

Feedback Form

School of Geography
FACULTY OF ENVIRONMENT

UNIVERSITY OF LEEDS



Students to complete all of the following (or work will not be accepted)

Name (optional):

Richard Thomas

Student ID: 200818341	Assessment Name (e.g. Essay 2, Group Project etc): Assignment #1: Demographic profile
Degree Programme & Level (e.g. BA1 Geog): MSc GIS	Assessment Marker: Paul Norman
Module Title & Code: GEOG5240: Applied Population & Demographic Analysis	Word Count: (2,000 words max) 1973

Content, research and reading

Structure and argument

Writing, presentation and referencing

Areas for improvement to prioritise

Marker's signature:	Date:	Provisional mark:

Any mark given here is provisional and subject to moderation by the School's Board of Examiners. This is to ensure comparable marking standards for all students. In a minority of individual cases moderation can lead to either the raising or lowering of the provisional marks.

Demographic profile: geographical distributions of ethnicity, deprivation and health, Yorkshire 2001

INTRODUCTION

This report aims to investigate appropriate methodologies for taking meaningful measurements of ethnicity, deprivation and health across Yorkshire, aiming to simplify where possible to improve clarity, but to explore in detail unusual distributions. Inter-dependency of these factors are considered more qualitatively at the end of the report.

Figure 1 illustrates the area covered and how most of the population is located in the West Yorkshire Conurbation (including Bradford, Leeds and Wakefield) as well as the larger South Yorkshire settlements, particularly Sheffield.

Small area analysis of ethnicity and deprivation can be a better predictor of health (Bajekal, 2005) than focusing solely on individuals as it factors in contextual effects (physical and social environment); Bajekal identified wards as being an appropriate size for statistical validity and availability of data.

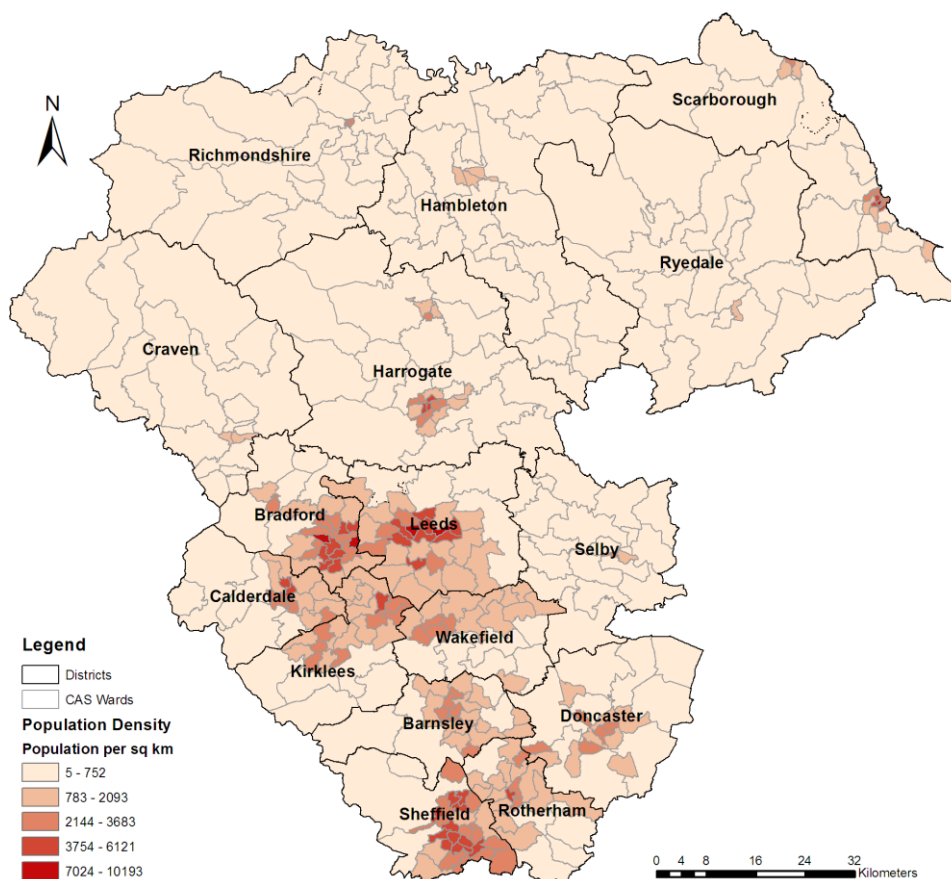


Figure 1: Population Density

DATA USED

- 2001 English Census data for CAS Wards (details in table 1)
- Boundary data supplied by Edina/UKBORDERS.
- Mortality taken from Vital Statistics pooled for 2000-2002

Table 1: 2001 Census data used for the Yorkshire and Humberside Government Office Region (GOR)

Census Table	Description
KS006	Ethnic group: All people
CS001	Age by sex and Resident Type: All people
ST017	Tenure and Age by General Health and Limiting Long-Term Illness (LLTI): All People in Households
KS008	Health and provision of unpaid care: All people

ETHNICITY

Methodology

The 16 ethnic groups of the 2001 census have been compressed into 7 broader ‘profiling’ groups (table 2) to simplify the data based on small group size or lack of spatial clustering as well as literature and basic statistical calculations.

Table 2: Population of Yorkshire & Humberside Government Office Region (GOR) by ethnic groups

Census Group	%GOR	Profiling Group	%GOR	Reason for Profiling Grouping
White British	90.3	White	92.2	Little clustering seen for non-British whites (max concentration in any ward is 2.3% of GOR total).
White Irish	0.7			
Other White	1.2			
White & Black Caribbean	0.4	Mixed	1.0	Max ward concentration of any mixed subgroup is 3.3% GOR total. Dobbs et al (2006, p44) reports ‘Mixed’ and ‘Chinese’ most spread out groups, so not expecting clustering of any ‘Mixed’ subgroup.
White & Black African	0.1			
White & Asian	0.3			
Other Mixed	0.2			
Indian	1.2	Indian	1.2	Johnston et al (2002) reports “polarised enclave” in Kirklees in 1991 census
Pakistani	3.7	Pakistani	3.7	“Ghetto” in Bradford in 1991 census (Johnston et al, 2002). Dobbs et al (2006, p44) reports this as one of few non-white groups in majority.
Bangladeshi	0.3	Bangladeshi	0.3	Rapid expansion of group in 1980s due to immigration (Dobbs et al, 2006, p31), so expect clustering due to young population (naturally high

				birth and low death rate). Small group outside London, but tend to live in “polarised enclaves” (Johnston et al, 2002).
Black Caribbean	0.5	Black	0.8	Little evidence of black segregation in England (Johnston et al, 2002)
Black African	0.2			
Other Black	0.1			
Chinese	0.3	Chinese / Other	0.7	‘Other Asian’ included here as this study measured a more even spread than (and with no strong correlations to) other specified Asian groups. Johnston et al (2002) notes Chinese generally widely spread residentially despite “Chinatowns” in many cities.
Other Asian	0.3			
Other Ethnic Group	0.2			

The white ethnic group is by far the biggest, so the analysis concentrates on unusual concentrations of non-whites. Several measures were generated (table 3) to explore distributions.

