Exploring the impact of public services on quality of life indicators: the case of health

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(1) Introduction

The fundamental aim of public services is to improve the quality of life of citizens. Quality of life is a multi-dimensional concept, covering aspects such as health and social well-being, economic well-being, education, the nature of the environment, access to transport, and security and safety. Our overall aim in this study is to investigate the contribution of a range of public service organisations to the quality of life of citizens across **all** these dimensions.

Our study has been designed to address two particular issues related to this broad aim. First, we explore a broad range of quality of life domains rather than restricting our analysis only to health related quality of life and we also consider a range of public sector organisations, not just health care providers. This is a useful approach both because public sector organisations may impact on more than one dimension of quality of life; and also because the overall quality of life experienced by citizens will depend on more than one aspect of their living and working environment. Over the last decade with the advent of the modernisation agenda, there has been increasing emphasis on the need for partnerships between organisations and for policy to be developed and implemented across the traditional sector boundaries. In particular, local authorities have been charged with promoting the well-being of their area and this explicitly entails working with other agencies (in strategic partnerships) - even where boundaries are not coterminous - in order to develop sustainable community strategies that address the full range of quality of life issues. Partnerships between organisations have been seen as a major tool for delivering change at local level and have been formalised in many sectors (Glendinning, Powell, Rummery 2002; Audit Commission, 2005). However, despite the policy emphasis on "joined-up thinking", the extensive partnership agenda and the recognition of the need to work across traditional public sector boundaries, policies are still often developed largely within their main domain and the performance of public services tends to be measured by the impact in their specific context, rather than across other domains. Although our study cannot by itself evaluate the effectiveness of individual policy initiatives, by focusing on a range of organisations we hope to shed light on the impact of public policy. In addressing a wider arrange of quality of life indicators we are recognising that quality of life is multi-dimensional and encompasses many facets of life beyond health related quality of life (Phillips 2006).

The second characteristic of our study is that it seeks to address the **level** at which the quality of life of citizens may be influenced. Public services are organised at a variety of geographical and organisational levels such as local authority and PCT areas. The level at which influences on quality of life can be exerted may vary across organisations and with aspects of quality of life. Our aim is to look at the sources of variation in quality of life indicators and attempt to pinpoint the level at which policy

might potentially have most influence. The increasing emphasis on notions of "community" and "neighbourhood" as levels at which community cohesion and social capital are fostered, implies that is useful to look beyond the usual regional, local authority or health area level to smaller geographical areas (Robinson 2005; Green and Pinto 2005). In this study we look at different hierarchical levels – ranging from government region down to small areas called lower super output areas (LSOA). The latter have a minimum population of 1000 and are created by "taking into account measures of population size, mutual proximity and social homogeneity" (ONS, 2008). There are 32,482 LSOAs in total in England.

Taking these two strands together our overall approach is to use multi-level modelling methods to explore the impact of public services at different geographic and organisational hierarchical levels, such as regions, local authorities and small areas. We also examine the relationships between public sector organisations in terms of their combined influence over aspects of quality of life. However, although this paper refers to this broad context we report mainly on the health related results as these have been the focus of our preliminary work to date.

(2) Data

(a) Quality of Life

Indicators have been developed by the Audit Commission in England to capture several broad concepts of quality of life at a local authority level (Audit Commission, 2005). These indicators have been developed by the Audit Commission together with the Department of Environment, Food and Rural Affairs (DEFRA) and the Office of the Deputy Prime Minister (ODPM). The set covers diverse aspects of quality of life, such as health, environment and education, all of which contribute to the long-term well-being of citizens. These indicators are reported at local level (local authority and local strategic partnership level). Overall, there are 45 quality of life indicators, which cover ten quality of life themes (eg health and social well being, culture, transport) with between one and 9 indicators in each area. Whilst they may not give a comprehensive measure of quality of life, the indicators fit our purpose in representing a broad range of domains.

