NHS

Health Development Agency

Social capital, place and health: creating, validating and applying small-area indicators in the modelling of health outcomes

November 2004

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This document is also published on the
Health Development Agency website at:
www.hda.nhs.uk/evidence

Acknowledgements

First we are grateful to the Health Development Agency (HDA) for funding this work and to Antony Morgan for his support and encouragement throughout the course of this project. The thought-provoking comments of S. V. Subramanian on an earlier version of this book were invaluable and we are indebted to him. Sarah Curtis also made a number of relevant and useful suggestions.

A number of organisations kindly supplied us with data for the project, which we wish to acknowledge:

- The National Blood Service for supplying an anonymised data set on the distribution of several million registered donors
- Colin Rallings and Michael Thrasher of the Local Government Elections Centre at the University of Plymouth for supplying data on voter turnout for English local government wards
- Mai Stafford and her colleagues at University College London, for data from their survey of social capital in London
- Charles Pattie (University of Sheffield) for supplying data for local authorities gathered in the course of the ESRC-sponsored 'Citizen Audit', one of the main projects in the ESRC's Democracy and Participation research programme.

The survey datasets on which we drew were supplied in electronic format by the Data Archive at the University of Essex. Census data were obtained from Manchester Information and Association Services (MIMAS).

Earlier versions of aspects of this work were presented to the International Symposium on the Geography of Health, Montreal, 2000; the Royal Geographical Society/Institute of British Geographers conference, Plymouth, 2001; and at the HDA Social Action for Health and Wellbeing conference, London, 2002. We are grateful to participants in those meetings for valuable comments and suggestions.

Despite these attempts to diffuse blame, responsibility for what follows is ours alone.

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Summary

The aim of this project was to assess whether social capital, measured at the community level, had identifiable effects on health outcomes. A review and assessment of previous work on this subject showed that many studies, in the UK and elsewhere, had:

- Been conducted for large spatial units, which bore little relation to the contexts in which people live their daily lives
- Relied on aggregate statistical methods, which could not distinguish context from composition.

To get round these problems we devised small-area measures or estimates of social capital. We first reviewed direct methods: this entailed an evaluation of the potential of indicators such as blood donation and voter turnout. We then turned to a method we term 'synthetic estimation'. This was a multilevel modelling approach to the determinants of behaviours thought likely to contribute to social capital formation. It generated coefficients, which could be applied to census data for electoral wards, thereby producing estimates of the proportions of the population expressing attitudes, or engaging in behaviours, which were constitutive of social capital. We validated these measures against other directly-observed data supplied by other researchers. The bulk of the research effort on the project went into generating these estimates but we also applied the indicators in a modelling exercise.

The response variable was the probability that an individual respondent to the original Health and Lifestyle Survey (HALS) of 1985 was still alive on re-survey in 1999. Explanatory variables, entered into a multi-level model, included individual characteristics, health-related behaviours, area measures of material circumstances, and area measures of social capital. We found that social capital added little or nothing to models which incorporated area measures of material circumstances. We therefore suggest that, at the scale for which we produced our estimates of social capital, and for the aspects of it deployed in our models, area-level estimates of social capital contribute little to the explanation of variations in health outcomes.

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Introduction

Geographical inequalities in health have long fascinated researchers, practitioners and the general public, as is readily attested by the coverage given to reports about geographical variations in mortality, morbidity or health-related behaviour. The existence of such inequalities is incontestable (Britton, 1990; Jones et al., 2000; Gatrell 2002). Spatial differences exist at several geographical scales, from standard regions (Drever and Whitehead, 1995) to electoral wards (subdivisions of local government districts containing populations of 5-10,000: Townsend et al., 1988; Eames et al., 1993; Ben-Shlomo et al., 1996).

Moreover, while absolute levels of mortality are declining, relative differences between places are widening. Curtis et al. (1994) found evidence of greater variability in coronary heart disease (CHD) mortality over time. Congdon et al. (2001) showed that despite steady reduction in absolute levels of infant mortality for a consistent set of spatial units, the gap between the extremes of the distribution of values increased over time. Dorling (1997) similarly showed that, when Standardised Mortality Ratios (SMRs) for 1951 and 1991 were presented for identical spatial units (1951 administrative areas to which 1991 data had been reaggregated), the range of values had increased: some areas were moving further away from the national average, in both positive and negative directions. These studies were generally conducted at a high level of aggregation. However, studies of changes in mortality at ward level in the northern region of England, and in Scotland, have demonstrated large and widening differentials in mortality between the most and least deprived areas. Indeed there is some evidence of an absolute worsening in the mortality experience of some groups in England (Phillimore et al., 1994; McLoone and Boddy, 1994).

The implication of these studies is that there is something about the character of the place in which one lives that affects life expectancy and mortality experience. However, explaining precisely how those processes work is a challenging problem. After the publication of the Black Report (DHSS, 1980) much research was conducted which emphasised the influence of material circumstances, such as social deprivation, on the patterning of health outcomes. Yet, once allowance had been made for material circumstances, there still remained variations between places in terms of health experience. This raised the intriguing possibility that there is something about the character of a place that can exert a positive – or negative – influence on health.

This seems plausible; we've probably all heard or used the expression 'this place is driving me crazy', suggesting associations between the environment and mental health (eg Weich et al., 2002). The influence of neighbourhoods on the quality of life was a central theme of the report of the Commission on Social Justice (1994: 307-9):

> *'...where you live, who lives there, and how they lead their lives – cooperatively or selfishly, responsibly or destructively – can be as important as personal resources in determining life chances.'*

In a similar vein, more recently, the white paper *Saving Lives: Our Healthier Nation* laid much emphasis on the influence of social cohesion and social networks on health (Department of Health, 1999: para 4.34). While we would accept that such statements indicate that the quality of social relationships can, to some extent, influence health outcomes, the extent of that influence and its size relative to other influences remains to be determined.

There is room for much debate about these issues. A key question concerns the ways in which the characteristics of a place can be said to affect the health of the individuals who live there. A distinction is often made between

compositional and contextual effects. The former are those due to the socio-economic composition of the population – for example, a high proportion of old people will generate an above-average mortality rate, but differences between places might disappear once allowance is made for demographic structure. We need, in addition, to be able to isolate contextual effects – those which are evident after allowance has been made for compositional factors. Some social scientists argue that geographical variations in health experience are merely compositional, but many others disagree. Among those who favour contextual explanations, there are differences of opinion regarding causal pathways. The recent work of Richard Wilkinson (1996, 2001) is important here, because he argues that even after allowance is made for differences in material circumstances (eg comparative levels of economic development) there remain important differences in health outcomes. This draws attention to the importance of the social environment as an influence on health.

Wilkinson has argued that, among those societies which had attained a level of economic development which permitted them to satisfy the basic material needs of their citizens, the best health records were found among societies with the most egalitarian income distribution. Wilkinson therefore examined the relationships between income inequality and health, mainly for groups of nation states. It was postulated that a psychosocial mechanism of adverse social comparisons might lead individuals to experience stress as they compared their own situation with that of their neighbours. This led researchers to consider the possibility that differential levels of social capital in a community might have a differential impact on health standards.

Social capital has a long history and many antecedents. The central proposition is that through participation in associational life of various kinds, people become members of groups, which 'both reflect and help shape identity, norms, beliefs, and priorities' (Macinko and Starfield, 2001: 388). Robert Putnam, perhaps the key contemporary advocate of the concept, defined it as 'features of social organisation such as networks, norms and trust' (Putnam, 1993a). Through these groups, people are able to share information, obtain and give support, and cooperate to achieve collective goals. Macinko and Starfield therefore suggest that the term refers to 'available resources (capital) that can accrue to people by virtue of their mutual acquaintance and recognition (social) and that can be used for a variety of productive activities' (Macinko and Starfield 2001: 388). The concept was traced by Portes (1998) to important social theorists in the 19th century, such as Marx and Durkheim. Perhaps a novel feature of contemporary analysis, especially in the work of Putnam, is the emphasis on social capital as a property of spatially defined communities ranging from villages, through regions (Putnam, 1993b), to nation states (Fukuyama, 1995). It is suggested that in communities possessing high levels of social capital a number of beneficial outcomes may obtain, including economic development, better government, and improved health. If so, it is therefore important that policy makers understand the concept and its consequences.

One of the distinctive contributions made by our project is in the development of small-area measures of social capital. Anticipating an argument developed in Chapter 1, we suggest that in previous studies social capital has been measured largely at a high level of aggregation – states in the US, or regional units in the Russian Federation, for example. These units (eg states in the US) may not be meaningful as contexts in which people live their lives. Yet much research conducted in the UK in recent years has emphasised variations between small areas in mortality experience (eg Phillimore et al., 1994). Given this, we have attempted to devise measures of social capital for small areas – electoral wards – with a view to testing whether relationships found at one level hold at another.

Our analytical strategy, in common with much contemporary research on neighbourhood effects on health, is a multilevel one (Kawachi and Berkman, 2003). This approach allows for the simultaneous modelling of compositional and contextual influences. Individual mortality experience is conceptualised as a function of their individual characteristics (age, gender, socio-economic status) and behaviour (eg whether or not they smoke) and the ecological characteristics of the places in which they live. This approach also allows for interactions between these levels of analysis.

The contribution of our work is therefore twofold:

- The development of a methodology for producing small-area indicators of social capital
- An investigation of whether the relationships that other scholars claim to have found for large spatial units can be shown to obtain for small areas in England.

The structure of this book is as follows. First, we provide a review of relevant debates about neighbourhood influences on health inequalities. It has generally been

found that material circumstances alone cannot explain spatial variations in health. It has been suggested that comparative levels of social capital can play a part in explaining variations between places in health outcomes. The position we take is that social capital is not just an economic, social and political concept, but also a geographical one, and we discuss the challenges of developing ecological measures of social capital. There follows a review of previous applications of the concept to debates about health geography. We argue, following Pearce and Davey-Smith (2003: 125), that if social capital is to be a major focus of health and social policy, then it is necessary to show that social capital has an independent effect on health outcomes.