Table 3: Calculations used to generate maps in Ethnicity section

Ethnic Group Population Measure	Calculation	Use
Distribution across GOR	$\text{Ward_Sum}(\text{Ethnic Group}) / \text{GOR_Population}(\text{Ethnic Group})$	Indicates if a group is clustered in certain wards within region
Proportion within CAS Wards	$\text{Ward_Sum}(\text{Ethnic Group}) / \text{Ward_Population}(\text{All Groups})$	Indicates if a group is a significant proportion of the local population (in an extreme this would be a ghetto)
Index of Diversity	$1 - \text{Sum_over_all_profiling_groups} \{ (\text{Proportion within CAS Wards})^2 \}$	Probability (0..1) that any 2 people independently selected will be of different ethnic profiling groups.

Results and Analysis

Selected distribution and ward-proportion measures are presented below. For the South Asian groups there is a relatively small population and no marked clustering outside of the major conurbations, so maps are zoomed in to detail. Interval ranges are selected using the ‘Natural Break (Jenks)’ method to highlights characteristic value clustering.

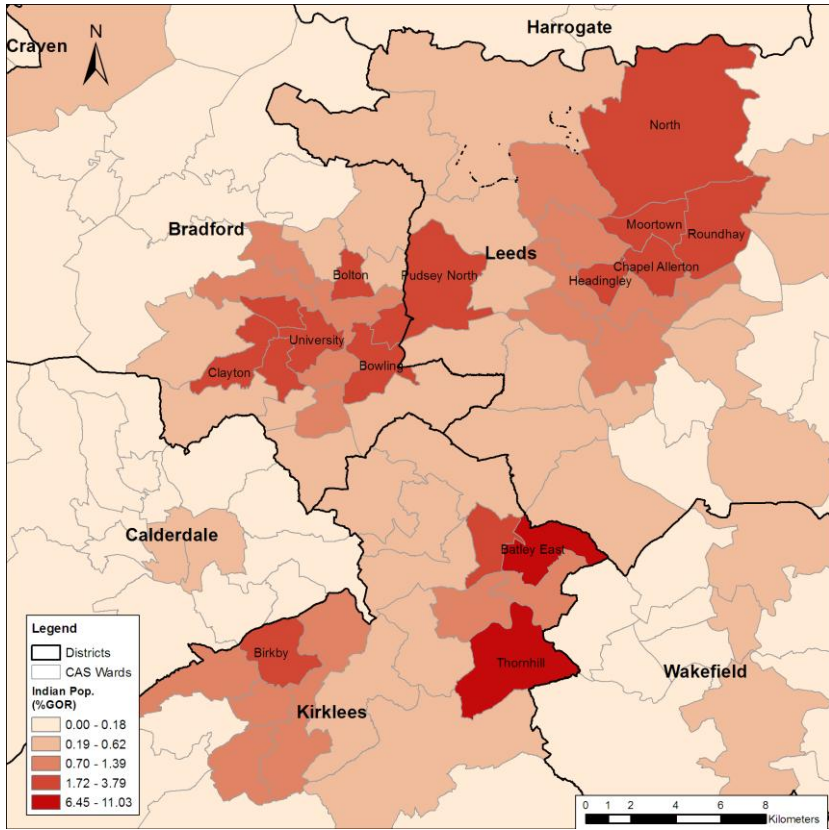


Figure 3: Indian distribution across GOR (zoomed in on major clusters)

Indian: Indian immigrants were the first of the South Asian groups to arrive in the 1960s, but there are still some surprisingly tight clusters. The largest distributions of this ethnic group are in wards Thornhill (6.5%) and Batley East (11.0%), where they form a significant fraction of the ward population (17.2% and 28.2% respectively). This tallies closely with the Kirklees Indian “polarized enclave” seen by Johnston et al (2002) in the 1991 census data, which analyzed smaller Enumeration Districts (EDs) – thus this is not likely to be a quirk of area size selected.

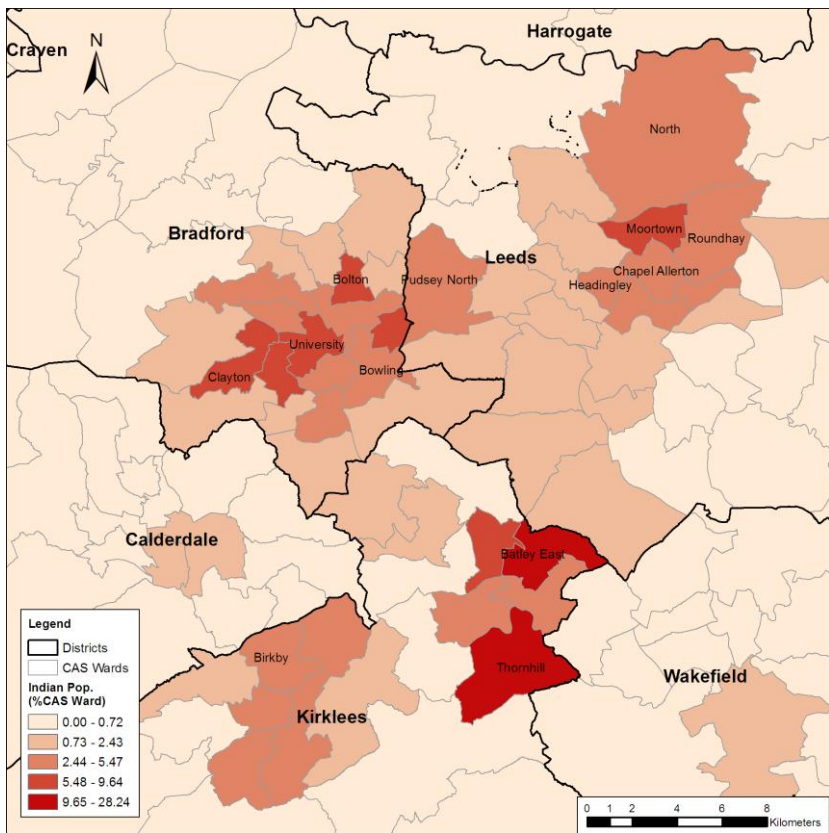


Figure 2: Indian proportion within CAS Wards

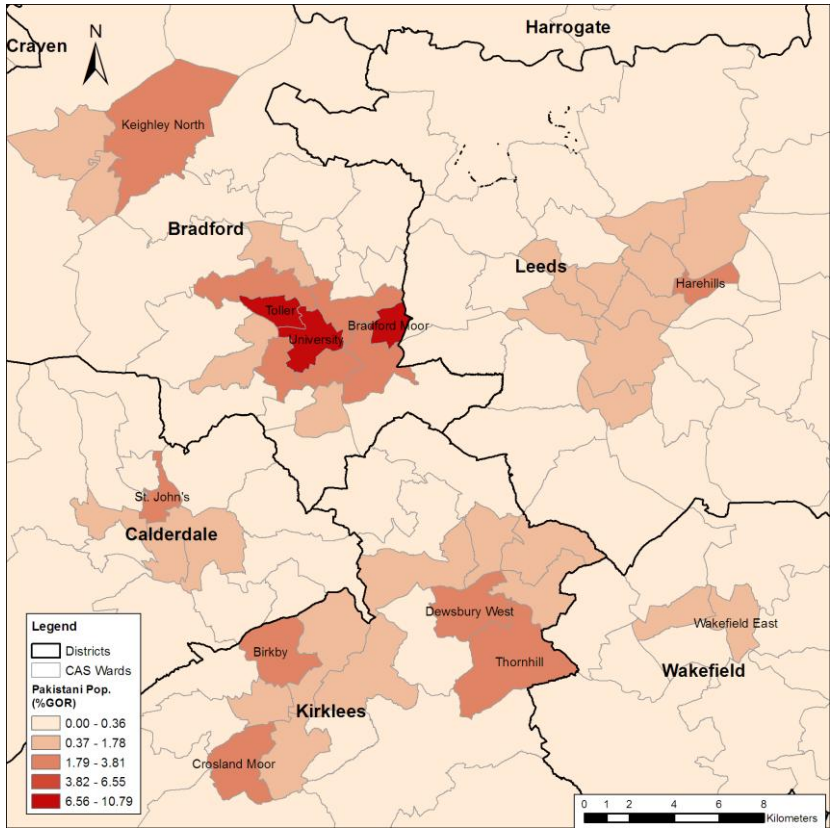


Figure 5: Pakistani distribution across GOR (zoomed in on major clusters)