As our analysis aims to look at smaller levels than local authority areas, we then selected a sub-set of themes and looked for indicators similar to those published by the Audit Commission, but defined at small area level. Our sub-set contains the following 20 quality of life indicators:

1) Community cohesion and involvement
   - Election turnout

2) Community safety
   - IMD score on crime

3) Economic well-being
   - IMD score on children (IDACI)
   - IMD score on older people (IDAOPI)

- All people of working age claiming a key benefit
- All people of working age claiming job seekers allowance

4) Education and life-long learning
   - Secondary school absence
   - National Curriculum assessments: average point score for Key Stage 4

5) Environment
   - Combined air quality indicator
   - Area of green space

6) Health and social well-being
   - Life expectancy at birth
   - Teenage conceptions
   - Standardised mortality ratio
   - Households with one or more limiting longstanding illnesses

7) Housing
   - People living rough
   - Households (Occupied) without central heating

8) Transport and access
   - Population travelling over 20km to work
   - Population travelling to work by private vehicle
   - Population travelling to work by public transport
   - Population travelling to work by bike or foot

A wide range of different data sources are used in the creation of the variables: eg the 2001 Census, Index of Multiple Deprivation (IMD), British Local Elections Database, Neighbourhood Statistics and Public Health Observatory data. Details of the methods used to create each of the variables are available from the authors on request, but space prohibits us from reporting them here.

Seventeen of our quality of life measures are defined at lower super output area level and three are available at ward level - either electoral ward or 2001 Census Standard table ward. Details of how these levels fit together hierarchically are provided in **Appendix One.**

In this paper we report only on four indicators which traditionally fall within the realm of the health sector, namely:

- life expectancy at birth expressed in years, which is defined at standard census ward level;
- total number of teenage conceptions, which is defined at electoral ward level;
- standardised mortality ratio defined at LSOA level for 2001;
- percentage of households with one or more individuals with a limiting longstanding illness or disease also defined at LSOA level.

(b) *Other Data*

Socio-economic factors and performance indicators of key public sector services are added to our database. We include socio-economic variables in order that we can control for the level of "need" in the population and our main source is the Index of Multiple Deprivation (IMD) for 2004. This index is the weighted combination of 7 domain indices and further details of its composition are given in section 3. In one version of our models we choose to separate the components of the IMD because some of our quality of life indicators also use domains from the IMD which may produce endogeneity problems. Details of how we do this are given in section 3.

Performance ratings for PCTs and local authorities will be added to our database in due course so that we can examine the association between the performance of institutions and the quality of life of local populations . They will consist of star ratings for PCTs as well as Comprehensive Performance Assessment ratings and Best Value Performance Indicators for local government.

The complete dataset will be the most detailed of its kind to present a snapshot of public services and quality of life at a small area level in England.

(3) Methods

In this paper we are interested in examining the degree of variation in quality of life indicators that exists at each level in the hierarchy. First, we explored a simple analysis of variance or ANOVA model, where the observed variance is partitioned into components given by spatial level, for example governmental regions. Our aim was to identify the spatial level to which most of the observed variance can be attributed. The analysis of variance was performed for each quality of life indicator in our dataset and for each of the six spatial levels (governmental regions, strategic health authorities, wards, etc.). Each ANOVA model uses as the dependent variable a given organisational hierarchy, say local authority, and decomposes the variance in the quality of life indicator under consideration into a **between** organisational hierarchy variation and a **within** organisational hierarchy variation.

ANOVA models are not helpful when one wants to analyse the residual variances in hierarchical (multi-level) structures. This information is provided through a multi-level modelling approach which enables one to account for the several hierarchical levels and to analyse the extent of variability in the dependent variable that is attributable to these different hierarchical levels. So we use multi-level modelling techniques to disentangle the extent of variability in quality of life indicators at each of our hierarchical levels. Once we control for exogenous constraints (socio-demographic characteristics of the population) which can also play an important role in affecting the quality of life of citizens, and also account for random variation, we assume that the remaining variation attributable to different levels gives an indication of the degree to which quality of life may be amenable to policy interventions undertaken at each of these levels.

We consider a simple multi-level (random effect) model with no explanatory variables in a three tier hierarchical structure[1]. Let's assume for the time being that the top level is composed of governmental regions, the middle level is composed of local authorities, and the bottom level is given by LSOAs/wards. One can represent this type of multi-level model with the following equation:

$$
\begin{aligned}
y_{ijk} &= \beta_{0jk} + e_{ijk} \\
\beta_{0jk} &= \beta_0 + v_{0k} + u_{0jk} \\
v_{0k} &\sim N\left(0, \sigma^2_{v0}\right) \\
u_{0jk} &\sim N\left(0, \sigma^2_{u0}\right) \\
e_{ijk} &\sim N\left(0, \sigma^2_{e0}\right)
\end{aligned}
$$

Figure 1

where y is our quality of life indicator. The terms v_{0k}, u_{0jk} and e_{ijk} represent error components. v_{0k} is the random error for the *k*th region, u_{0jk} is the random error for the *j*th local authority within the *k*th region and e_{ijk} represents the random effect for the *i*th small area within the *j*th local authority within the *k*th region. All random errors are assumed to be normally distributed with mean zero and constant variances (σ^2_v, σ^2_u, σ^2_e).