The second chapter is an attempt to replicate, for the UK, the kind of ecological analysis of social capital and health which has been developed in other contexts, such as the US and Russia. We devise measures, for standard regions of England, which correspond to various aspects of social capital, and we relate these to outcome measures – regional variations in all-cause mortality. Although the standard regions of England compare in population, if not area, with the states of the US, we do not find relationships that compare, in terms of statistical significance, with those found in previous work. We offer some reasons why we think that is the case.

Having concluded that standard regions do not provide a promising scale at which to investigate links between social capital and health, we then turn to the question of obtaining measures of social capital for small areas. The basic problem here is that it is difficult to observe social capital for small areas – survey datasets do not contain sufficient respondents for subnational disaggregation; direct observation of community 'norms', for more than a small sample of areas, is prohibitively expensive; and the census does not ask relevant questions. Yet the probability of individuals engaging in, for example, voluntary activity, varies considerably between places even after allowing for compositional influences. This suggests a need to develop more refined measures. In Chapter 3 we consider the possibility of using several direct measures such as blood donation and voter turnout. These correspond broadly to indicators of the quality of social relationships in particular places. It could therefore be argued that they offer reasonable measures of the propensity of the individuals in a place to express either their trust in the political system, or an altruistic orientation towards their fellow citizens. We explain why we moved away from deploying these extensively as indicators of social capital.

Having concluded that direct measurement was unsatisfactory, our approach to the estimation of levels of social capital involved modelling the relationships between individual and area circumstances on the one hand, and behaviours thought to contribute to social capital formation on the other (Chapter 4). A multilevel modelling process was used to generate coefficients which were then applied to census data to produce estimates of various surrogates for social capital.

We then validated our estimates against other directly observed measures of constructs related to social capital produced, such as those generated by other research studies. We found a reasonable degree of consistency between our estimates and those produced by other authors (Chapter 5). The analysis of our estimates suggested that there was more than one dimension to social capital. The strongest element of it appeared to comprise a range of activities that involved direct, face-to-face contact with individuals in the locality through various channels (voluntary, political, altruistic or social activity). A second dimension, negatively correlated with the first, appears to be related to perceptions of community spirit (frequency of meeting friends and neighbours; friendliness of the neighbourhood; degree of community spirit), rather than to engagement with others.

The principal analytical findings from our analysis are then described in Chapter 6. We used the Health and Lifestyle Survey (HALS) for England, with postcoded data from this facilitating linkage to census data. HALS was conducted in 1984-85 and our response variable was the probability that individuals in HALS were still alive 15 years after that date (the respondents to HALS are regularly re-surveyed and the dataset updated). This was taken to be a function of their individual characteristics, individual health-related behaviours and the characteristics of the places in which respondents lived. The latter included both measures of material prosperity (eg deprivation scores) and our ward-level estimates of components of social capital. A modelling strategy was developed which explored the relationships between these individual and area influences on the probability of dying. This entailed fitting a range of models to the data, each representing a plausible combination of individual characteristics and ecological material circumstances, and ecological social capital indicators. We present a subset of these results in Chapter 6. The findings do not suggest that our social capital indicators, measured at this geographical scale, add much to the explanation of health inequalities. The effects of

ecological measures of social capital tended to be weak and/or operated in contradictory directions. There was some support for a mediating role for health-related behaviours and material circumstance in the relationship between social capital and mortality. In summary, however, effects were not strong once individual material circumstance and areal deprivation were taken into account.

In the concluding chapter we reflect on these findings and their practical implications. We believe that the methodology used to generate estimates is a valid one that has also been tested in other contexts, but we draw attention to some possible limitations of the estimation process. Notwithstanding this, we contend that this analysis demonstrates that at this geographical scale, social capital adds little to explanations of health outcomes that is not accounted for by individual circumstances and by area measures of deprivation. While there may be grounds on which one would advocate the promotion of social capital, these results suggest that public health alone is not one of them. In terms of other practical applications of this work we argue that the methods described provide a useful means of charting the broad contours of social capital. If, therefore, policies are to be predicated on raising the level of social capital, it will have to be recognised that the terrain on which these policies operate is an uneven one. The indicators produced here can provide guidance which will supplement local knowledge as to where such policies are likely to have most impact.

Chapter 1

Social capital, geography and health

Introduction

An interest in geographical variations in health outcomes can arguably be traced to the ancient Greek civilisation and the writings of Hippocrates (Macintyre and Ellaway, 2003) but the focus at that time was firmly on the natural environment, as evidenced by the title of possibly the oldest work of medical geography: Hippocrates' *Of Airs, Waters and Places*. Today, it is the social environment that attracts most attention. Material circumstances and individual characteristics and behaviours have not provided a full account of mortality differentials, and as a result scholars have turned to features of the social environment. The current interest in social capital is an element of this shift in focus.

In this chapter we review some of the explanatory problems that arise in seeking to demonstrate whether places have an independent effect on health outcomes over and above those which are attributable to the characteristics of the individuals who live there. (Those interested in a more comprehensive treatment of this question are referred to Kawachi and Berkman, 2003.) In brief, there has been a shift in emphasis away from material indicators (of area deprivation, for example) towards a stress on social epidemiology – that is, the influence of the social environment on health outcomes. A key suggestion has been that income inequality, as well as absolute levels of income, influences health outcomes, and that social capital plays a vital role in a causal chain leading from income inequality to health inequality. We follow other researchers in investigating the possibility that some of the variability in health outcomes might be explained by variations in levels of social capital between places, and we review arguments which imply that the geography of social capital would be uneven. Then we provide a critical review of previous studies of the influence of social capital on geographical variations in health outcomes.

Explaining inequalities in health: from social deprivation to social capital

A growing body of research contends that the place in which you live makes a difference to health-related behaviour and its outcomes (Jones and Moon, 1993; Macintyre et al., 1993). Health outcomes thus depend not only on individual characteristics (age, gender, occupation, etc) but also on the 'ecology', or the surrounding environment in which individuals live and work. The supporting evidence for this proposition includes:

- Differences in health profiles between places with broadly similar socio-economic profiles (Ecob and Jones, 1998)
- Occupational differences in health status that appear to be wider in some geographical contexts than in others (Popay et al., 1998)
- Small but significant amounts of between-area variations in ill-health which remain unexplained at most scales of analysis (Shouls et al., 1996)
- Associations between area type (as revealed by classifications of census data) and unexplained high or low rates of health or premature mortality (eg Wiggins et al., 1998).

While statistical associations can therefore be demonstrated, it is less easy to describe the actual mechanisms whereby residence in an area affects health. Because of this uncertainty, Macintyre and Ellaway (2003: 25) suggest that it 'has almost been an article of faith' that geographical variations in health are merely the result of compositional effects rather than contextual factors, and much of the debate about geographical variations in health has featured these competing schools of thought. For example, Sloggett, Joshi et al. (Sloggett and Joshi, 1994; Sloggett et al., 1996) insisted that

evidence for excess mortality in deprived areas was explicable in terms of the concentration in those areas of people with adverse personal characteristics or circumstances. (This compositional explanation was somewhat contradicted by their finding of a residual north-south difference in mortality, even when deprivation and individual social characteristics were included in the model: see Jones et al., 2000: 1061).

The question of area effects on a number of social outcomes has attracted growing interest in the social sciences (see Dietz (2001) for a review of the technical problems; see Sampson (2003) and Macintyre and Ellaway (2003) for discussion of the implications for research on health inequalities). In a critical review of research on the effects of neighbourhood socio-economic context on health, Pickett and Pearl (2001) identify 25 studies of the effect of local area social characteristics on individual health outcomes, adjusted for individual socio-economic status. All but two reported a statistically significant association between at least one measure of social environment and a health outcome, though such contextual effects were generally modest and much smaller than compositional effects. Robert (1999) is concerned about the processes by which contextual influences affected health. She argues that 'community socio-economic level' is associated with individual health, over and above the impact of individual socio-economic position, but the effects are modest. Her review draws attention to several important problems affecting studies of such issues.

First, it is possible that reverse causation and selection bias will affect who lives where, thus influencing variations in health standards between places. This generates endogeneity (Dietz, 2001); most people have a degree of choice in where they live; some have more and some less; the degree of choice may be related plausibly to other determinants of health (eg wealth) and it may also contribute to psychosocial processes which affect health adversely (eg a sense of powerlessness). Consequently, what appear to be neighbourhood effects are in fact artefacts of the processes producing residential segregation.

Second, delimiting areas for study is problematic – most studies are forced to work with the data that exists and to analyse it at the geographical scale for which it is available (though there is now work emerging on the creation of 'bespoke' neighbourhoods, which will permit testing of relationships at a range of spatial scales, unconstrained by the availability of data solely for administrative units).

Third, there are definitional issues relating to how one measures community context (eg through composite or individual measures) and to the nature of relationships between community context and individual health.

Fourth, although the effects of community context may be small, their overall importance may be underestimated, to the extent that community socio-economic context shapes the socio-economic position of residents (for instance, by virtue of its influence on educational opportunities: Macintyre and Ellaway, 2003). Despite these criticisms, the general conclusion which can be drawn (see the reviews by Macintyre et al., 2002, or Pickett and Pearl, 2001) seems to be that where you live matters to health outcomes, but it is less influential than who you are. Furthermore there is not one single, universal area effect; instead, the effects seem to vary between places, health outcomes and population groups (Kawachi and Berkman, 2003: 9; Macintyre and Ellaway, 2003; Robert, 1999).