Pakistani: this is the most intensely clustered non-white ethnic group in the study, particularly in Bradford wards of ‘Toller’ and ‘University’ where it forms 62% and 54.9% respectively of ward populations. This tallies with the findings of Johnston et al (2002) whose definitions rated this as the only “ghetto” in the region.

This is also one of the few ethnic groups in majority in an MSOA (Dobbs et al, 2006), showing that the result is not a quirk of area size chosen.

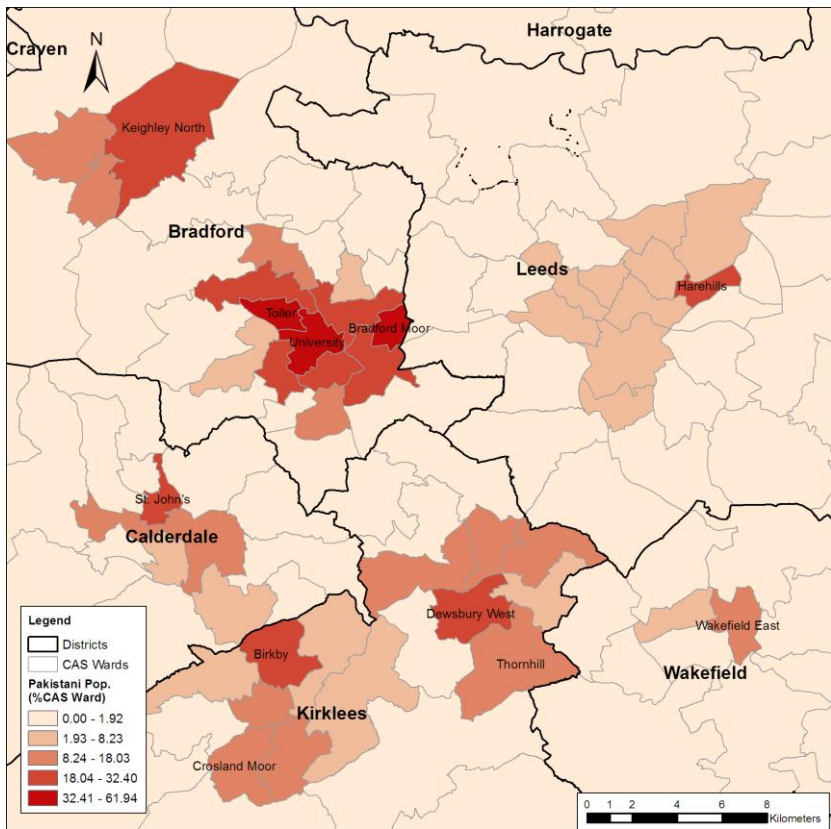


Figure 4: Pakistani proportion within CAS Wards

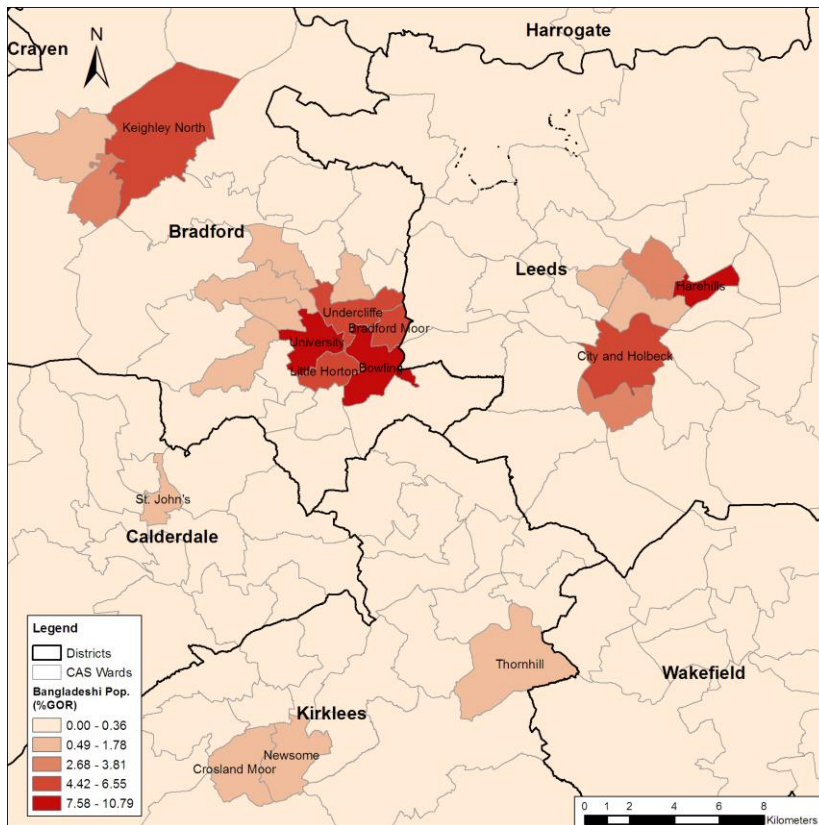


Figure 7: Bangladeshi distribution across GOR (zoomed in on major clusters)

Bangladeshi: although forming much smaller proportions of wards than Indian or Pakistani groups, Bangladeshis are particularly closely clustered in some of the same wards in Bradford and the Leeds 'Harehills' ward.

If smaller area sizes are used in an analysis, there would naturally be an increase in apparent clustering. Simpson (2007) noted that although the increase is usually similar for different ethnic groups, it is much greater for Bangladeshis, suggesting smaller more localized clusters.