The proportion of total variation (intra-class correlation coefficient) that can attributed to any level is defined for governmental regions by

$$\rho_v = \frac{\sigma^2_v}{\left(\sigma^2_v + \sigma^2_u + \sigma^2_e\right)}$$

Figure 2

with $0 \leq \rho_v \leq 1$. The closer ρ_v is to 1 the larger the extent to which the variance in the quality of life indicator is attributable to the governmental regional level.

Similarly, for local authorities the proportion of variance that can be attributed to this level is given by

$$\rho_u = \frac{\sigma^2_u}{\left(\sigma^2_v + \sigma^2_u + \sigma^2_e\right)}$$

Figure 3

with $0 \leq \rho_u \leq 1$. As before, the closer ρ_u is to 1 the larger the extent to which the variance in the quality of life indicator is attributable to the local authority level.

[1] See Appendix Two for model specification with need adjustors.

The proportion of variance attributable to the lowest level in our hierarchy (LSOA and ward) is given by

$$\rho_e = \frac{\sigma_e^2}{\left(\sigma_v^2 + \sigma_u^2 + \sigma_e^2\right)}$$

Figure 4

Estimates of residual variance at the first two levels are easy to interpret as accountable public sector organisations exist at these levels. Hence, the working hypothesis is that if a large portion of residual variance is attributed to either government region or local authority level, than public sector organisations operating at any of these two levels exert some influence on various measures of quality of life. Estimates of residual variance at small area level are more difficult to interpret no obvious accountable public sector organisations exist at this level, making it difficult to draw policy implications. However, as we explain later, we believe that variation at this level should be considered with care.

This model can be applied to any three-level random effect model, where different geographical and/or organisational levels are used. We analyse four different hierarchical structures, which differ only with respect to the organisational hierarchy that we assign to levels 1 and 2 respectively. The lowest level in our analysis stays always the same, and it is defined at both lower layer super output area (LSOA) or ward.

In this paper we report on just two of the four models - the first has the following hierarchical structure:

- Level 1 (highest): governmental regions
- Level 2: local authorities
- Level 3(lowest): lower super output areas or wards

The 9 governmental regions constitute the highest level, within which 354 local authorities are nested. The lowest level is represented by LSOAs/Wards, which are, in turn, uniquely clustered within local authorities. There are 32482 LSOAs and 8797 Wards. We call this model **Basic Model 1**.

The second model is:

- Level 1(highest): strategic health authorities
- Level 2 primary care trusts
- Level 3 (lowest): lower super output areas or wards

LSOAs/Wards are here nested within 304 PCTs, which are in turn clustered within 28 SHAs. We call this model **Basic Model 2**.

The basic models have no explanatory variables and just show the proportion of variance in each QoL variable attributable to each organisational level.

We then control for socio-demographic characteristics in two ways. Firstly, we introduce the overall score Index of Multiple Deprivation for 2004. This index is the combination of 7 domain indices, which are all defined in different metrics, and hence were standardised using an exponential transformation. This results in greater levels of deprivation being associated with higher scores. Every domain has attached a weight that represents their relative importance in the overall composite measure. Table 1 summarises the domain weights used.

Table 1 – Domains of the Index of Multiple Deprivation

Domain	Weight
Income deprivation	22.5%
Employment deprivation	22.5%
Health deprivation and disability	13.5%
Education, skills and training deprivation	13.5%
Barriers to housing and services	9.3%
Crime	9.3%
Living Environment deprivation	9.3%

We call this model **Extended Model A**; thus, becoming model A1 when it is used within the same hierarchical structure of basic model 1 or model A2 when it used within the same hierarchical structure of basic model 2.

As the overall IMD score adjustor includes indicators for health deprivation and disability, this may potentially cause a problem of endogeneity when we are considering the four health related quality of life indicators described earlier. Hence, to avoid the risk of building endogeneity into the estimation procedures, domain specific indicators of deprivation are used for all domains except for health deprivation and disability. Further, the use of domain specific indicators of deprivation has the advantage of enabling us to elicit the effect that each individual domain has on the four quality of life indicators for health. We call this **Extended Model B**. The box below shows the content of each domain of deprivation.