If differences in material circumstances or in population composition between areas cannot provide a complete explanation of health differentials, what plausible explanatory pathways might be considered? The contribution of Wilkinson (1996; 2001) is crucial here. He has consistently argued that individual risk factors and behaviours cannot account for all observed health variations. Moreover, in advanced societies, absolute levels of material prosperity cannot be held solely responsible for persistent health inequalities. While the ability of individuals to access and afford sufficient goods to survive and thrive in the contemporary world is seen as important for health and general wellbeing, Wilkinson's work has led a shift towards assessing the influence of social hierarchies per se in determining health outcomes.

The fundamental arguments brought together in Wilkinson's *Unhealthy Societies* (1996) can be summarised in two propositions. First, for developed countries, it is the most egalitarian rather than the richest countries that have the best health standards. Nations with an inegalitarian distribution of income have worse health than those with a narrower spread of income even after taking account of absolute income levels (Wilkinson, 1996: ix). Second, the most important links between disease and income inequality are psychosocial, operating through the

pathway of social cohesion. The central point here is that even for people living in unhealthy environments and damp housing, 'what matters most... is psychosocial welfare' (Wilkinson, 2001: 7). It is not the absolute standard of living in advanced economies that affects a population's health experience; instead, relative inequality influences levels of isolation, anxiety and insecurity, with the key causal pathway being chronic stress (Wilkinson, 1998; Kawachi and Kennedy, 1999). Wilkinson stresses that these arguments hold only for developed nations. In countries that have not yet 'progressed' through the epidemiological transition, material circumstances, and therefore absolute income, are still much more important in determining health outcomes.

As Berkman et al. (2000) observe, this is the re-emergence of a concept which has a long history; the importance of social circumstances and group membership in shaping life chances. Szreter and Woolcock (2003) review some of the reasons for this revival of interest, which include limited returns from public service delivery reforms, the persistence of health inequalities and signs of social disorder, and the salience of communitarian and neoliberal discourses (see also Coburn, 2000; Mohan, 2003).

The Wilkinson thesis has been subject to considerable discussion and controversy. Regardless of one's position on the merits of his arguments, his work leads to a consideration of social capital because he emphasises psychosocial aspects of the relationship between income inequality and health. In societies which are unequal individuals are more aware of their position vis-à-vis others against whom they compare themselves. These adverse social comparisons produce negative perceptions about relative position, which are translated into poorer health 'inside' (ie through biological processes) and 'outside' of the body (ie through social processes). Negative biological processes inside the body result directly in ill health via the psycho-neuro-endocrine mechanism or through the indirect result of stress-induced unhealthy lifestyles (eg smoking or high alcohol consumption). Outside of the body, invidious social comparisons lead to a breakdown in social cohesion and to an increase in anti-social behaviour. This is the point at which social capital enters the fray – essentially as an intervening variable which completes the chain of causative reasoning connecting income inequality and health. This requires a definition of social capital, and some consideration of how, and at what spatial scale, to measure it.

Social capital: issues of definition and measurement

Putnam's definition suggests that social capital refers to 'features of social organisation, such as networks, norms and trust' (Putnam, 1993a). If so, social capital is a property of a collectivity, and Putnam contends that if these norms and networks link large proportions of the community, and succeed in spanning underlying social divides (what he terms 'bridging' social capital), then enhanced cooperation is 'likely to serve broader interests'. Such norms and networks are said to be created through participation in various forms of associational and civic activity which involve face-to-face interaction, producing greater disposition towards trust. Broadly speaking, social capital is said to have beneficial effects on a range of social outcomes, such as health, where there is a growing body of evidence of associations between commonly used measures of social capital and health outcomes.

Conventionally, two distinct types of social capital are identified. 'Bonding' social capital is usually taken to refer to relations between members of a group or network who share a common aspect of identity (ethnicity, religion, gang membership). 'Bridging' social capital crosses such divides: the concept implies, through participation in associational activity, that relationships of trust can be built which transcend social barriers (class, race, etc). It is clear that bonding social capital can have negative outcomes – it may be produced through membership of groups which are socially exclusive, inward looking, and hostile to outsiders (consider teenage gangs, for instance), and it may therefore prevent individuals developing the multiplicity of what Granovetter (1985) terms 'weak ties', which can have socially beneficial outcomes.

It has been claimed that social capital has beneficial effects on both individuals (promoting better health, social interaction; increasing the probability of successful job search; providing a favourable climate for entrepreneurship) and communities (generally, stimulating economic development by making certain resources available that otherwise would be lacking – eg microcredit schemes or sharing of capital equipment). The concept has been deployed in explanations of economic growth and uneven development (both between and within nations), of the comparative 'success' and 'competitiveness' of cities and regions, of the effectiveness of government institutions

(inspired, of course, by Putnam's work on Italy (Putnam, 1993b), and of inequalities in health (for a fuller review, see Mohan and Mohan, 2002; PIU, 2002).

The British government's Performance and Innovation Unit (PIU) argues that the evidence for the beneficial effects of social capital is impressive, though it concedes that the evidence for health effects of social capital for communities (as opposed to individuals) is patchy (PIU, 2002: 29). What sometimes appears as the ubiquity of social capital has its problems – if social capital can explain everything, can it really explain anything? There have been strong claims for its explanatory efficacy. Putnam himself has argued that, if you give him data on social capital for the regions of Italy, he 'will tell you, plus or minus three days, how long it will take the average citizen to get their health bills reimbursed' (Putnam, 2001: 152); this seems to be over-egging the pudding somewhat).

Similarly, the PIU (2002) contends that social capital may facilitate regional development on the basis of a strong correlation between regional GDP and membership of civic associations for 11 regions in Britain. But correlation is not causality, especially with such a small number of observations, and there is of course the possibility that high levels of economic development were the cause of high levels of participation in civic associations, rather than the other way round.

Social capital must be distinguished from other properties of individuals, families or communities. First, it should be distinguished from human capital, which should be conceived as the endowment of *individuals* in the form of skills and competencies in performing productive tasks. Ostrom (2000) argues that social capital may be developed as a by-product of other activities in a community, while human capital tends to be generated through the more reflexive and purposeful efforts of individuals. It does not automatically follow that human and social capital are correlated. Clearly, human capital may be positively associated with health outcomes because of the influence of education on health-related behaviours.

Social capital should also be distinguished from *cultural* capital, in the sense in which Bourdieu conceives it, as possession of the cultural resources and skills necessary to participate in elite social interactions (see Portes, 1998). There are likely to be connections but cultural capital is largely thought of as a property of individuals. Others prefer the concept of social networks: these systems offer access to resources of a material or (possibly) non-material kind. However, while both social capital and social networks may enable individuals to gain access to other resources, the former is characterised as a public good to which all residents of an area have access, in contrast to social networks, access to which generally requires that an individual meets certain membership (eg religious affiliation) or entry criteria (eg qualifications or professional accreditation).

Social capital is not synonymous with social equality or inequality, nor with social cohesion. The former clearly refers to disparities in the material resources available to individuals. The latter is usually taken to refer to perceptions of community solidarity, safety or simply community 'spirit'. This is not the same as assessments of the degree of interaction with and trust in one's fellow citizens which are implicit in the idea of social capital, though there is clearly some degree of overlap, and some commentators note that social cohesion is subsumed under the more general concept of social capital (see Macinko and Starfield, 2001: 389).

Is there a geography of social capital?

Social capital is simultaneously an economic, sociological and political concept (Szreter, 1999). It can also be thought of as a geographical concept; a property of places or communities, if you like. If social capital is created through interactions between individuals it would seem reasonable to argue that the quality of relationships between individuals is shaped by, and itself shapes the character of, the contexts in which they live. Thus Putnam (1993a) suggests that networks of civic engagement:

- Foster norms of 'generalised reciprocity' by creating the expectation that spontaneously given favours will be reciprocated
- Foster coordination and communication, by producing channels through which information about the trustworthiness of individuals and groups can flow
- Embody past success at collaboration, thus serving as a template for future cooperation on other issues
- Increase potential risks to those who act opportunistically that they will not share in the benefits of current or future transactions.
  (Sirianni and Friedland, 1999)

Such processes operate at the level of communities because they relate to the quality of social relationships.

Are there grounds for anticipating variations between places in levels of social capital? Putnam's causal model, which implies that participation in various forms of associational activity contributes to the formation of social capital, suggests that this is the case. This is evident from an examination of the literature on political cultures, civic participation and patterns of membership of voluntary associations, and on the geography of the voluntary sector.

First, political participation and volunteerism vary by age, class, ethnicity and gender (Davis-Smith, 1998) and so, at a minimum, one would expect compositional effects to produce spatial variations. National surveys of volunteering in the UK revealed geographical variations (the range was from 17% to 31%) which were too great to be explained by variations in the composition of those living in different areas (Davis-Smith 1998; Lynn, 1997). Summaries of more recent national datasets (Coulthard et al., 2002; Williams, 2002) reveal similar patterns. Our own work, using multilevel modelling techniques to explore the geography of volunteering, builds on these studies in two ways. We show that the probability of an individual participating actively in voluntary activity varies between places, and we also demonstrate that the interaction between individual circumstances and area characteristics also varies depending on the context (Chapter 4). However, there are contradictory findings from the US, where an extensive review of research found little evidence of significant contextual effects (Wilson, 2000: 229).

Second, there is evidence from intensive studies of particular localities that the extent and character of participation varies from place to place. There is ample historical evidence for this from studies of memberships of friendly societies or contributory welfare arrangements (eg Gorsky, 1998; Gorsky et al., forthcoming), or of the formation of charitable or voluntary associations (Gamm and Putnam, 2000). Contemporary studies of political participation also indicate substantial place-to-place variations (eg Miller et al., 1996; Parry et al., 1992; Verba et al., 1995), which are attributed to local contextual factors. Thus Parry et al. (1992) contend that civic participation is very much shaped by 'an appreciation of local issues and problems' because 'most people's lives are conducted in the locality in which they reside'. They conclude that, after allowing for compositional effects, 'locality counts': in other words, there were locality specific variations in the form and extent of participation in the six localities studied (p347). These conclusions are broadly echoed by the results of the recent Citizen Audit for Britain (Pattie et al., 2004).

