

# Demographic and Health Time-Series Analysis of Small Areas in GB: The Development of Area Measures and Population Estimates

## Abstract

In health and other applied studies, there is a need for populations as denominators and measures of area type as covariates by time point and small area geographies. The work referred to here demonstrates how resources have been developed and made available to other researchers which subsequently has been reported in numerous journal articles. Some of the work has been area based and some about outcomes for individuals. Recently, the estimates and area type measures have been updated and extended so as to underpin current research. This work is ongoing and will be reported in time but the resources used as denominators and area types are now available to the wider research community. This short paper gives an overview of the relevant research and points others to the source of freely downloadable datasets.

## Short Communication

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### Paul Norman\*

*School of Geography, University of Leeds, UK School of Geography, University of Leeds, UK*

\*Corresponding author: Paul Norman, School of Geography, University of Leeds, UK, Tel: +44 (0) 113 34 38199; Email: p.d.norman@leeds.ac.uk

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## To Date

The need for population estimates and measures of area type was demonstrated by Norman [1]. Essentially, at appropriate time points and by small geographical areas, populations by age and sex are needed as denominators in rates and area type measures, particularly deprivation measures, are needed as covariates in models. Various publications report on the production of a set of sub national small area population related resources for GB and the UK through the development of methods: for geographical harmonisation when small area boundaries change [2,3]; of populations by age and sex in terms of the estimation of the past [4-7] and projection of the future [8-11]; of the calculation of changing area deprivation [12]; and of the analysis of demographic change [13-15]. 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 [16]. In applied work, the resources have mainly been used for health related research of; infant mortality [17], all cause mortality [18,19], cause specific mortality [20]; limiting long-term illness and incapacity benefit [21-23], of children with life limiting conditions [24,25] and in small animal veterinary practice [26]. Further topics include small area analyses of local democracy [27], environmental equity [28], traffic accidents [29] and fire risk [30].

The examples above are area based; about whether aspects for small populations vary over space and time. Parallel to this, research has sought 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 [31,32] at different ages [33] or between urban and rural areas [34];

in different countries from where they were born [35,36]; who do not move residence [37]; or who are socially mobile [38]; and where linkages to residential areas need estimation when specific locations are unclear or names of places have changed [39]. Analogous situations for cardiovascular disease have been researched in New Zealand [40,41]. As knowledge of the availability of the demographic resources became more widely known, various researchers specified custom data requests for ongoing research. These resulting studies included research into general cancer [42-44]; specific cancers [45-51], coronary heart disease [52-54]; coronary intervention treatment [55,56], diabetes [57,58], asthma [59,60], hearing and visual impairment [61-63], muscular dystrophy [64] and neuromuscular disease [65].

## 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, Malleon & Clarke). Previous collaborators at Leeds (Mitchell; Feltbower & Parslow), York (Fraser) and at Newcastle (McNally & colleagues) needed updated information and fuller resources for ongoing research. There are also 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:

- a. 1971-2001 annual time-series of populations by five year age-groups and sex;
- b. Population density for the census years, 1971, 1981, 1991, 2001 and 2011;
- c. Deprivation scores and quantiles for the census years, 1971, 1981, 1991, 2001 and 2011;
- d. 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 Data zones 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 [66] for a solution using population surfaces across the UK. The development of the resources and initial analyses are reported in Norman [67] and Norman et al. [68] and have been used in studies of accessibility to sports facilities [69] and of inequities in improvements in air quality [70]. 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 [71] and an equivalent dataset for England and Wales for attachment to the ONS Longitudinal Study (via Dennett at Celsius).

## Conclusion

Populations by age and sex and measures of area type by time point and small area geographies have been used by the research community in the UK. Some of the work has been area based and some about outcomes for individuals and without the resources provided, the research could not have gone ahead so readily. The estimates and area type measures have recently been updated and extended to underpin current research. This work is ongoing and will be reported in time but the resources used as denominators and area types are now available freely to the wider research community. This short paper gives an overview of the relevant research and points others to the source of readily downloadable datasets [72].

## Acknowledgement

None.

## Conflict of Interest

None.

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