Domains of Deprivation	Content
Income deprivation	Adults and children in Income Support households Adults and children in Income Based Job Seekers Allowance households Adults and children in Working Families Tax Credit households whose equivalised income (excl. housing benefits) is below 60% of median before housing costs Adults and children in Disabled Person's Tax Credit households whose equivalised income (excl. housing benefits) is below 60% of median before housing costs National Asylum Support Service supported asylum seekers in England in receipt of subsistence only and accommodation support
Employment deprivation	Unemployment claimant count of women aged 18-59 and men aged 18-64 averaged over 4 quarters Incapacity Benefit claimants women aged 18-59 and men aged 18-64 Severe Disablement Allowance claimants women aged 18-59 and men aged 18-64 Participants in New Deal for the 18-24s who are not included in the claimant count Participants in New deal for 25+ who are not included in the claimant count Participants in New Deal for Lone Parents aged 18 and over
Health deprivation and disability	Years of potential life lost (YLL) Comparative illness and disability ration Measures of emergency admissions to hospital, derived from Hospital Episode Statistics Measure of adults under 60 suffering from mood or anxiety disorders , based on prescribing, Hospital Episode Statistics, suicides and health benefits data
Education, skills and training deprivation	Average points score of pupils in Key Stage 2 (end of primary school) Average point score of pupils at Key Stage 3 Average points score of pupils at Key Stage 4 (GCSE/GNVQ – best of eight results) Proportion of young people not staying in school or non-advanced further education above 16 Secondary school absence rate (average of 2001 and 2002) Proportion of those aged under 21 not entering Higher Education
Barriers to Housing and Services	
Wider Barriers	Household overcrowding LA level percentage of households for whom a decision on their application for assistance under the homeless provisions of housing legislation has been made, assigned to the constituent SOAs Difficulty of Access to owner-occupation
Geographical Barriers	Road distance to GP premises Road distance to a supermarket or convenience store Road distance to a primary school Road distance to a Post Office
Living Environment	
The 'indoors' living environment	Social and private housing in poor condition Houses without central heating
The 'outdoors' living environment	Air quality Road traffic accidents involving injury to pedestrians and cyclists
Crime	Burglary Theft Criminal damage Violence

(4) Results

We focus in this paper only on the four indicators which traditionally fall within the realm of the health sector, namely:

- life expectancy at birth expressed in years, which is defined at census ward level;
- total numbers of teenage conceptions, which is defined at electoral ward level;
- standardised mortality ratio defined at LSOA level for 2001;
- percentage of households with one or more individuals with a limiting longstanding illness or disease also defined at LSOA level.

Model 1: Government regions, local authorities, LSOA

The proportions of variability in the 4 quality of life indicators for health attributable to each of the three levels in the basic model and the two need-adjusted models are shown in table 2. The estimates of residual variance are significant at 5 percent level for all quality of life indicators[2] and in all three models, with the exception at governmental region level for the indicator 'total number of teenage conceptions' in the basic model and in the extended model B1, and for the indicator 'percentage of households with one or more limiting and longstanding illnesses or disease' in the extended model A1.

Table 2 – Three-level random intercept model to explain proportion of variance in quality of life indicators attributable to government regions and local authorities

Quality of life indicators	BASIC MODEL			EXTENDED MODEL A1: 1 need vbl			EXTENDED MODEL B1: 6 need vbls		
	ρ_v	ρ_u	ρ_e	ρ_v	ρ_u	ρ_e	ρ_v	ρ_u	ρ_e
Life expectancy	0.101	0.220	0.679	0.050	0.118	0.832	0.047	0.105	0.848
Teenage concept	0.098	0.327	0.575	0.095	0.290	0.615	0.108	0.287	0.604
Stand. Mortality ratio	0.025	0.054	0.921	0.007	0.034	0.959	0.019	0.033	0.949
Limiting longstanding illness	0.169	0.256	0.575	0.175	0.209	0.617	0.069	0.201	0.729

ρ_v, proportion of variance attributable to government regions; ρ_u, proportion of variance attributable to local authorities; ρ_e, proportion of variance attributable at small area level.

In the basic model, we are simply eliciting the proportion of residual variance attributable to each of the three hierarchical levels without taking into account of differential population characteristics at small area level. The results suggest that most of the residual variance exists at the lowest level. Variation in the quality of life measures for health exists also at both government region and local authority level, with the latter showing a higher degree of residual variance.