Third, the voluntary sector exhibits uneven development, as is well illustrated by the many statistical analyses that have been carried out in the US (eg Wolpert, 1990; Wolch, 1989; Wolch and Geiger, 1983). Other national and international comparisons confirm these variations (Kendall and Knapp, 1996; Salamon, 1995). Such variations have often been related statistically to the fortunes of local economies and/or to compositional effects. To the extent that such studies draw inferences about causality, they apparently contradict Putnam's causal mechanisms, since according to Putnam high levels of voluntary activity precede (rather than follow) economic development.

Fourth, several commentators argue that institutional structures can make a difference to levels of participation and, thereby, influence the formation of social capital. Examples might include the former Greater London Council's populist programmes aimed at enlisting a rainbow coalition (Mackintosh and Wainwright, 1987) and the many other efforts by central and local government in the UK to stimulate voluntary activity (Hall, 1999; Maloney et al., 2000). Studies of social capital formation in developing countries have made similar points (Fine, 1999). This evidence led Skocpol (1997) to emphasise the symbiotic relationship between institutional structures and the production of social capital.

Fifth, contemporary processes of uneven development may have an impact on the quality of social relationships and, therefore, on levels of social capital. The flight of capital from certain locations has certainly been associated with a decline in civility and increasing levels of crime (Anderson, 1990; Campbell, 1993; Wilson, 1987). This is a 'tipping point' argument: there comes a point at which normal social codes in neighbourhoods may break down (Subramanian et al., 2002: S32). Insofar as the affected neighbourhoods may be relatively small areas, this raises the question of the spatial scale at which social capital operates. Putnam does not commit himself on this point and, as we shall see, different writers adopt a pragmatic approach to this problem.

Finally, there are examples of deliberate localised efforts to stimulate community development in neighbourhoods evacuated by capital, as a strategy of economic and social

renewal. The ensemble of 'action zone' programmes promulgated by the present UK Labour government is an example: the intention is to stimulate voluntarism and enhance community capacity through partnerships between the public and private sectors and between voluntary and statutory services (Mohan, 2003).

As well as examining geographical variations, one profitable line of inquiry might be the extent of dispersion in levels of social capital. Much urban policy is concerned with small areas that, it appears, have gone past a threshold at which traditional behavioural codes do not apply (Forrest and Kearns, 2001; Social Exclusion Unit, 1998). However, it may be that voluntarism continues to thrive in other environments. If so, we may be dealing not with a generalised but a localised decline in social capital, the contours of which need to be charted.

Discussions of temporal trends in levels of social capital have not considered this issue. Putnam's (2000) exhaustive analysis of trends in the US says relatively little about whether disparities between communities are rising. His later edited collection (Putnam, 2002) called for efforts to chart the contours of social capital, but the contributions to that book largely focus on national-level studies. He is clearly concerned about the possibility of growing disparities in levels of social capital between communities within the US, although he insists that this is 'a hypothesis, not a confirmed generalisation'.

Reviewing the British evidence, studies by Hall (1999) and the Performance and Innovation Unit (PIU, 2002) likewise concentrate on national-level data. Hall argues that there may be emerging divisions between a 'well connected and highly active group of citizens with generally prosperous lives, and another set of citizens whose associational life and involvement in politics are very limited'. However, he does not comment on the possibility that these social divides in social capital might translate into variations in levels of social capital between places. This question is important. If social capital is declining, and if social capital is a causal influence on health standards, then this is hard to reconcile with the evidence that, overall, health standards are improving (Pearce and Davey-Smith, 2003). However, if the distribution of social capital is changing, so that there are widening gaps between places in terms of levels of social capital, this might provide a way of reconciling the apparent paradox.

In short, then, there are reasons to suppose that there is a geography of social capital; the evidence implies substantial variation in the presence of, or participation in, organisations credited with producing social capital. Accepting this criticism, this in turn raises the question of how one devises spatially disaggregated measures of social capital.

Measuring social capital for communities

Authors differ on issues such as the scale at which social capital should be measured, and the indicators that can be used to measure it. While neoclassical economists apply a narrow definition, conceiving social capital as a property of individuals, political scientists have characterised entire societies as being high or low in social capital (Szreter and Woolcock, 2003). In between these extremes there are considerable challenges for those who wish to measure social capital as a property of spatial units such as local government units, regions or states.

A key problem in developing measures of social capital for areas, regardless of their size, is that the concept refers to community norms, which cannot be directly observed. There have been some interesting attempts at what Sampson and Raudenbush (1999) refer to as 'systematic social observation' of behavioural norms, through covert observational techniques (video recorders traversing parts of cities in unmarked vans), but these could not easily be generalised beyond small areas without vast resources. However, their indicators have been used in studies of social capital and health within the city of Chicago (Lochner et al., 2003; Subramanian et al., 2003b).

There are other possibilities for measuring aspects of social capital. Harpham et al. (2002) draw on Krishna and Shrader's (2002) distinction between structural and cognitive components of social capital (see also Subramanian et al., 2002). The former measures the quantity and quality of associational links or activity, while the latter refers to perceptions of support, reciprocity, and trust.

Obviously, the structural component is more readily open to quantification, either because data on associational membership or political participation are often readily available or because it is susceptible to relatively straightforward survey questions (eg about the number and type of associations in which individuals are

involved). Studies which have used data on levels of associational activity as proxies for social capital include Narayan and Pritchett's (2000) use of group or association membership at the village level in Tanzania. They found that an increase of one standard deviation in such membership was associated with increases in household incomes by 20-30% per person. Similarly Veenstra and Lomas (1999) developed a range of measures of participation in civic and associational life in their study of Canadian provinces. Veenstra (2002) went on to create a 'social capital index' for health districts in Saskatchewan, Canada. He was unable to obtain a comprehensive listing of all clubs and voluntary associations in the province, and therefore contacted parent associations with subsidiary groups. This allowed him to map the number of such groups by health district. Additionally he obtained individual level data on associational membership which could, again, be mapped at health district level, and he also measured voter turnout. These indicators were combined to produce a composite index.

Others have used (or have considered using) voter turnout, blood donation or membership of environmental groups as indicators of community level social capital (Lindstrom et al., 2003; Lochner et al., 2003; Macintyre and Ellaway, 2003). However, such indicators are all aggregations of individual perceptions, characteristics or actions, and in that sense they may not be 'true' ecological measures. Instead they are just measures of the frequency with which a given social property recurs. Can social capital therefore be regarded as a true contextual construct or is it merely a function of the population composition of an area (Subramanian et al., 2002)?

The problems of relying on data regarding individual affiliations, behaviours or attitudes are well rehearsed by Paxton (1998) and Rich (1999). Membership statistics are available for a long time-series for some key organisations, but simply counting aggregate numbers and presenting trends for single indicators may not tell us very much. For example, what are the ramifications of associational membership for one individual, or for the area in which he/she lives? To explore this one would need individual-level data about other aspects of participation by individuals and how such participation was related to the formation of social capital. Associational membership may also have different implications for social capital, depending on the type of organisation to which one belongs. Even Putnam's paradigmatic choral societies differ in the kinds of members they attract and in the norms or dispositions which they foster (Stolle and Rochon, 1998; Eastis, 1998). And some associations are clearly exclusive and inward looking, whereas if Putnam's causal model works at all, it does so by promoting 'bridging' social capital – cutting across social divides, not reinforcing them (Portes, 1998; 2000). Finally, rather than social capital determining the character and vitality of political institutions, could it not be the other way round, with political institutions determining the character and extent of voluntary activity (Skocpol, 1997)?

Cognitive elements of social capital are typically investigated through questions about trust, reciprocity, perceptions of fairness and social responsibility. Of the various possibilities, Halpern (1999; see also PIU, 2002) believes that the level of trust people have in institutions or their fellow citizens is the best indicator of social capital. He therefore recommended inclusion of a measure of trust as part of routine government social surveys. This might give rise to problems, at least in comparative studies, because of the context-dependent nature of responses (Knack and Keefer, 1997). And while such a measure could be used for comparisons within individual societies (eg between sub-national units), again, the question to be asked is whether such a measure is an index of social capital, or an outcome of it. The more general point to be made is that social capital indicators, whether structural or cognitive, are usually aggregations of the properties or characteristics of individuals resident in an area. It is not easy to overcome such a problem, and we simply acknowledge it, as others have done (Lochner et al., 1999; Subramanian et al., 2003b).

Social capital, geography and health: a review and critique of previous work

We now look at the way social capital has been operationalised in the study of geographical variations in health outcomes. The main studies of social capital's influence on health outcomes have been well summarised by Macinko and Starfield (2001). A range of definitions have been used, and analyses have been carried out at various scales.

Many studies of social capital and health have been conducted on data relating to individuals and have used

data on individual aspects of social capital as independent variables. Here social capital appears to be used almost interchangeably with social networks or social support (see Szreter and Woolcock, 2003) with a considerable body of evidence implying that social capital influences individual health standards through a social support mechanism. This might be through enabling individuals to access health-related information and resources, or it might be through direct material support for individuals to which they would otherwise not have access. Szreter and Woolcock (2003) quote several analyses at the individual level which bear out the contention that social capital is beneficial (for example, Veenstra, 2000; McCulloch, 2001; Rose, 2000) in relation to outcomes such as mental health, susceptibility to depression, perception of wellbeing and self-related health. They therefore claim that the body of evidence supporting an effect of social capital on health is impressive.

What of the evidence that, when conceived as a property of places or geographically defined communities, social capital has a beneficial effect? We first review the lessons to be drawn from studies which have considered this question before discussing the general explanatory problems which arise.

