norman P, Gregory I, Dorling D & Baker A (2008) Geographical trends in infant mortality: England and Wales, 1970–2006. *Health Statistics Quarterly* 40: 18-29 <http://www.ons.gov.uk/ons/rel/hsq/health-statistics-quarterly/no--40--winter-2008/index.html>
- Norman P, Purdam K, Tajar, A & Simpson S (2007) Representation and local democracy: geographical variations in elector to councillor ratios. *Political Geography* 26 57-77
- Norman P, Rees P & Boyle P (2003) Achieving data compatibility over space and time: creating consistent geographical zones. *International Journal of Population Geography* 9(5): 365-386
- Norman P, Rees P, Wohland P & Boden P (2010) Ethnic group populations: the components for projection, demographic rates and trends. Chapter 14 in Stillwell, J. and van Ham, M. (eds.) *Ethnicity and Integration*. Series: Understanding Population Trends and Processes. Springer: Dordrecht: 289-315
- Norman P, Simpson L and Sabater A (2008) 'Estimating with Confidence' and hindsight: new UK small area population estimates for 1991. *Population, Space and Place* 14(5): 449-472
- Pierotti, L, Mohammed, MA, Wildman, M, Bilton, D, Boote, J, Carr, SB, Collins, K, Cullinan, P, Elston, C, Harrison, S, Norman, P and MacNeill, SJ(2015) Using funnel plots to make meaningful centre comparisons. In: *Thorax*. British Thoracic Society Winter Meeting 2015, 2015-12-02 - 2015-12. BMJ Publishing Group, A187-A188
- Popham F, Boyle P & Norman P (2010) The Scottish excess in mortality compared to the English and Welsh: Is it a country of residence or country of birth excess? *Health & Place* 16: 759-762
- Rees P, Brown D, Norman P & Dorling D (2003) Are socioeconomic inequalities in mortality decreasing or increasing within some British regions? An observational study, 1990-98. *Journal of Public Health Medicine*. 25(3): 208-214
- Rees P, Norman P & Brown D (2004) A framework for progressively improving small area population estimates. *Journal of the Royal Statistical Society A* . Vol. 167 Part 1: 5-36
- Rees P, Parsons J & Norman P (2005) Making an estimate of the number of people & households for Output Areas in the 2001 Census. *Population Trends* 122: 27-34
- Rees P, Wohland P & Norman P (2013) The demographic drivers of future ethnic group populations for UK local areas 2001-2051. *Geographical Journal* 179(1): 44-60 doi: 10.1111/j.1475-4959.2012.00471.x
- Rees P, Wohland P, Norman P & Boden P (2011) A local analysis of ethnic group population trends and projections for the UK. *Journal of Population Research* 28(2): 129-148 doi: 10.1007/s12546-011-9047-4
- Rees P, Wohland P, Norman P & Boden P (2012) Ethnic population projections for the UK, 2001-2051. *Journal of Population Research* 29(1): 45-89 DOI 10.1007/s12546-011-9076-z

- Riva M, Curtis S & Norman P (2011) Residential mobility within England and urban-rural inequalities in mortality. *Social Science & Medicine* doi:10.1016/j.socscimed.2011.09.030
- Scholes S, Bajekal M, Norman P, O'Flaherty M, Hawkins N, Capewell S, Raine R (2013) Quantifying Policy Options for Reducing Future Coronary Heart Disease Mortality in England: A Modelling Study. *PLOS ONE* 8(7): e69935. doi:10.1371/journal.pone.0069935
- Tromans N, Natamba E, Jefferies J & Norman P (2008) Have national trends in fertility between 1986 and 2006 occurred evenly across England and Wales? *Population Trends* 133: 7-19
- van Laar M, McKinney PA, Parslow RC, Glaser A, Kinsey SE, Lewis IJ, Picton SV, Richards M, Shenton G, Stark D, Norman P, Feltbower RG (2010) Cancer incidence among the south Asian and non-south Asian population under 30 years of age in Yorkshire, UK. *British Journal of Cancer* 103(9):1448-1452
- van Laar M, McKinney PA, Parslow RC, Glaser A, Kinsey SE, Lewis IJ, Picton SV, Richards M, Shenton G, Stark D, Norman P, Feltbower RG (2013) Cancer incidence among the south Asian and non-south Asian population under 30 years of age in Yorkshire, UK [Corrigendum]. *British Journal of Cancer* 108, 1223–1224 | doi: 10.1038/bjc.2013.67
- van Laar M, McKinney PA, Stark DP, Glaser A, Kinsey SE, Lewis IJ, Picton SV, Richards M, Norman P, Feltbower RG (2012) Survival trends of cancer among the south Asian and non-south Asian population under 30 years of age in Yorkshire, UK. *Cancer Epidemiology* 36(1): e13–e18
- Woodcock I R, Fraser L, Norman P, Psyden S, Manning S & Childs A-M (2016) The prevalence of neuromuscular disease in the paediatric population in Yorkshire, UK: variation by ethnicity and deprivation status. *Developmental Medicine & Child Neurology* 58(8): 877–883 DOI:10.1111/dmcn.13096