The case of standardised mortality ratio is quite interesting with estimates of residual variance at government region and local authority level explaining only 2.4 per cent and 5.4 per cent of total variability in the quality of life indicator, respectively. Overall, the results suggest that government regions exert only a marginal influence

[2] Please note that 'life expectancy at birth' and 'total number of teenage conceptions are defined at ward level.

on the quality of life measures for health. The higher estimates of residual variance at local authority level indicates, on the contrary, that these organisations may have a greater impact on the four quality of life indicators (e.g. 'total number of teenager conceptions').

The main effect of need-adjusting the basic random intercept model is to increase the proportion of variance attributable to the small area level. This is true for all quality of life indicators, and for both need-adjusted models. The effect on standardised mortality ratio is quite dramatic with about 96 per cent of residual variance now existing at small area level. Government regions appear to impact only very marginally on this quality of life measure, with the proportion of total variance equal to 0.7 per cent and about 2 per cent respectively in model A1 and B1. Further, the residual variance at local authority level for 'total number of teenage conceptions', after adjusting for need (in both models A1 and B1), does not change greatly from the basic model, thus suggesting that local authorities may have differential policies in place that may influence the number of teenage conceptions in some areas to a greater extent than in others.

In conclusion, substantial variation in all of the four quality of life indicators for health appears to exist at LSOA/ward level, even after taking into account differences in levels of deprivation at small area level (whether we use the overall deprivation index or the domain specific deprivation indicators). These results can be interpreted in several ways. It may be the case that we would not expect government regions and local authorities to have a direct influence on our health related measures of quality of life. However, if we believe that public services directed to specific areas of public interest can have an impact on quality of life in other domains (e.g. education on health and education on income), then the existence of small variations (after controlling for levels of deprivation) at both levels are important. They may suggest that there are policies made by government regions and local authorities that have an indirect and differential impact on health related quality of life of citizens at lower level areas

The two need-adjusted models have similar results in terms of residual variance at each hierarchical level. The advantage of using the six deprivation indicators is in terms of avoiding problems of endogeneity. The overall deprivation index is, in fact, a combination of four different health related indicators (see box), including an indicator for years of life lost (built from mortality data) and one for comparative illness and disability ratio, which are similar to two of the health quality of life indicators – standardised mortality ratio and percentage of households with one or more limiting longstanding illness.

The estimates of the slope coefficient for model A1 are shown in table 3. Only the estimate of the slope coefficient for the indicator 'life expectancy at birth' is significant at 5 percent level. It also has the expected sign, as lower life expectancy is associated with higher levels of overall deprivation registered at LSOA level.

Table 3 – Coefficient on overall index of multiple deprivation 2004 – model A1

Quality of life indicators	β_0	SE	β_1	SE
Life expectancy	80.666	0.1516	-0.0957	0.0001
Teenage concept	7.0244	1.6582	0.5949	0.001
Stand. Mortality ratio	0.8612	0.013	0.0123	3E-05
Limiting longstanding illness	26.715	0.8804	0.3358	0.0004

Tables 4a and 4b show the estimates of the 6 domain specific deprivation indicators used in model B1.

Table 4a – Coefficients of domain specific deprivation indicators 2004 – model B1

Quality of life indicators	β_0	SE	β_1	SE	β_2	SE	β_4	SE
Life expectancy	80.22	0.14	-2.84	0.05	-8.15	0.07	-0.01	0.0002
Teeancge concept	8.88	1.73	13.05 *	0.36	0.72	0.50	0.35 *	0.0013
Stand. Mortality ratio	0.91	0.02	1.54 *	0.01	0.11 *	0.02	0.00	0.00004
Limiting longstanding illness	27.68	0.47	-2.73	0.13	57.08 *	0.18	0.13 *	0.0005

* = significant at 5 percent level

Table 4b - Coefficients of domain specific deprivation indicators 2004 – model B1 (c'ed)

Quality of life indicators	β_5	SE	β_6	SE	β_7	SE
Life expectancy	0.0048 *	0.0002	-0.5597	0.0033	-0.0165	0.0002
Teenage concept	0.0342 *	0.0017	3.1359 *	0.0250	0.0343 *	0.0011
Stand. Mortality ratio	0.0006 *	0.00004	0.0359 *	0.0008	0.0015 *	0.00004
Limiting longstanding illness	-0.0516	0.0005	-0.3854	0.0082	-0.0591	0.0004

* = significant at 5 percent level

where β_1 is the coefficient for IMD income deprivation score, β_2 IMD employment deprivation score, β_4 IMD education, skills and training deprivation score, β_5 IMD barriers to housing and services deprivation score, β_6 IMD crime score and β_7 IMD living environment deprivation and SE stands for standard error.