For our purposes the most relevant studies are those which have investigated associations between area measures of health and area measures of social capital. Kawachi et al. (1997b) tested ecological associations between various aspects of social capital (trust, perceived lack of fairness, perceived helpfulness of others, and membership of groups) and mortality rates for American states. There were associations between social capital, income inequality and mortality, and their analysis suggested that income inequality acted through social capital to influence mortality. Kawachi et al. (1999a) used three measures of trust, reciprocity, and civic engagement and argued, using a multilevel model, that people living in states characterised by low levels of social capital tended to have higher probabilities of lower self-reported health. Even after controlling for individual-level variables (socio-economic characteristics and health-related behaviours) residence in a low social capital area was still associated with an excess risk of reporting fair or poor health.

Kawachi et al. (1999b) demonstrated an association between social cohesion and violent crime. There was a strong correlation between income inequality, crime and social trust at the state level, suggesting a link between income inequality and social cohesion. A similar analysis was conducted by Kennedy et al. (1998) on the Russian mortality crisis. Their various indices of social capital and social cohesion were strongly associated with age-adjusted mortality and life expectancy for both men and women.

Walberg et al. (1998) also used crime as an index of social cohesion in Russia, using regression analysis to 'explain' the regional variations in the fall of life expectancy which occurred after the collapse of communism. Reductions in life expectancy were most closely associated with labour turnover and were greatest in regions where crime levels were highest and where incomes were most unequal. Their causal model postulated that acute economic transition (measured through indices of labour turnover), in the presence of low social cohesion and inequality, led to a decline in health, though this was at least partly mediated by behavioural changes.

Blakely et al. (2001), in a multilevel study, explored the relationship between voting rates and self-rated health in the US. There was no direct association between income inequality and variations in voter turnout (suggesting that the connection between inequality and this dimension of social capital was not clear) but there was a suggestion that individuals living in states with low voter turnout had increased odds of fair or poor self-rated health.

Subramanian et al. (2001b) investigated the health effects on individuals (measured in terms of the probability of self-reported poor health) of state-level income, income inequality and social capital. As absolute income increased, the probability of reporting poor health decreased. There were modest effects for income inequality for high-income groups but not for other income groups. Finally, the probability of reporting poor health increased significantly as state-level social capital declined. The authors thus contend that this study 'demonstrates an independent effect of social capital' (Subramanian et al., 2001b: 16).

Some more recent studies have explored relationships at a smaller geographical scale. Lochner et al. (2003) provided a cross-sectional analysis of the relationship between social capital and mortality for 342 neighbourhood clusters in Chicago. They found that higher levels of neighbourhood social capital were associated with low mortality for white people, even after adjustment for neighbourhood deprivation. For black people, however, the associations were less consistent and often not statistically significant.

Subramanian et al. (2002) found complex effects of community level social capital on the probability of reporting self-rated poor health in 40 communities in the US. Higher levels of community social trust were associated with a lower probability of reporting poor health. Controlling for individual-level perceptions of trust, however, rendered the main effect of community level social trust statistically insignificant. However, there was a complex interaction effect in that the health-promoting effects of community level social trust were apparently greater for high-trust individuals. So, if social capital does have beneficial effects, we cannot assume that it is equally beneficial for all; it 'may be "good medicine" only for for those who express high levels of trust or who value trustworthiness in others'. Furthermore, once allowance was made for the individual compositional effects of socio-economic status, 'communities do not make a difference to poor self-rated health' (Subramanian et al., 2002: S31).

These studies seem to indicate some support for a possible link between community level social capital and health outcomes, but there are several unanswered questions, relating in particular to the causal connections between social capital and health. Criticisms of social capital as an explanatory pathway also arise from scepticism as to the scale at which it is alleged to operate, and (in some cases) from dissatisfaction with the analytical methods used to demonstrate its influence.

Causal connections

Despite the strength of the associations between community level social capital and health outcomes, specifying the causal connections between the two is not easy. How might community level social capital influence health outcomes in such a way as to produce variations in health outcomes between places? Are health outcomes explicable in terms of variations between places in levels of social capital? Alternatively, is the pattern of social capital merely a reflection of the outcomes of broader political and economic forces?

Three possible mechanisms have been suggested. The first is disinvestment in human capital. Kaplan et al. (1996) found that US states where income inequality was high spent less of their state budget on education, producing poorer educational outcomes with longer-term effects on health. This requires an explanation of how income inequality produces a social and political climate that in turn leads certain states to pursue these policies. One argument is that individuals can only benefit from public expenditures to a certain and finite extent: therefore, as their income rises, the very wealthy are likely to become more resistant to taxation. This means that localities with an unequal income distribution will find it harder to secure support for redistributive policies.

A second mechanism might be through the direct psychosocial effects of adverse social comparisons. It has been suggested that widening inequalities in the US have been associated with a culture of upward social comparisons. Regardless of the fact of rising incomes, most households believed that their financial resources were inadequate. Anthropological evidence suggests that communities possess shared cultural models of acceptable standards of living, which individuals seek to achieve. Adverse health effects ensue to the extent that individuals fail to attain the cultural ideal (Kawachi and Kennedy, 1999: 222-4). In other words, living in neighbourhoods in which one is constantly aware of one's relative social position can lead to stress and, in turn, to worse health experience. Another possible avenue for investigation that this suggests is that the degree of heterogeneity or homogeneity of a neighbourhood may have health effects.

Third, income inequality may be associated with the erosion of social capital. The evidence of strong cross-sectional correlations between measures of income inequality, mortality and social capital has led to suggestions that the three are causally related. Thus, individual communities may experience a better health record than places of similar socio-economic status because of high levels of social cohesion, trust and respect. Conversely, residents of states characterised by high income disparities tend to be more mistrustful of each other. This could result in enhanced levels of psychosocial stress, or in the passage of social policies which adversely affect the poor.

Such convoluted explanations are challenged by Mellor and Milyo (2001). They do not find a coherent body of evidence in support of an association between income inequality and health. If there is an association, it results from the omission of variables which simultaneously affect income inequality and health, such as economic growth. If there is no meaningful link between income inequality and health, they argue, there is no need to interpose social capital as a mediating variable between income inequality and health inequality. (Mellor and

Milyo, 2001: 515). They agree that perceptions of relative deprivation might induce unhealthy or antisocial behaviour on the part of some individuals, but they cannot see 'why income inequality at the country or state level should be a good proxy for whether an individual feels well treated'. In Mellor and Milyo's view there is no coherent theory of precisely how income inequality might interact with political institutions to the detriment of population health. Given this, critics contend that the strength of the claims made by Putnam (2000: 326-31) for the health effects of social capital is unfortunate, as it threatens to foreclose debate (Pearce and Davey-Smith, 2003).

These comments signal a wider concern about whether social capital is genuinely independent of material circumstances. This is obviously important if greater explanatory reliance is to be placed on social capital as opposed to, say, social position or socio-economic deprivation. Lynch et al. (2000a), for example, contend that at a national scale there are stronger associations between GDP per capita and indicators of social capital (such as memberships of voluntary organisations) than between social capital and income inequality. This is not strong evidence for a claim that income inequality affects health outcomes through social capital. Rather, it suggests that material circumstances matter more.

Our own work (see Chapters 3 and 4) suggests that material circumstances in neighbourhoods are strongly associated with the propensity, on the part of individuals, to engage in behaviours relevant to the formation of social capital. These problems suggest that social capital may simply be capturing surface manifestations of structural inequalities, and this is why critics contend that interpretation of health inequalities should begin with structural causes. In this light it is interesting to note Muntaner and Lynch's (1999) observation that indicators of social capital typically exclude forms of participation – union membership, for instance – which are structured along class lines. The types of formal voluntary organisations discussed by Putnam do not exhaust the range of forms of community participation. They may consequently under-represent levels of social capital in certain types of community. For example Williams (2002) notes the under-reporting of informal voluntary activities by national surveys, which tend to emphasise more organised and formal activities. Informal volunteering is therefore beneath the radar of such activities. These indicators thereby underestimate the strength of social capital in poor communities, and overestimate the variability in levels of social capital between places. From this perspective the choice of indicators serves to deny the possibility of a materialist interpretation of health inequalities. When such an analysis is carried out, social capital appears to be less significant as an explanatory factor. For instance Muntaner et al. (2002) provide a cross-sectional analysis which shows, for 16 wealthy nations, that social capital was less strongly associated with population health indicators than with indicators of economic inequality and working-class power.

Furthermore, by defining social capital as a form of horizontal and informal social relations, analysts obscure or ignore the 'crucial role that vertical, institutional social relations (political, economic, legal) play in structuring the environments in which informal relations play out' (Lynch et al., 2000b). There is also the question of the regressive political implications of social capital, since it can be used as the basis for policies predicated on self-help rather than redistribution. Lynch et al. (2000b) therefore favour a neo-material interpretation, which argues that the effects of income inequality on health are related to a combination of adverse social comparisons and lack of resources held by individuals, along with systematic under-investment across a wide range of infrastructures. Thus income inequality does not have independent causal powers, but is instead 'one manifestation of a cluster of neo-material conditions that affect health'. The associations between income inequality and health may break down if income inequality is less clearly linked to investments in health-related public infrastructures. If these authors are correct, social capital adds nothing to explanations of health inequalities. This implies the need for an analytical strategy which assesses the relative contributions of individual and area circumstances, and of social capital and material indicators of deprivation.

Spatial scale

Much work on social capital and health has involved analyses for large spatial units – for example, several of the best-known papers report analyses carried out for states in the US, or units of a similar size in the Russian Federation. Occasionally, there is analysis for smaller spatial units, as in the 40 communities analysed by Subramanian et al. (2002), which were described as a broadly representative sample of communities in the US. Much depends on how meaningful the spatial units are; in Chapter 2, for example, we show that the relationships found by Kawachi et al. (1997b; 1999a) for the US

cannot easily be replicated for regional units in the UK. This may reflect the differences in the character and meaning of these units because the standard regions of the UK are merely administrative divisions. Whether this matters depends partly on our understanding of the processes involved. If poor health status is really caused by a lack of investment in human capital, and if the major political decisions governing such investment are taken at the state level, then analysis at that spatial scale may be appropriate. On the other hand, if social capital affects health outcomes through a process of adverse social comparisons, a smaller scale would seem appropriate.