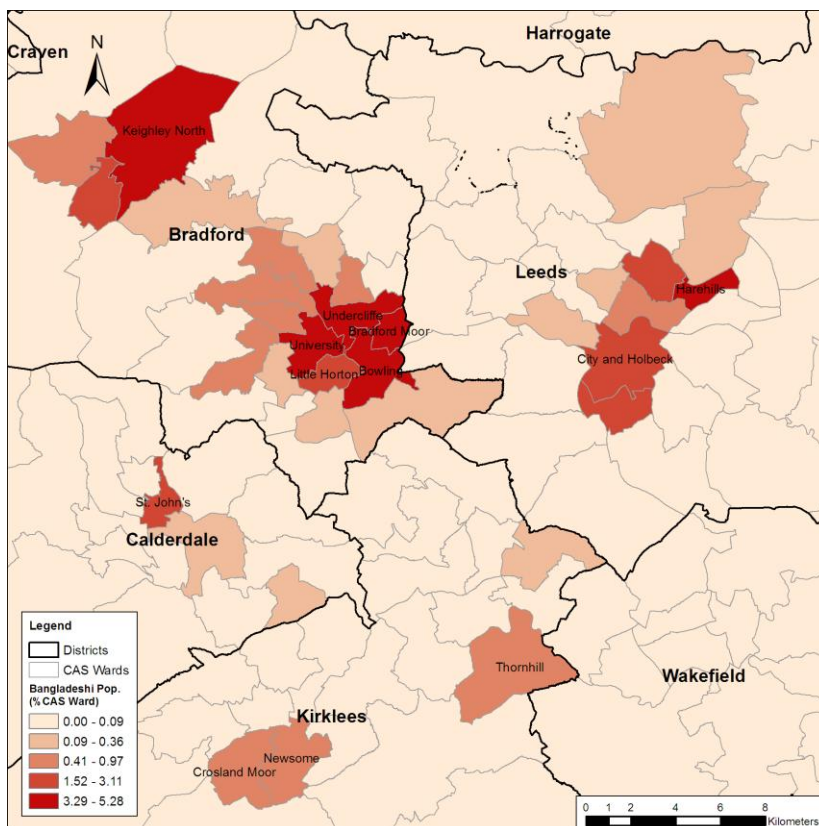


Figure 6: Bangladeshi proportion within CAS Wards

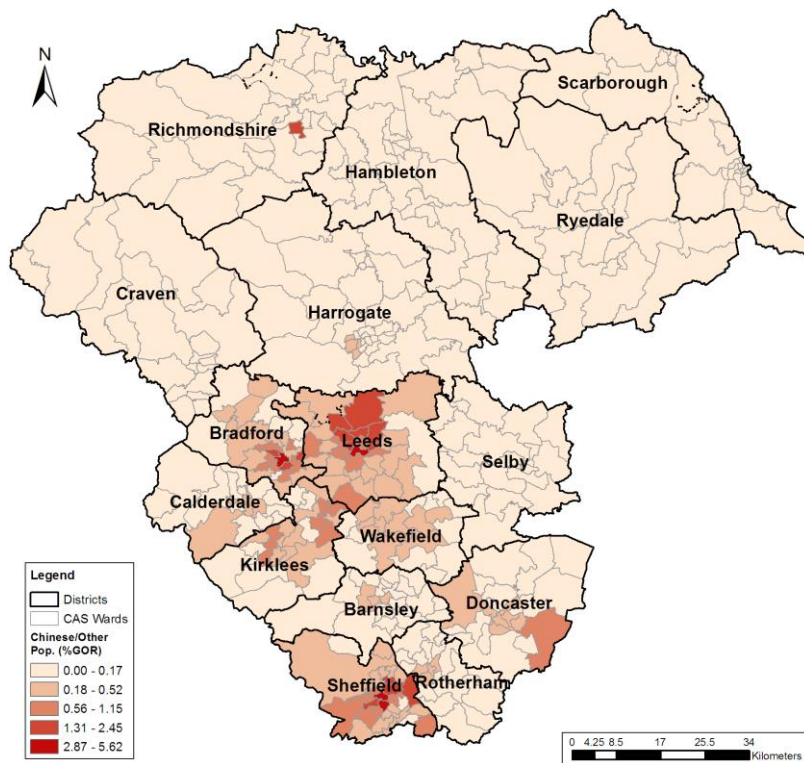


Figure 8: Chinese & Other distribution across GOR

Chinese: although generally more widely spread than other immigrant groups (Dobbs et al, 2006), there are intense clusters centred on the 3 university sites of Leeds, Bradford and Sheffield suggesting a Chinese population dominated by students. The cluster near Richmond is at the Catterick army barracks.

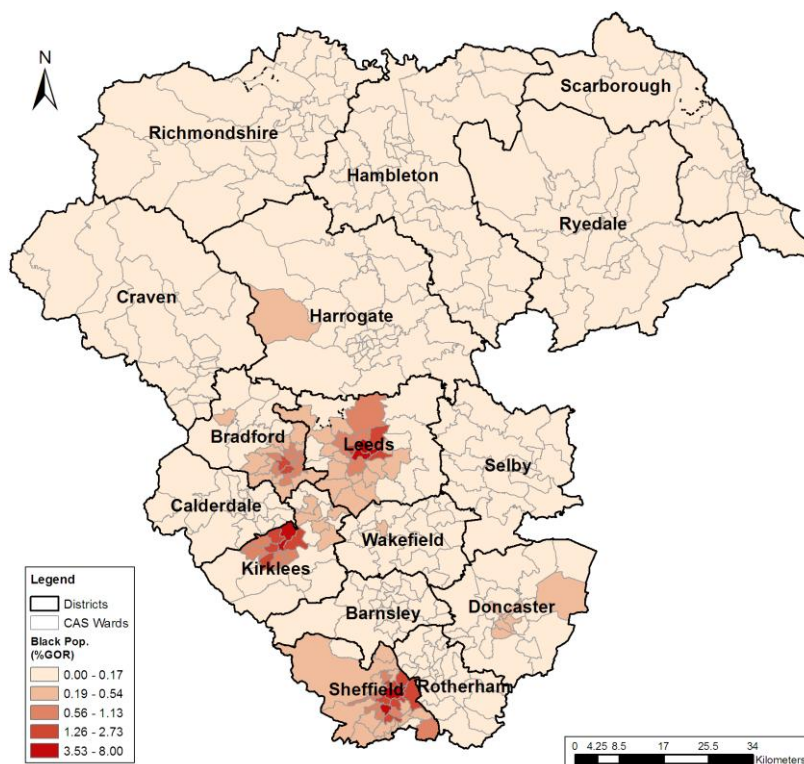


Figure 9: Black distribution across GOR

Black: as the first large post-war immigrant group (Johnston et al, 2002), the wide distribution of this group might be expected due to increased integration. In the Black CAS Ward proportion map (not shown), there is also a peak at the Catterick army barracks. This is somewhat surprising as in the 2001 census, the army had only 6.9% from ethnic minorities, lower than the 7.9% of the UK population as a whole (Wainman et al, 2005, p157).

Areas north of the Leeds/Bradford area are not displayed as they show very little diversity.

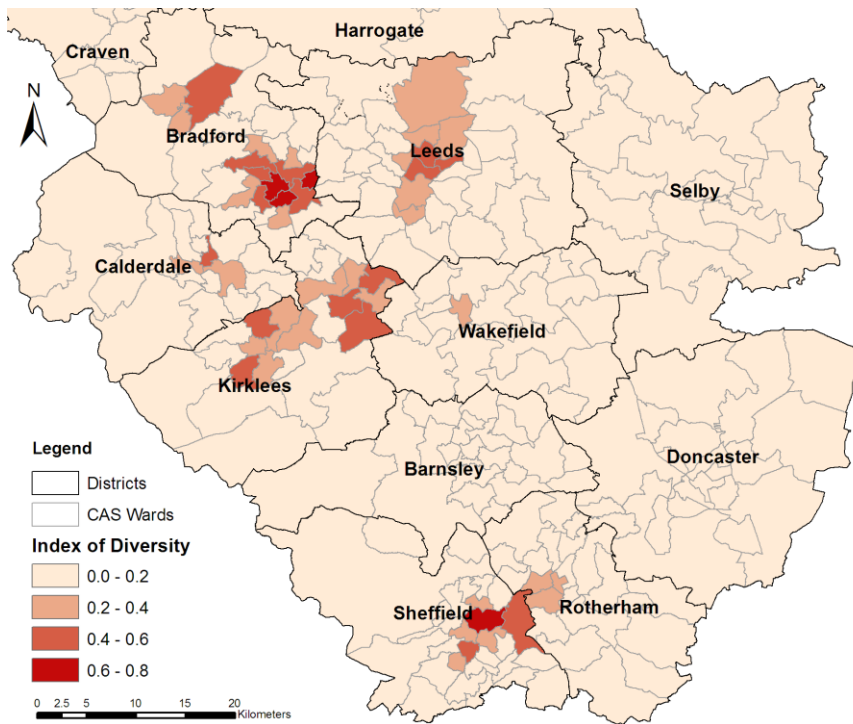


Figure 10: Ethnic diversity in GOR (zoomed in to show peaks only)

Ethnic diversity is high around university centres and areas with large migrant populations. 18.0% of all students over 16 in the UK were from non-White ethnic groups (Wainman et al, 2005, p165).