The estimates of the six deprivation coefficients appear to have the expected signs in most quality of life indicators, showing, for example, that more deprived areas are associated with greater mortality ratio. However, only a few (indicated with a star in tables 4a and 4b) are statistically significant at 5 per cent level. For example, more deprived areas in income, employment, barriers to housing and services, crime and living environment are associated greater 'standardised mortality ratio'

Model 2: Strategic health authorities, PCTs, LSOA

All estimates of residual variance at all hierarchical levels and for all quality of life indicators are significant at 5 percent level, in all models (see table 5).

Table 5 – Three-level random intercept model to explain proportion of variance in quality of life indicators attributable to strategic health authorities and primary care trusts

Quality of life indicators	BASIC MODEL			EXTENDED MODEL A2: 1 need vbl			EXTENDED MODEL B2: 6 need vbls		
	ρ_v	ρ_u	ρ_e	ρ_v	ρ_u	ρ_e	ρ_v	ρ_u	ρ_e
Life expectancy	0.24	0.30	0.46	0.12	0.34	0.54	0.09	0.35	0.56
Teenage concept	0.34	0.38	0.29	0.36	0.29	0.35	0.37	0.27	0.35
Stand. Mortality ratio	0.07	0.21	0.72	0.04	0.18	0.78	0.04	0.17	0.78
Limiting longstanding illness	0.34	0.19	0.48	0.29	0.17	0.53	0.27	0.15	0.57

ρ_v, proportion of variance attributable to strategic health authorities; ρ_u, proportion of variance attributable to PCTs: ρ_e, proportion of variance attributable at small area level.

A high proportion of variation (ρ_v and $\rho_u \geq 52$ %) in the basic model is attributed to strategic health authorities (SHAs) and primary care trusts (PCTs) together for the indicators 'life expectancy at birth', 'total numbers of teenage conceptions' and 'percentage of households with limiting longstanding illness'. This suggests that SHAs and PCTS have an important impact on these quality of life indicators. PCTs have a smaller scope on influencing the 'percentage of households with limiting longstanding illness'.

The estimates of residual variance attributable to these two levels together after controlling for levels of deprivation (in both model A2 and B2) become smaller for many quality of life indicators. It is worth noting, however, that in the case of 'life expectancy at birth'(for PCTs) and 'total numbers of teenage conceptions' (for SHAs), the proportions of residual variance, after controlling for level of deprivation, increase - suggesting that disparities in policies across these organisations may exist and that they have a differential impact on these domains of quality of life.

The magnitude of the proportion of residual variance that exists at small area level cannot be ignored for the same reasons outlined in the previous section. In the case of 'standardised mortality ratio' it is particularly significant, as the proportion of variance at small area level is equal from around 72 per cent in the basic model to around 79 per cent in extended model B2.

The estimates of the slope coefficient of the overall deprivation measure all have the expected sign (see table 6), albeit only the coefficient for the 'life expectancy at birth' is statistically significant at 5 percent level. The results indicate that greater levels of deprivation at small area level are associated with lower life expectancy.

Table 6 – Coefficient on overall index of multiple deprivation 2004 – model A2

Quality of life indicators	β_0	SE	β_1	SE
Life expectancy	80.720	0.097	-0.087	0.00014
Teeancge concept	12.132	1.161	0.475	0.00092
Stand. Mortality ratio	0.851	0.013	0.0123	0.00003
Limiting longstanding illness	24.274	0.342	0.345	0.00398

Estimates of coefficients for domain specific deprivation indicators are shown in tables 7a and 7b.