Drawing on the income inequality literature, Wagstaff and van Doorslaer question the emphasis on state-level income inequality because the effect of measured income inequality 'ought to be stronger when measured closer to home than when measured at a level involving as many people as a state' (2000: 563). There are different opinions here. Cattell (2001) and Morrow (1999) present plausible cases, based on intensive qualitative research, to suggest that the analytical focus should be on small areas. Soobader and LeClere (1999) develop an interesting argument, and one with ramifications for social and spatial policy. Though their case was made with reference to the debate about income inequality, it is relevant here. They argue that income inequality is manifest through residential spatial segregation of poor and rich households. When there is low income inequality, sharing of resources occurs, so that the poor benefit from facilities shared with the rich. However, at extreme levels of inequality, the rich and poor share neither physical spaces nor communal services. This in turn produces, and is sustained by, the decay of social capital and social cohesion as societies become more fragmented.

Soobader and LeClere hypothesise that, at the smallest geographical scale (the census tract in their American study), individual socio-economic characteristics are likely to absorb most of the effect of income inequality, but at the county level income inequality will 'generate more economic segregation with associated geographic consequences' (p736). Thus they contend that the spatial scale at which these effects operate is neither at census tract nor at state level, but at the intermediate scale of counties. This finding – for which their published paper actually presents fairly weak statistical support – echoes Wilkinson's (1996: 81) view (in a critique of Ben-Shlomo et al., 1996) that 'many of the important social structures which define our social position are not confined to small areas but involve wider processes of social comparison'.

Apart from the work of Subramanian et al. (2002) there have not been studies of the influence of area social capital at intermediate scales between states and small areas. Wilkinson (2002) contends that an attempt to research the effects of income inequality on health for small areas is likely to produce inconclusive results because the choice of smaller areas for analysis converts variance (what would be income inequality in large areas) into absolute income. Hence 'associations between income inequality and health tend to be strongest in larger areas and weakest in smaller areas, while the opposite is true of associations between median income and health'. In other words, the results of such analyses are scale dependent. By extension, if social capital is the pathway through which income inequality affects health outcomes, we should not expect to find demonstrable effects of it for small areas. However, recent research (Subramanian et al., 2003b) does claim that, for small areas in Chicago, social capital can be regarded as a true contextual construct.

A different perspective is provided by recent work on income inequality and health for small areas in Denmark and Japan (Osler et al., 2002; Shibuya et al., 2002). This work shows that effects of income inequality are context dependent: in both of the societies under consideration welfare regimes mitigate the impact of socio-economic segregation of the population, and thus the effects of income inequality are far less evident than in the US. By extension, if social capital is not independent of institutional structures, it seems reasonable to acknowledge that spatial disparities in social capital will take different forms in different welfare regimes.

The general point to be made on the basis of this review is that there are no a priori grounds for believing that one spatial scale ought to be preferred over another. In fact, Subramanian et al. (2003a) contend that statistical models should take account of interactions at a range of spatial scales.

Analytical strategy

Critiques of work on income inequality, social capital and health have been provided by Wagstaff and van Doorslaer (2000), Macinko and Starfield (2001) and Mellor and Milyo (2001). Criticism is directed particularly

to the problems of drawing inferences from aggregate data and from cross-sectional studies. While these critiques are mainly aimed at the literature on income inequality, broadly similar points could be made, by extension, about work on social capital. Mellor and Milyo (2001) are concerned at the use of cross-sectional analyses to investigate what is essentially a dynamic process – most studies focus on a single year but, if there is genuinely a rise in income inequality and/or a decline in social capital, then analyses are needed which track change over time. So far we do not have such analyses, though Pearce and Davey-Smith (2003) question the plausibility of the links given that health standards are improving at the same time as social capital is allegedly declining. The criticism of aggregate and cross-sectional studies is that they cannot be used to distinguish between competing hypotheses. The early work of Kawachi and associates offers a good illustration of the problems that arise (Kawachi et al., 1997a). Superficially, there was a striking gradient demonstrating an inverse association at state level between mortality and indicators of social capital, such as trust. However, Kennedy et al. (1998: 2038) note the explanatory problems this poses:

> *'Arguably, the mortality-social capital link could go either way – higher mortality rates in a region could serve to erode social cohesion rather than the reverse. Indeed, crude death rates... predict most of the variables used in our models.'*

Similarly, Lochner et al.'s (2003) analysis of mortality rates in Chicago did describe some associations between social capital and mortality rates, but the authors admitted the possibility that 'higher death rates led to erosion of trust and other indicators of social capital' (p1802). Mitchell et al. (2004) have put this point rather more pungently: commenting on the negative association between violent crime and indicators of social capital, they point out that people would be well advised not to trust one another in communities where violent crime is high, but lack of trust is the outcome, not the cause of the relationship.

Such aggregate analyses cannot distinguish the causal processes involved. Nor can they separate compositional and contextual influences on individual health outcomes. Multilevel approaches can help resolve the second of these problems, but not the first. Thus far, few studies exist which have adopted such an approach to the study of social capital. Subramanian et al.'s (2001a) argument for multilevel analysis was that most empirical analyses of income inequality and health have fallen short of recognising the multilevel nature of influences on individual health, from neighbourhoods, through regions, to states. Their argument, which we would endorse, is that a successful modelling strategy needs to encompass the following:

- It is crucial to distinguish the individual (compositional) sources of variation from the place (contextual) ones to minimise confounding. It is imperative to maintain these two levels in any analysis
- If places do indeed vary, once allowance is made for individual, compositional characteristics, it is necessary to determine whether the variation is the same for different social groups
- It is also necessary to examine cross-level interactions; for example, in analysing health-related behaviour, does the probability that an individual with certain characteristics will smoke vary from place to place?

Where such studies exist, they add depth to our understanding of the influence of social capital on health because they draw attention to the complexity of the effects – for example, the effects of area-level social capital may be greater for some groups than for others. Our work essentially attempts to build on this by providing small-area estimates of social capital for electoral wards. This does not entirely meet the objections of those who argue that analysing the relationships between social capital and health requires tests at various spatial scales, but it does allow us to offer an investigation of the relationship between social capital and health at a lower level of aggregation than hitherto available in the UK.

Conclusions

The central aim of this chapter has been to draw attention to problems encountered in previous research on the impacts of social capital, considered as a contextual influence, on health outcomes at the individual level. We contend that there are reasons to expect geographical variations in levels of social capital, and we discuss ways in which community level social capital might be measured. However, a key problem is the geographical scale at which social capital might be measured. There is no agreement on this, and ideally one would conduct tests at a range of spatial scales. We have therefore given much attention to the

development of small-area measures of social capital, either through direct measurement or through indirect estimation of structural components of it. Much of this book (Chapters 3-5) is therefore devoted to a discussion of how we attempted to meet the challenge of obtaining and evaluating small-area measures of social capital.

Having regard to the limitations of other work our preferred analytical strategy is one which simultaneously models individual and area characteristics, using multilevel modelling. This strategy also allows us to compare the effects of our social capital measures for small areas with the effects of measures of deprivation for the same areas. We cannot resolve all the criticisms of previous work – for example, we present results for one spatial scale (electoral wards) and we do not have time-series data which would permit an assessment of how the relationship between social capital and health outcomes has changed over time. Nevertheless we believe that our work is innovative in a British context because of its analytical strategy and the comprehensiveness of its local measures of social capital.

The more general issue raised by these discussions concerns the extent to which area effects can be detected, over and above those due to the composition of the population. This topic is attracting increased attention in the social sciences (for a recent review, see Dietz, 2001) and its implications are important: they concern whether policies to improve health should focus on people, on places, or on a combination of the two. We return to this debate in the concluding chapter.

Chapter 2

An ecological analysis of relationships between income inequality, social capital and mortality for England

Introduction

We begin our consideration of the influences of geographical variations in social capital on health with an attempt to replicate, for England, the approach taken by several studies which used aggregate data for the US states. As shown in Chapter 1, there was evidence of an association between high income inequality, low levels of trust, low membership of voluntary organisations and higher disease-specific death rates. No extant study has directly sought to replicate this work in the UK. While we acknowledge that the regions of England do not equate with the states of the US in terms of area, the population base is comparable and we can undertake a similarly defined aggregate, large-scale analysis of such relationships. Furthermore, recent work has relied on regional-level data to support arguments about the advantages of social capital (PIU, 2002).

Construction of an English equivalent of the state-level indicators of social capital produced in the US has been handicapped because the national household surveys that ask questions on topics relevant to social capital (see appendix 1) contain insufficient respondents for reliable regional disaggregation. This comment certainly applies to sources such as the British Household Panel Survey (BHPS) and the General Household Survey (GHS). Furthermore these studies do not contain data that would allow the calculation of measures of income and income inequality. However, an exception to this general verdict is the Survey of English Housing (SEH), which covers approximately 20,000 individuals, giving a substantially firmer base for regional-level estimates.

We first describe the data that are available in the SEH, and show how they can be used to construct measures for standard regions of various dimensions of social capital, mean income and income inequality. We then analyse the use of these indicators in an aggregate analysis of all-cause standardised mortality ratios (SMRs). The results do not show strong associations between social capital and all-cause SMRs and in our concluding discussion we consider why this might be so.