Note that this diversity measure does not necessarily indicate how multi-cultural an area is – high diversity is often where population is polarised to just two groups.

Although we would expect the proportion of ethnic

group distribution to be lowest in rural area due to low general population (see figure 1), low diversity and low CAS ward proportions for most ethnic groups (except ‘Chinese and Others’) indicates a distinct absence (exclusion?) of these ethnic groups from rural areas.

Concerns are sometimes raised about whether certain ethnic groups are self-segregating. This diversity index cannot be used to determine that (Simpson, 2007) – a longitudinal survey would be required, though this is difficult to implement with census data due to boundary changes and 10 year separations. Any such segregation can be due to choice (such as community) or constraints (such as harassment, deprivation) (Dobbs et al, 2006). For a more recent immigrant population with a consequently young age-structure (like the Bangladeshi one), increased clustering may also be a reflection of natural high birth and low death rates (Simpson, 2007).

DEPRIVATION

Methodology: constructing a deprivation index

"Deprivation is not easy to measure: it depends on what you want to find" (Lee, 1999). Thus for this study a suitable index might indicate any disadvantage associated with ethnic minority clusters and any increased risk of poor health outcomes. However it is important not to effectively count twice by inclusion of correlated variables such as direct health measures. Table 4 describes the composition of some popular indices and a proposed 'alternative', with detailed calculations (and justifications for each variable) outlined in table 5.

Table 4: Composition of Selected Deprivation Indices

Index	Census Statistic Components	Notes
Townsend	Overcrowding, No Car, Unemployment, Non-home Ownership	Defined in Townsend (1987) and became health authorities favoured index (Mackenzie et al, 1998), though Jarman index used for GP funding.
Carstairs	Overcrowding, No Car, (Male) Unemployment, Low Social Class (class IV or V)	Defined in Carstairs and Morris (1989). Low social class based on occupation of Household Representative Person (HRP) only. Owner-occupier not used as public housing seen as more popular in Scotland.
Breadline Britain	Unemployment, No Car, Non-home Ownership, Low Social Class (class IV or V), Lone Parents, Limiting Long-Term Illness (LLTI)	Defined in Gordon (1995). Popular in media (Mackenzie et al, 1998). Components weighted based on interviews with large sample population. "Conceptually robust. However the index is not standardised to take into account variations in ward size and this has meant that it is more sensitive to small areas" (Lee, 1999) => will shy away from highlighting rural deprivation. Inclusion of LLTI makes it unsuitable for predicting health outcomes. Senior (2002) favours as clear focus in estimating poverty and has been validated against that.
Index of Multiple Deprivation (IMD)	(based on administrative data not census)	Defined in (Noble et al, 2006). "government's current preferred indicator of deprivation in England" (Norman, 2010). "The IMD includes a 'health' component which makes use of the overall scores in health analysis conceptually problematic." (Morgan and Baker, 2006).
Alternative (proposal for this report)	Overcrowding, No Car, Unemployment, Non-home Ownership, Low Social Class (NS-Sec based)	low social class used in breadline + now more usefully related to deprivation as not just occupation. Carstairs justification for removing non-home ownership seems unjustified.

Table 5: Calculations for selected deprivation index from census 'Key Statistics' tables

Variable	Calculations	Comment
Unemployment	$\frac{\text{ks09a0005(Unemployed)}}{\text{(Economically Active)}}$ <p>where 'Economically Active' = ks09a0002(Part-time Employees) + ks09a0003(Full-time Employees) + ks09a0004(Self-employed) + ks09a0005(Unemployed) + ks09a0006(Full-time students also working)</p>	Not using just male unemployment (as in Carstairs) as difficult to justify given increases in number of women working (and working longer hours) in the 25 years since Carstairs index created.
Overcrowding	$\frac{\text{ks0190004(Occupancy rating < 0)}}{\text{ks0190001(All Households)}}$	New 'Occupancy rating' measure is more representative of overcrowding as it determines rooms required based on ages and relationships of members of household (ONS, 2004, p38)
No Car	$\frac{\text{ks0170002(No Car)}}{\text{ks0170001(All Households)}}$	Seen as a major proxy indicator for deprivation by many indexes, despite criticism of "urban bias" (Senior, 2002, p134).
Non-home Ownership	$\frac{\{ \text{ks0180001(All Households)} - \text{ks0180002(Owns outright)} - \text{ks0180003(Owns with mortgage)} - \text{ks0180004(Shared ownership)} \}}{\text{ks0190001(All Households)}}$	Carstairs' justification for removing this is less relevant in England. Also council housing "Right to Buy" programmes from the 1980s may indicate the less deprived as being ones to take up the offer.
Low Social Class	$\frac{\{ \text{ks14a0007(Lower supervisory and technical occupations)} + \text{ks14a0008(Semi-routine occupations)} + \text{ks14a0009(Routine Occupations)} + \text{ks14a0010(Never worked)} + \text{ks14a0011(Long-term unemployed)} \}}{\{ \text{All 16-74 (ks14a0001)} - \text{Not Classifiable(ks14a0013)} \}}$	<p>"association of inequalities in health with measures of socio-economic status is well established." (Bajekal, 2005).</p> <p>Lowest of 3-way NS-SeC grouping (not mapping of NS-SeC to old-style SC). Not just HRP either.</p> <p>'Not Classifiable' removed from denominator as this will include many normally retired people.</p>
Transformation	<p>For skewed variables (Unemployment, Overcrowding)</p> $\text{Var}^T = \log_e(\text{Var} + 1)$ <p>For other variables, no transformation needed:</p> $\text{Var}^T = \text{Var}$	Gilthorpe (1995) highlights that in composite indices variables with significant skew must be transformed to remove skew to avoid exaggeration of the relative dispersion of that variable compared to other components. Histograms of the above five variables were examined

		indicating significant skew for only 'Unemployment' and 'Overcrowding'.
Standardisation	$\text{Var}^S = \{ (\text{Var}^T(\text{observed}) - \text{Mean}(\text{all Var}^T)) / \text{Standard Deviation}(\text{all Var}^T) \}$	Applied to all transformed component variables to avoid unintended weighting of any variables.
Summation	Index = sum of standardised variables Var^S	Absolute value of resulting index has little meaning, but allows ranking to determine relative deprivation.