Table 7a – Coefficients of domain specific deprivation indicators 2004 – model B2

Quality of life indicators	β_0	SE	β_1	SE	β_2	SE	β_4	SE
Life expectancy	80.096	0.085	-2.430	0.050	-7.608	0.069	-0.008	0.0002
Teenage concept	15.111	1.145	17.124 *	0.321	-6.838	0.448	0.263 *	0.001
Stand. Mortality ratio	0.895	0.013	1.622 *	0.012	0.056 *	0.017	-0.003	0.00005
Limiting longstanding illness	26.046	0.289	-1.943	0.129	58.221 *	0.178	0.129 *	0.00049

* = significant at 5 percent level

Table 7b – Coefficients of domain specific deprivation indicators 2004 – model B2 (c'ed)

Quality of life indicators	β_5	SE	β_6	SE	β_7	SE
Life expectancy	0.007 *	0.00018	-0.550	0.003	-0.014	0.00015
Teenage concept	0.003	0.002	3.009 *	0.023	0.008 *	0.001
Stand. Mortality ratio	0.00042 *	0.00004	0.033 *	0.0008	0.0015 *	0.00004
Limiting longstanding illness	-0.0477	0.00046	-0.336	0.008	-0.0589	0.00039

* = significant at 5 percent level

where, β_1 is the coefficient for IMD income deprivation score, β_2 for IMD employment deprivation score, β_4 for IMD education, skills and training deprivation score, β_5 for IMD barriers to housing and services deprivation score, β_6 for IMD crime score and β_7 for IMD living environment deprivation.

The estimates of the six deprivation coefficients show - in most cases - the expected relation to all our four quality of life indicators. Only a few are statistically significant at 5 per cent level (indicated with a star in tables 7a and 7b). For example, greater levels of deprivation in the living environment domain are associated with higher numbers of teenage conception and higher standardised mortality rates at small area level.

(5) Interim Conclusions

The study is work in progress and we have not yet completed our full analysis. However, the results reported here for the health related indicators suggest that significant variations in the quality of life of citizens may exist at levels below both the strategic health authority and regional office level and also below the primary care trust and local authority level. What does this tell us? Interpretation is not straightforward for a number of reasons. First, although we observe variation at each level and we assume that organisations at these levels have some influence over this, we cannot say that it is all within managerial control as there may be other organisations or factors excluded from our analysis that have an influence, despite our attempts to include several PSOs and to control for levels of population need. Second, the policy implications are not immediately clear because at small area level there are no obvious accountable public sector organisations to which responsibility for improving quality of life can be delegated.

However, despite these caveats there are a number of messages suggested by our initial results and we will in future investigate whether these are borne out by the full analysis. First, we can see that despite the existence of substantial variation at lower levels, there still appears to be a role for the higher level organisations in influencing the health related quality of life indicators along some dimensions. Strategic health authorities and PCTs play such a role and, although their influence may be relatively small, regional offices and local authorities also appear to have an effect on some health related quality of life indicators. It will be interesting to see the influence of governmental organisations and other PSOs on the full range of indicators and also the influence of health care organisations on non-health related quality of life indicators. This should tell us something about the degree to which PSOs influence indicators that cover aspects of quality of life falling outside their traditional boundaries.

Second, the existence of large variation at small area level suggests that organisations with responsibility at higher levels need to consider the variation that exists at lower levels within their area and the differential impact that their policies may have locally. Since the Local Government Act in 2000, there has been a focus on the responsibilities of PSOs for the quality of life and well-being of citizens in their areas. Recent government policy has emphasised the importance of local communities and neighbourhoods and has put in place a wide range of mechanisms with the aim of giving more power, authority and rights to local communities (Dept for Communities and Local Government, 2008). As we noted above, there are no obvious PSOs with particular responsibility for quality of life below these levels but the whole thrust of government policy over the past few years has been to encourage PSOs to become more responsive to local needs and circumstances and to devolve to communities a greater role in decision-making. A range of financial and non-financial resources with which to implement local policies and schemes is to be made accessible to local community and neighbourhood groups (Dept for Communities and Local Government, 2008). Indeed, the degree to which local councils succeed in engaging the public at local level will be part of their performance assessment in future. Our results suggest that attention to this local level may well be a fruitful approach. Policies should be built upon the best available evidence about what strategies and activities work best in terms of enhancing the quality of life of citizens.

Third, there is a large literature on the creation of social capital and the way in which it enhances the quality of life of citizens and can protect them from social exclusion (Halpern, 2005). There is also an emphasis on the role of informal networks, neighbourhood groups and communities in the creation and maintenance of such social capital (LGA, 2004; Henderson 2003). This suggests that when considering the potential influences on citizens' quality of life it may well be more appropriate for the focus to be on the lower levels rather than on the traditional boundaries such as local authorities and PCTs.