Data and methods: the Survey of English Housing

The Survey of English Housing (SEH) is an annual survey commissioned by the the relevant government department (currently the Office of the Deputy Prime Minister, ODPM) to provide information on housing circumstances in England. This continuous survey began in April 1993 and up until 1999 was undertaken by the Office for National Statistics, Social Survey Division; it is now administered by the National Centre for Social Research. The survey is designed to be as consistent as possible from year to year with a standard set of core questions and a set of varying attitude questions. In 1997, a sample of 25,902 eligible households was derived via the postcode address file. Of these, approximately 84% (21,802) participated in the survey with data on household income available for approximately 18,800 households (87% of the participating household sample). The results presented in this book were derived from the electronic file that contains data on anonymous individuals and households; this file was supplied by the Data Archive at the University of Essex (DETR, 1999).

Attitudinal data

A number of special attitude questions were asked in the 1997 survey that relate to some of the concepts surrounding various elements of social capital. While there are no questions in this year of the survey that relate directly to civic participation, levels of trust or norms of reciprocity, there are questions that arguably

draw on some of these aspects of Putnam's definitions of social capital. Table 2.1 lists the questions grouped into four conceptual areas.

Questions in Group 1 capture an element of the strength of community or neighbourhood by first asking a question that assesses directly the presence or absence of 'community' spirit. The second question addresses the friendliness of the neighbourhood while the third probes for the presence or absence of other close relatives in the area. Although this latter question does not directly monitor aspects of community or neighbourhood it does provide some indication of the ability of individuals to turn to other members of the family for help, support and friendship, albeit on the assumption that close relatives can be relied upon to provide such services. Similarly while the first two do not measure 'trust' directly, a strong sense of community and the presence of a friendly neighbourhood would seem to imply an element of trust between residents of an area and reflect levels of social integration.

The second group of questions survey an individual's perceptions of potential problems in their neighbourhood.

Table 2.1: Attitudinal questions from the 1997 Survey of English Housing

Group 1	Would you say that there is a lot of community spirit in this area? Yes/No On the whole, would you describe the people who live in this area as friendly or not? Would you say that they were: Very friendly, fairly friendly, not very friendly, not at all friendly Apart from the people in this household – do you have any (other) relatives in this area? Yes/No
Group 2	The following can cause problems for people in their area… Vandalism Graffiti Crime Dogs Litter and rubbish in streets Problems with neighbours Racial harassment Noise Indicate whether each is a serious problem, a problem but not serious, or not a problem Generally speaking, how secure do you feel when you are inside your home? Completely safe, fairly safe, not very safe, not at all safe
Group 3	Please could you tell me how good or bad you think your area is for the following things: Schools Public transport Street lighting Rubbish collection Leisure facilities General appearance Very good, fairly good, fairly bad, very bad
Group 4	From here, how easy is it for you to get to the following: A corner shop A medium to large supermarket A post office A doctor A hospital Very easy, fairly easy, fairly difficult, very difficult

Other research has argued that such problems (ie vandalism, graffiti, crime etc) are often evident in communities with low levels of social capital, possibly reflecting elements of social disorganisation (Sampson and Groves, 1989). Such communities are often described as lacking 'social cohesion', a construct very closely related to social capital (Lochner et al., 1999) and the two terms are often used interchangeably. Neighbourhoods with low social cohesion and low social integration may also be characterised by low levels of community networks. Furthermore, levels of informal social control, which are thought necessary for preventing negative acts such as vandalism and graffiti, are not sufficiently high. Sampson et al. (1999) has characterised these as part of a process of 'collective efficacy', which can also be thought of as the willingness and ability to act on behalf of the common good.

While it is individuals who provide the responses to the questions in Group 2, the subject matter is inherently ecological. However, developing a direct ecological measure of social capital is problematic. As Lochner et al. (1999) indicate, collective attributes can only be really captured via intrinsic measures of community characteristics. They use the examples of neighbours clearing their paths of snow after a snowstorm, and petrol stations requesting payment before or after filling the tank, as ecological measures of reciprocity and trust, respectively. The questions in Group 2 are not intrinsic measures of aspects of community social cohesion, 'independent of the individuals who live there' (Popay, 2000) but they do attempt to capture perceptions of these problems for the local neighbourhood.

The third group of questions again relates to ecological characteristics, but they are perhaps more fundamentally related to the relative wealth or spending policy of local government agencies. The presence or absence of some services and facilities may impact on social capital. For example, buildings such as schools and leisure centres act as 'local opportunity structures' which facilitate and sustain social interactions and networking (Macintyre and Ellaway, 1999). The standards of other community services and facilities such as street lighting, rubbish collection and public transport all add to the general perception of a place and research has suggested that people who live in declining areas tend to have negative perceptions about their capacity to exercise choices or their power to halt social disintegration (Popay, 2000). Some of the problems listed in both Groups 2 and 3 may have a direct or indirect impact on health. Vandalism, lack of street lighting, graffiti, and fear of crime all contribute to making an area less attractive for recreational use, since they discourage individuals from engaging in physical exercise through walking and jogging, and they reduce the likelihood that parents will permit children to play in their local neighbourhood (Macintyre and Ellaway 1999; Sooman and Macintyre, 1995). Such problems – or the perception that they are significant – may additionally result in chronic stress and thus impact on health directly. Arguably, fear and trust are negatively related and measures such as these have been used as a proxy for trust in other studies (Cooper et al., 1999).

The final group of questions represent more traditional measures of a person's ability to obtain access to resources for everyday living. Forrest and Kearns (2001) have emphasised that some of these facilities provide opportunity structures for sustaining social interaction and adding to the general 'feel good' sense about a place (Macintyre and Ellaway, 1999). Removal of services such as post offices or local shops may also have a psychosocial effect by contributing to a feeling of rejection by service providers, and in turn to the development of negative perceptions of an area.

For the analyses here, responses to most of the questions have been recoded. In those questions where there were more than two options for response, the results have been re-grouped to produce a dichotomised variable. For example, in the second question of Group 1, responses indicating 'very friendly' and 'fairly friendly' have been aggregated together as have 'not at all friendly' and 'not very friendly'. The same procedure has been followed for other attitudinal questions.

Data on income and mortality

Data on income is regularly collected in the SEH. The figures used here represent gross income for the head of household and partner where available. The figures have not been adjusted for household size and represent pre-tax income. Several indicators of income inequality were derived including the Gini coefficient (a measure of the extent to which the income distribution enjoyed by social groups – however defined – departs from a situation of proportionality) and the Robin Hood index (which is the proportion of income that would have to be reallocated to achieve an equal distribution of income). Other measures included the inter-quartile range (mid-spread),

the decile ratio (ie the ratio of the income for the richest 10% to the income of the poorest 10%), the proportion earned by the poorest 10%, the ratio of the poorest 50% to the poorest 10% and the ratio of the poorest 90% to the poorest 10%.

In this investigation of the income inequality, social capital and health debate for the standard regions of England we use data on all-cause SMRs for 15 regions of England. The data are derived from the Office of Population Censuses and Surveys Monitor Series VS (OPCS, 1997). There are 15 regional divisions because in some regions it is possible to distinguish between metropolitan and non-metropolitan areas.

Results

Attitudinal questions

From the survey, we generated regional summaries of responses to questions about the social environment. Our discussion focuses on perceptions of community spirit and neighbourhood friendliness. The highest levels of community spirit (56%) are found in the non-metropolitan North and in the South West (Table 2.2a). Lowest levels (39%) are found in Greater London. The non-metropolitan areas tend to exhibit higher levels of community spirit than the metropolitan areas. Community spirit is not synonymous with friendliness: a much higher proportion believes the people in their area to be friendly. All regions have proportions for neighbourhood friendliness above 90% and together with the North West non-metropolitan region, the highest levels are again found in the non-metropolitan North and the South West. In terms of social support from kin, the proportion reporting the presence of other close relatives in the area ranged from 34% in inner Greater London to 70% in the non-metropolitan North. High levels were also found in the Yorkshire regions, in the non-metropolitan regions of the North West and West Midlands and in East Anglia.

There are other contrasts, between and within regions, in relation to the perception of various neighbourhood problems (Table 2.2b). There are consistent differences between metropolitan and non-metropolitan areas: crime, vandalism and graffiti were consistently perceived as worse problems in metropolitan areas than in non-metropolitan areas, even within the same region. There was rather less differentiation between regions on the question of problems with neighbours and on racial tensions, but London's score on these measures was consistently high. Another dimension of interest here is the extent to which people feel 'secure in their own homes', but we found little variability between regions on this indicator.

Measures of income inequality

The regional summaries of absolute and relative income are shown in Table 2.3. The difference between the mean and median illustrate the presence of a positive skew in the regional income distributions, particularly for

Table 2.2a: Responses to questions in Group 1

Standard Statistical Region	Proportion who say there is a lot of community spirit in the area	Proportion who describe the people in the area as very or fairly friendly	Proportion who have (other) relatives in the area
North metropolitan	.50	.94	.63
North non-metropolitan	.56	.97	.70
Yorks and Humberside metropolitan	.50	.95	.63
Yorks and Humb. non-metropolitan	.53	.94	.60
North West metropolitan	.43	.95	.59
North West non-metropolitan	.51	.97	.62
East Midlands	.49	.93	.59
West Midlands metropolitan	.44	.94	.56
West Midlands non-metropolitan	.48	.95	.60
East Anglia	.53	.93	.63
Greater London – inner	.39	.85	.34
Greater London – outer	.39	.90	.48
SE Outer metropolitan	.47	.92	.53
Rest of South East	.50	.94	.57
South West	.56	.95	.56