In the 2001 census, the 'Social Class based on Occupation' (SC) was replaced by 'National Statistics Socio-economic Classification' (NS-SeC). This aims to have a "conceptual rationale" (Rose et al, 2005, p11) incorporating elements of contract security, flexibility and value in addition to just occupation. Although lookup tables are provided (and census data available) to map NS-SeC quite closely to the previous definition of 'low social class' (SC IV & V), it appears better to select the lowest of the 3-class version (the only one to be considered ordinal) of NS-SeC despite the caveats given that this includes long-term unemployed (Rose et al, 2005, p37) as for the 2001 census, people unemployed for less than 5 years were classified by their last job.

Results and Analysis

To give an indication of the sensitivity of indices to variables chosen, the 'Townsend' index is mapped in addition to the new 'Alternative' proposal. For areas of highest deprivation – mainly in built up areas – the results are very similar. However, across more sparsely populated rural areas there are many differences mainly in lower quintiles. (Using quintiles by population count (rather than ward count) would thus just increase the number of wards appearing in lower quintiles).

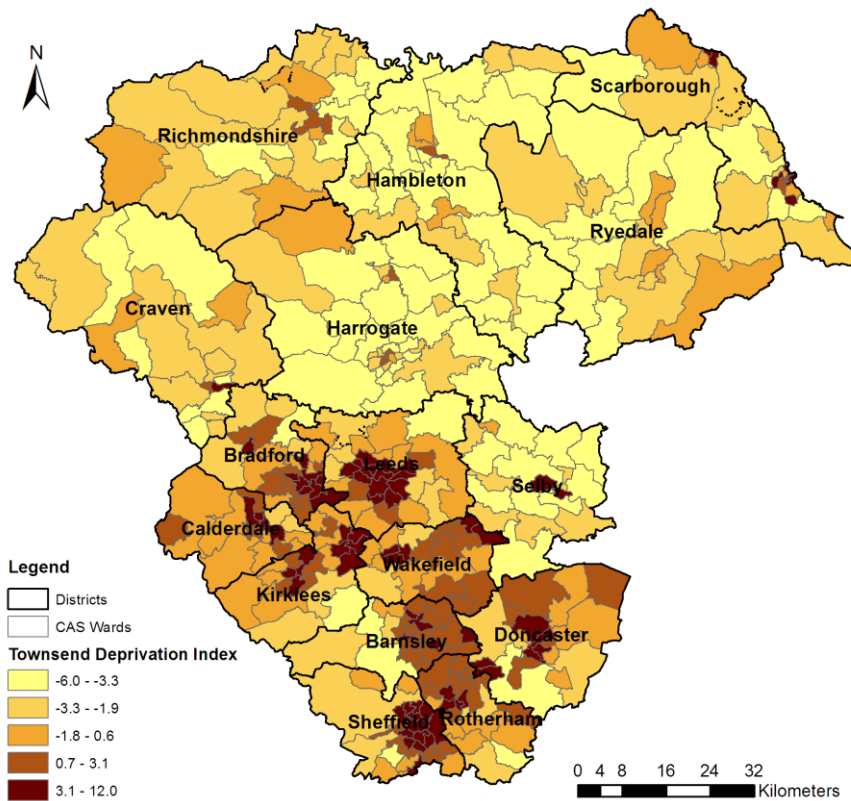


Figure 12: Townsend Deprivation Index (Quintiles by Ward Count)

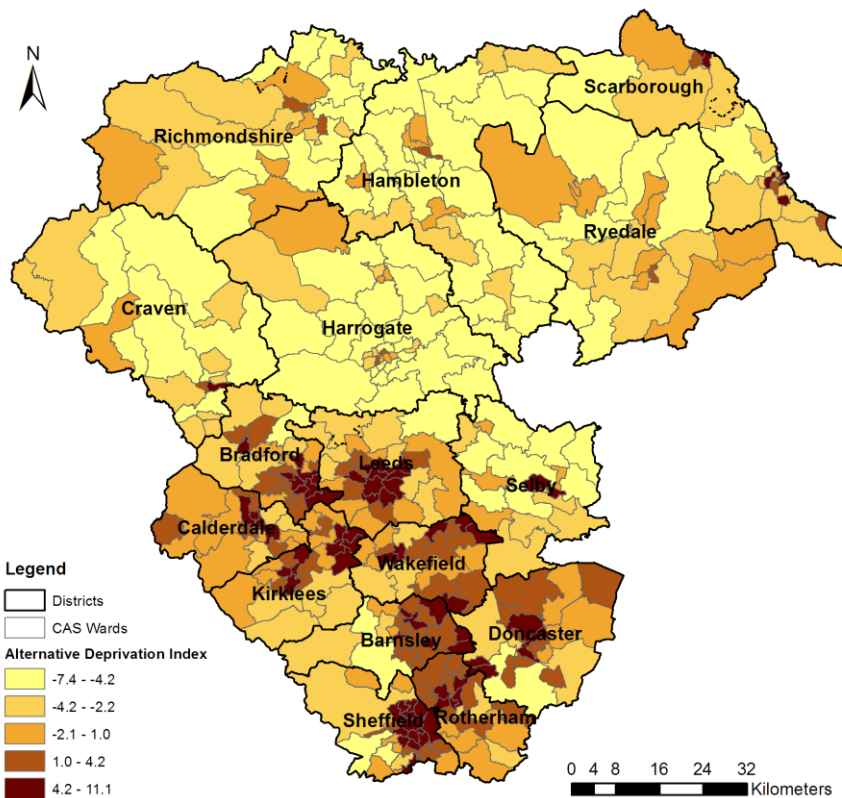


Figure 11: Alternative Deprivation Index (Quintiles by Ward Count)

Deprivation is focused on built-up areas (even though each variable was scaled for population). Harrogate (as a relatively affluent city) is a notable exception.

Most of the areas of high concentrations of Asian ethnic groups are notably high on the deprivation index. In addition there is high deprivation in Selby, Wakefield and Barnsley which were major centres of the coal industry and Sheffield which was a major steel producer. This deprivation might plausibly be linked to the rapid decline of these industries in the 1980s.

Two non-industrialized and not heavily built up areas with top-quintile deprivation are on the

east coast at Whitby, plus (slightly less deprived) around Scarborough. These feature a large population of retired people.

Note that a significant problem with deprivation indices is the difficulty in estimating the likelihood of individuals in 'deprived areas' actually being deprived (Lee, 1999). Conversely many deprived individuals will live outside these areas. Thus care must be taken to consider individuals as well as areas when making deprivation-related policy.

HEALTH

Although the 2001 census included questions on general health, the recording of Limiting Long-Term Illness (LLTI) is both less subjective and more serious – though 18% of the UK population recorded an LLTI (Bajekal et al, 2006). Crude rates (instances/ward populations) of LLTI and deaths can give an indication of the requirement for provision of services. However, where local population age-structures are unusual (such as the more youthful Bangladeshi immigrant populations, or older retired populations on the east coast) crude rates can give a misleading idea of local health/death risks. This can be overcome by adjusting for age-structures with standardized illness (SIR) and mortality (SMR) rates. Table 6 outlines the calculations done.