(6) Future directions

Our intention is to:

- examine the remaining two alternative hierarchical structures by repeating the multi-level models
- explore the full range of quality of life indicators rather than just the health indicators
- incorporate indicators of performance for PSOs where available
- explore the complex relationships *between* quality of life indicators by using seemingly unrelated regression (SUR) models and multi-variate multi-level (MVML) models

In undertaking the above tasks we hope to shed further light on the two aspects of our study that we highlighted earlier – the overlapping influence of PSOs on quality of life indicators and the level at which different aspects of quality of life varies most substantially. These should have implications for policy direction in the health care sector and across other public sectors.

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This is preliminary work - please do not quote without prior permission from the authors.

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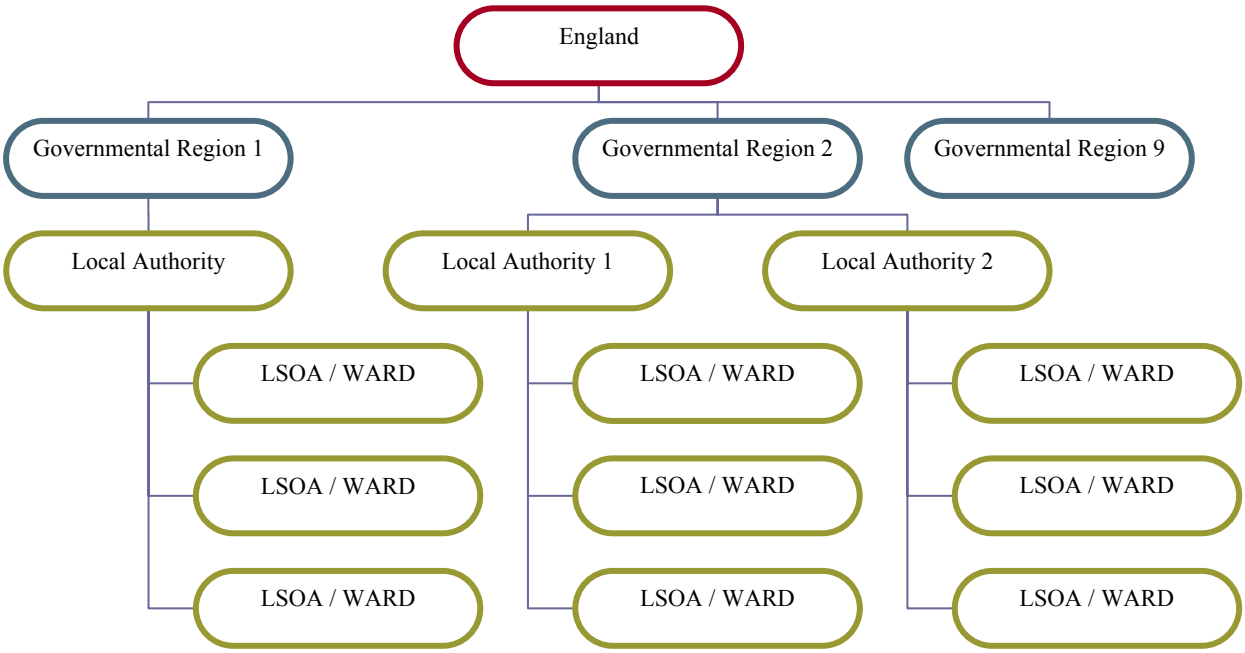
Appendix One – Hierarchical Structure of the Data



Appendix Two – Multi-level random effect model with need adjustors

Model A – Overall Score Index of Multiple Deprivation

$$y_{ijk} = \beta_{0jk} + \beta_1 x_{ijk} + e_{ijk}$$
$$\beta_{0jk} = \beta_0 + v_{0k} + u_{0jk}$$

$$v_{0k} \sim N\left(0, \sigma^2_{v0}\right)$$
$$u_{0jk} \sim N\left(0, \sigma^2_{u0}\right)$$
$$e_{ijk} \sim N\left(0, \sigma^2_{e0}\right)$$

Model B – Domain Specific Indices of Multiple Deprivation

$$y_{ijk} = \beta_{0jk} + \sum_{t=1}^{6} \beta_t x_{tijk} + e_{ijk}$$
$$\beta_{0jk} = \beta_0 + v_{0k} + u_{0jk}$$

$$v_{0k} \sim N\left(0, \sigma^2_{v0}\right)$$
$$u_{0jk} \sim N\left(0, \sigma^2_{u0}\right)$$
$$e_{ijk} \sim N\left(0, \sigma^2_{e0}\right)$$