Table 6: Calculations for illness and death rates (with census table codes)

Variable	Calculations
National Deaths(Age group)	(From 'Vital Statistics' pooled for 2000-2002)
Total Population(Age group) ¹	cs0010006(all people age 0-4) ... cs0010221(all people age 90+)
National LLTI(Age group)	st0170014(LLTI age 0-4) ... st0170058(LLTI age 85+)
Observed LLTI(Ward)	ks0080002(People with limiting long term illness)
National LLTI Rate(Age group)	National LLTI(Age group) / Total Population(Age group)
National Death Rate(Age group)	National Deaths(Age group) / Total Population(Age group)
Expected LLTI(Ward, Age group)	National LLTI Rate(Age group) * Total Population(Ward, Age group)
Expected Deaths(Ward, Age group)	National Death Rate(Age group) * Total Population(Ward, Age group)
Expected LLTI(Ward)	Sum over all Age groups { Expected LLTI (Ward, Age group) }
Expected Deaths(Ward)	Sum over all Age groups { Expected Deaths(Ward, Age group) }
Indirect SIR(Ward)	Observed LLTI(Ward) / Expected LLTI(Ward)

¹ Age groups 85-89 and 90+ must be collapsed to single 85+ group to match other variables

Indirect SMR(Ward)	$\frac{\text{Observed Deaths(Ward)}}{\text{Expected Deaths(Ward)}}$
Crude LLTI Rate (Ward)	$\frac{\text{Observed LLTI(Ward)}}{\text{Total Population(Ward)}}$
Crude Mortality Rate (Ward)	$\frac{\text{Observed Deaths(Ward)}}{\text{Total Population(Ward)}}$

Figures 13 and 14 illustrate these rates across the region, with value intervals set using ‘Natural Breaks (Jenks)’ algorithm to highlight any clustering of values.

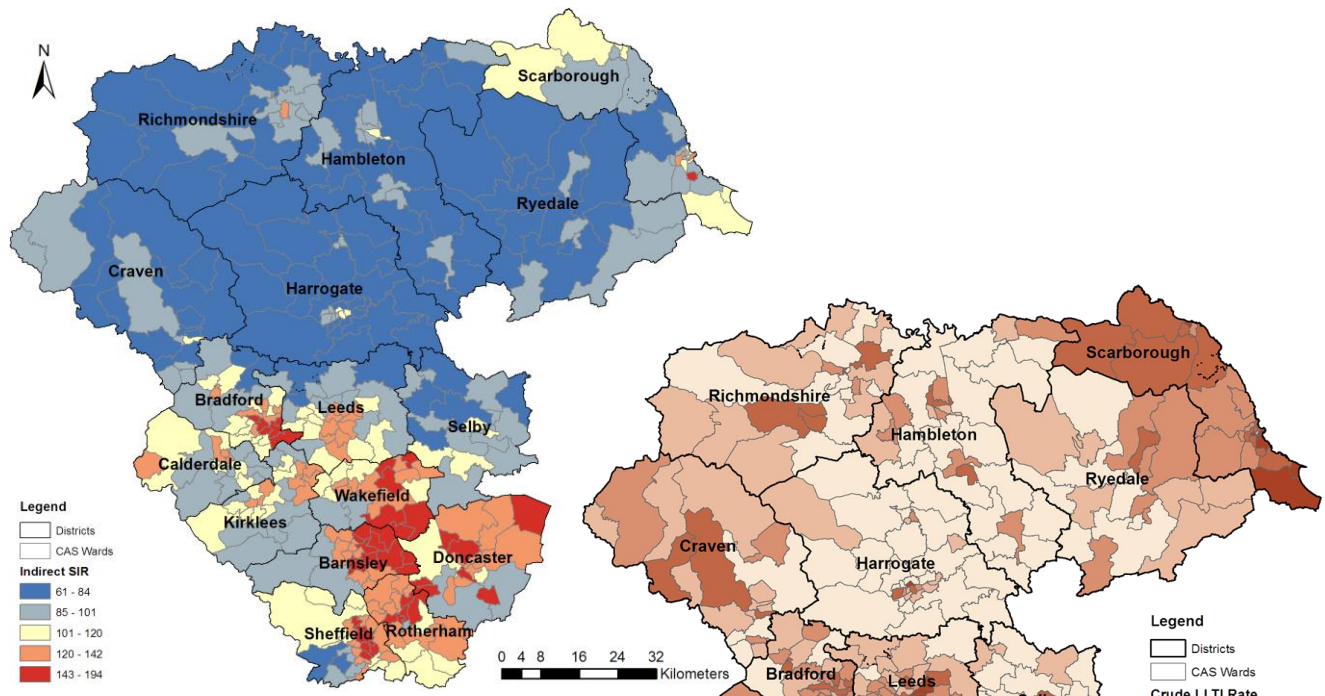


Figure 13: Crude and Indirect Standardised (SIR) Illness Rates

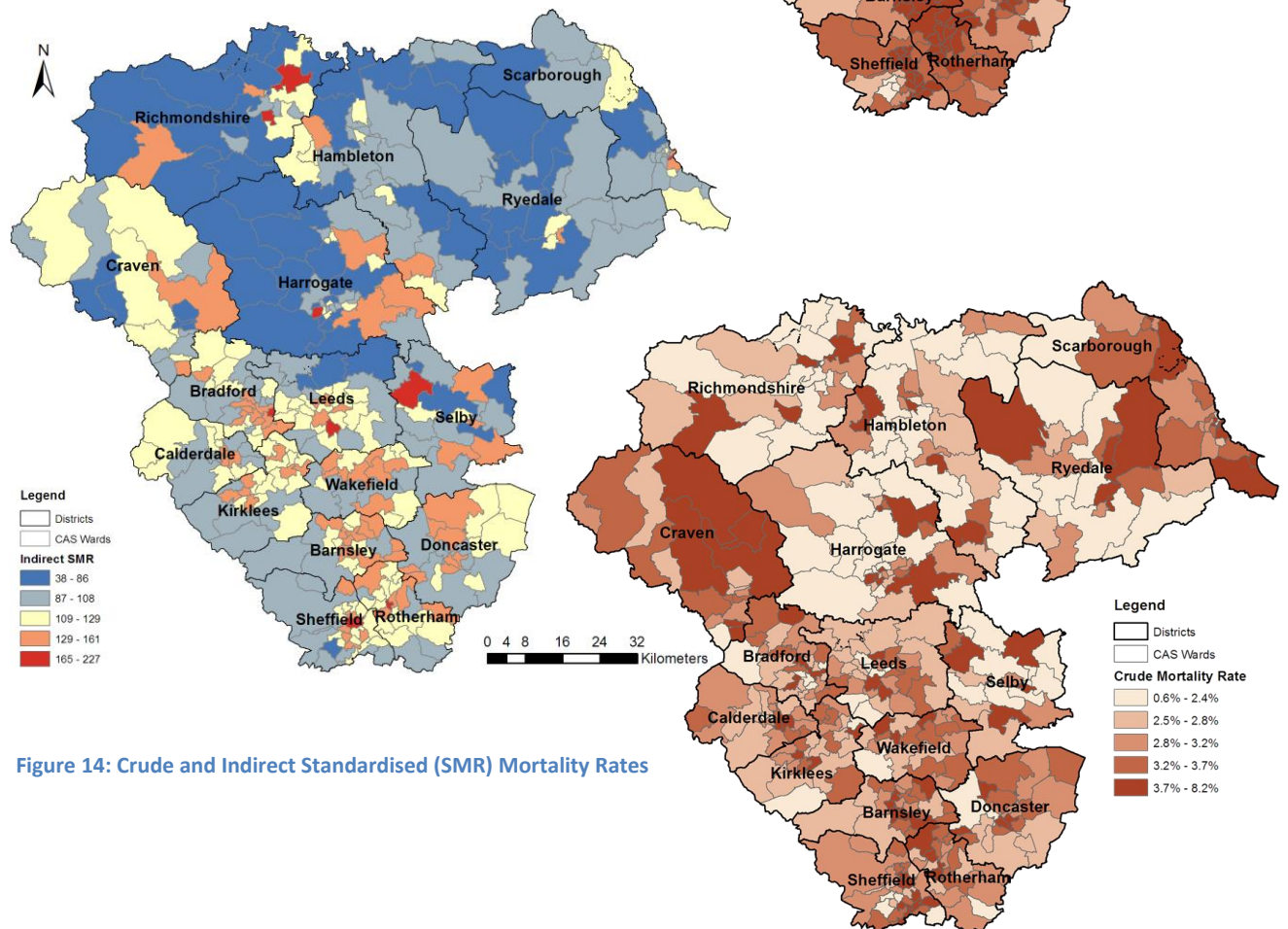


Figure 14: Crude and Indirect Standardised (SMR) Mortality Rates

Illness rates indicated by the SIR map are largely focused on the areas of textile mills (particularly Bradford), coal mining and the steel industry which Charlton et al (1994) note have a “strong association with long-term illness”. By comparison the map of Crude LLTI shows very high illness rates on the east coast which Charlton et al (1994) note can largely be accounted for by the large retired populations. Somewhat surprisingly, death rates – even in standardized SMR form – show the highest peaks in quite different areas to any of high SIR, high deprivation or ethnic clusters. Several of these are away from the built-up areas of the region.

COMPARING DISTRIBUTIONS

Although deprivation is often prevalent in areas of South Asian ethnic concentration, the fact that it is also significant in coal mining and heavy industry suggest that the general decline in manufacturing may be a strong factor.

Strong associations of ethnicity and health are also visible. Charlton et al (1994) noted that LLTI rates were highest for Bangladeshi men and Pakistani women. Similarly, Bajekal et al (2006) noted a 20% LLTI rate amongst Asians.

Adding to the observations of apparent associations for health outcomes in the previous section, there is a wealth of literature confirming this. Carstairs (1995) confirmed a definite effect of deprivation on mortality. Bajekal et al (2006) noted evidence for independent associations between separate specific measures of deprivation (including unemployment, deprived housing, social housing) and corresponding highest rates of LLTIs. Howden-Chapman (2004) noted that the selling off of better quality council housing has led to concentration of poorer tenants in more deprived areas.

For a more methodical comparison of ethnicity and health, census table CT003 (Theme Table On Ethnic Group – People) which includes general health and LLTI could be analysed. Similarly, for comparison of ethnicity and deprivation CT004 (Theme Table On Ethnic Group (of Household Reference Person)) could be used. However, care would be needed in handling standardization between ethnic groups and to deal with the likelihood of errors (or significance problems) due to small counts in some fields.

CONCLUSIONS

There is distinct clustering of South Asian ethnic groups; consideration should be given to how much this is a concern in itself (are they causing problems?) or indicative of other problems such as discrimination (even if not overt). The apparent association of deprivation with both South Asian ethnic group clusters and areas of declining industry suggests that care should be taken in exploring the root cause(s) - a common approach to deprivation reduction may not be appropriate. Even without applying the more methodical comparisons, it is clear that ethnicity and deprivation have a strong effect on health. However, marked differences between illness and mortality rates reinforces the suggestion of Bajekal (2005) that a measure of **healthy** life expectancy would be a good basis for any area-based provision of health resources.

ACKNOWLEDGEMENTS

This work used Census data obtained via MIMAS' CASWEB facility and GIS boundary data obtained via EDINA's UKBORDERS facility; services supported by ESRC and JISC. Census and Vital Statistics data for England and Wales, Scotland and Northern Ireland have been provided by the ONS, GROS and NISRA and the digital boundary data by OSGB and OSNI. These data are Crown copyright and are reproduced with permission of OPSI.

REFERENCES

- Bajekal, M. 2005. Healthy life expectancy by area deprivation: magnitude and trends in England, 1994-1999. *Health Statistics Quarterly*. **25**, p18.
- Bajekal, M., Osborne, V., Yar, M. and Meltzer, H. 2006. *Focus on health*. HMSO.
- Carstairs, V. 1995. Deprivation indices: their interpretation and use in relation to health. *Journal of Epidemiology and Community Health*. **49**(Suppl 2), pp.S3-S8.
- Carstairs, V. and Morris, R. 1989. Deprivation: explaining differences in mortality between Scotland and England and Wales. *BMJ: British Medical Journal*. **299**(6704), p886.
- Charlton, J., Wallace, M. and White, I. 1994. Long-term illness: results from the 1991 census. *Population Trends*. (75), pp.18-25.
- Darwin, C. 1859. *On the origins of species by means of natural selection*. London: Murray.
- Dobbs, J., Green, H., Zealey, L. and Britain, G. 2006. *Focus on ethnicity and religion*. Palgrave Macmillan.
- Gilthorpe, M.S. 1995. The importance of normalisation in the construction of deprivation indices. *Journal of Epidemiology and Community Health*. **49**(Suppl 2), pp.S45-S50.
- Gordon, D. 1995. Census based deprivation indices: their weighting and validation. *Journal of Epidemiology and Community Health*. **49**(Suppl 2), pp.S39-S44.
- Howden-Chapman, P. 2004. Housing standards: a glossary of housing and health. *Journal of epidemiology and Community health*. **58**(3), pp.162-168.
- Johnston, R., Forrest, J. and Poulsen, M. 2002. Are there ethnic enclaves/ghettos in English cities? *Urban Studies*. **39**(4), pp.591-618.
- Lee, P. 1999. Where are the deprived? Measuring deprivation in cities and regions. *Statistics in Society: The Arithmetic of Politics*. pp.172-180.
- Mackenzie, I.F., Nelder, R., Maconachie, M. and Radford, G. 1998. My ward is more deprived than yours. *Journal of Public Health*. **20**(2), pp.186-190.
- Morgan, O. and Baker, A. 2006. Measuring deprivation in England and Wales using 2001 Carstairs scores. *Health Stat Q*. **31**, pp.28-33.
- Noble, M., Wright, G., Smith, G. and Dibben, C. 2006. Measuring multiple deprivation at the small-area level. *Environment and Planning A*. **38**(1), p169.
- Norman, P. 2010. Identifying change over time in small area socio-economic deprivation. *Applied Spatial Analysis and Policy*. **3**(2-3), pp.107-138.
- ONS. 2004. Census 2001 Definitions. [Online]. [Accessed 24 February 2014]. Available from: <http://www.ons.gov.uk/>
- Rose, D., Pevalin, D.J., O'Reilly, K. and Britain, G. 2005. *The national statistics socio-economic classification: origins, development and use*. Palgrave Macmillan Basingstoke.
- Senior, M. 2002. Deprivation indicators. *The census data system*. pp.123-139.
- Simpson, L. 2004. Statistics of racial segregation: measures, evidence and policy. *Urban studies*. **41**(3), pp.661-681.
- Simpson, L. 2007. Ghettos of the mind: the empirical behaviour of indices of segregation and diversity. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*. **170**(2), pp.405-424.
- Townsend, P. 1987. Deprivation. *Journal of social policy*. **16**(2), pp.125-146.

Wainman, G. Ambrose, F. and Jefferies, J. 2005. *Focus on People and Migration: Special and Communal Populations*. HMSO