Table 2.2b: Responses to questions in Group 2

Standard Statistical Region	Proportion stating that they do not have a problem with:								Proportion who feel secure
	Vandalism	Graffiti	Crime	Dogs	Litter and rubbish	Neighbours	Racial harassment	Noise	
North metropolitan	.35	.55	.23	.57	.53	.85	.95	.76	.95
North non-metropolitan	.45	.69	.29	.54	.60	.90	.98	.83	.95
Yorks. & Humberside met	.37	.67	.22	.61	.51	.89	.95	.78	.95
Yorks. & Humb non-met	.53	.82	.37	.64	.68	.90	.98	.84	.96
North West metropolitan	.36	.62	.22	.59	.46	.84	.96	.73	.94
North West non-metro	.49	.76	.32	.60	.60	.90	.98	.81	.97
East Midlands	.47	.75	.31	.67	.62	.88	.96	.79	.96
West Midlands metropolitan	.40	.66	.25	.71	.51	.86	.95	.76	.95
West Midlands non-metro	.51	.76	.33	.64	.62	.89	.98	.80	.96
East Anglia	.49	.80	.43	.69	.70	.87	.98	.78	.98
Greater London – inner	.36	.50	.25	.60	.46	.80	.83	.57	.93
Greater London – outer	.44	.61	.30	.65	.51	.83	.89	.68	.95
SE Outer metropolitan	.47	.76	.37	.73	.65	.88	.97	.73	.97
Rest South East	.48	.77	.39	.71	.66	.88	.97	.79	.97
South West	.49	.83	.31	.67	.68	.90	.98	.78	.98

Table 2.3: Summary measures for absolute income and income distribution

Standard Statistical Region	Mean	Median	Midspread	Robin Hood index	Gini coeffi-cient	Ratio of richest to poorest 10%	Proportion of income earned by poorest 10%	Ratio of poorest 50% to poorest 10%	Ratio of poorest 90% to poorest 10%
North metro	14327.09	9880.00	14040.00	32.73	34.00	16.09	1.95	9.85	35.19
North non-metro	15963.69	11700.00	15080.00	31.55	29.60	14.41	2.11	9.73	32.99
Y. & H'side metro	15957.25	11960.00	16120.00	31.35	31.10	14.30	2.01	10.14	35.45
Y. & H'side n-met	18174.58	12740.00	17940.00	33.62	32.32	17.22	1.75	10.55	39.93
NW met.	15359.67	10920.00	15080.00	31.94	32.30	15.73	1.89	10.44	37.18
NW non-metro	19495.85	14040.00	18188.75	32.97	31.40	21.32	1.53	12.38	44.04
East Midlands	18113.15	14040.00	16696.35	30.52	31.70	16.57	1.81	11.57	38.68
W Mids metro	16194.92	11700.00	16120.00	31.83	32.91	15.68	1.92	10.27	36.40
W Mids non-metro	18695.75	14300.00	17160.00	30.25	29.13	16.27	1.87	11.29	37.21
East Anglia	19628.00	15580.84	17160.00	30.51	30.87	18.46	1.68	12.23	41.07
GL – inner	22648.81	10920.00	18980.00	41.30	49.50	35.09	1.26	10.92	44.28
GL – outer	23897.04	17213.17	22360.00	33.56	37.30	23.57	1.41	12.87	47.35
SE outer metro	25483.12	20280.00	23400.00	31.20	31.55	21.38	1.47	13.71	46.64
Rest South East	21087.64	15860.00	20020.00	31.69	32.28	18.90	1.64	12.00	42.07
South West	19122.34	15340.00	17420.00	30.05	29.46	16.93	1.74	12.14	40.54

inner Greater London where there is a difference of over £11,000 between the two summary values. Inner Greater London also had the highest Robin Hood index and Gini coefficient, the highest decile ratio of income (the ratio of the income of the richest 10% of households to that of the poorest 10%) and indeed the smallest proportion earned by the poorest 10%. However, using the indicators shown in the last two columns of Table 2.3, this region does not report the most extreme value and this highlights the problem of trying to capture income inequality with any one measure. Instead the ratio of the poorest 50% to the poorest 10% gives the South East outer metropolitan region the highest value and for the final indicator, outer Greater London scores highest. Rather than describe the detailed distribution of each indicator across the regions it is perhaps more important to stress that different indicators are picking up different types of inequality and for this reason all were included in the subsequent analyses.

Table 2.4: Bivariate correlation coefficients between regional SMRs and measures of income inequality

	SMR	Mean	Median	IQR	GINI	RHI	T/B10	BOT10	R50_10	R90_10
SMR	1.000									
Mean	-.699**	1.000								
Median	-.763**	.798**	1.000							
IQR	-.660**	.961**	.839**	1.000						
GINI	.024	.376	-.236	.253	1.000					
RHI	.131	.295	-.335	.185	.954**	1.000				
T/B10	-.257	.690**	.131	.547*	.892**	.861**	1.000			
BOT10	.541*	-.880**	-.503	-.798**	-.642**	-.589*	-.886**	1.000		
R50_10	-.743**	.850**	.929**	.840**	-.039	-.140	.353	-.710**	1.000	
R90_10	-.635*	.925**	.708**	.903**	-.408	.346	.710**	-.950**	.862**	1.000

** Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).
Definitions:
SMR: Age and sex standardised mortality ratio (all cause) Mean: Mean of regional income Median: Median of regional income
IQR: Inter-quartile range (midspread) of regional income GINI: Gini coefficient RHI: Robin Hood index
T/B10: Decile ratio – ratio of proportion of income earned by the richest 10% to the income earned by the poorest 10%
BOT10: Income earned by the poorest 10% of households R50_10: Ratio of income share held below 50th percentile to that held below 10th
R90_10: Ratio of income share held below 90th percentile to that held below 10th

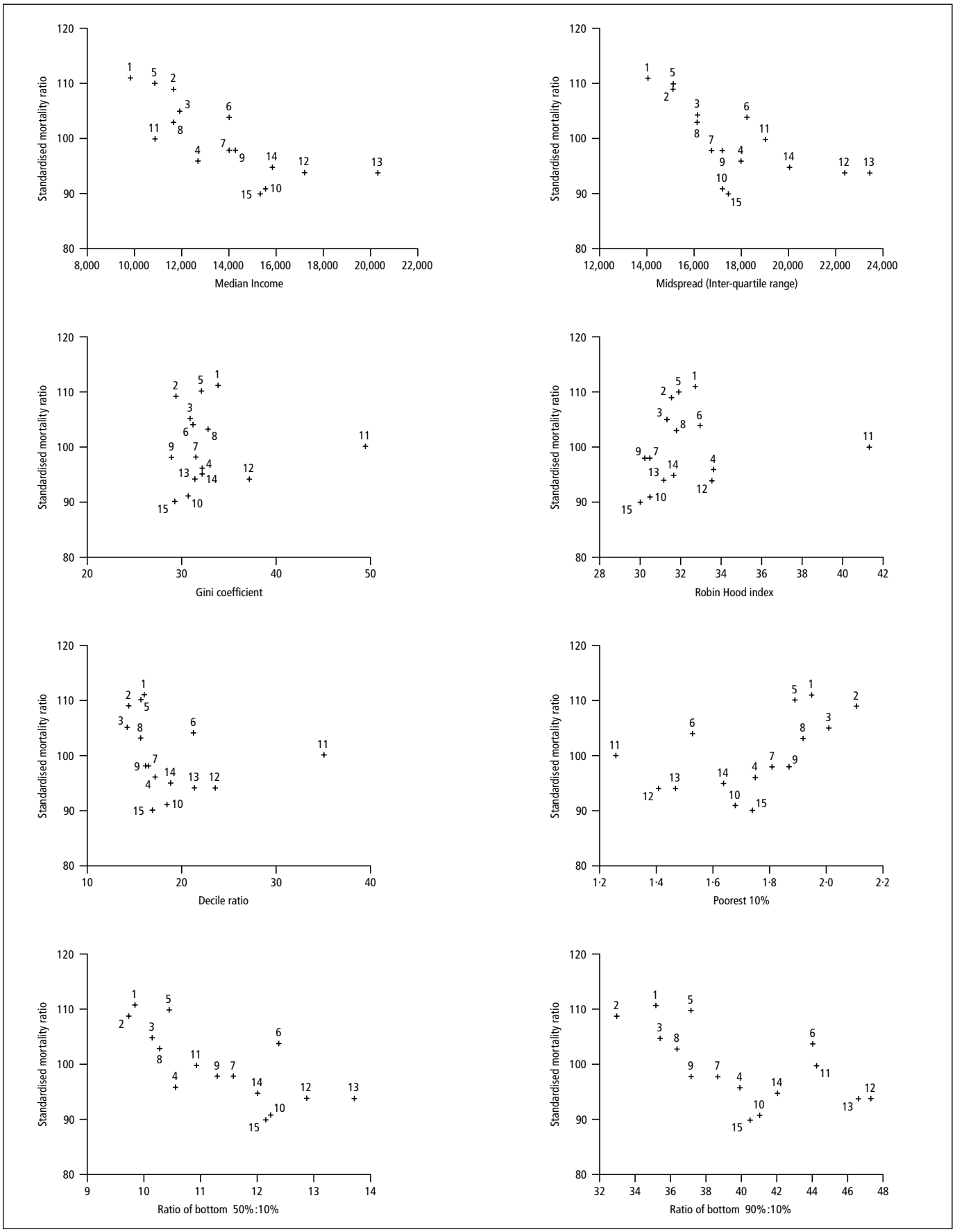
Comparing income inequality measures and SMRs

The bivariate correlation coefficients between the regional income distribution summary measures and the all-cause SMRs are given in Table 2.4. As mean income increases, SMRs decrease (r = -0.69, $p < 0.01$). The SMR is also significantly associated with the median income (r = -0.76), implying that absolute income at the scale of the standard statistical region is related to mortality. The relationships between the SMRs and the various measures of income inequality are more varied and the direction of association inconsistent. Only four of the correlation coefficients are significant, but in these the direction of influence does not support the income inequality thesis.

For example, the relationship with the mid-spread is significant – in this case, the correlation coefficient is -0.660 – but this implies that SMRs are reduced as the income distribution becomes more spread. Statistically significant negative correlations are also given for the ratios between the poorest 50% and 10% and the poorest 90% and 10%, where high values on these indicators represent greater inequality. Again as these measures of inequality increase, SMRs decrease. In addition, a significant positive correlation is given for the share of the income held by the poorest 10% (a higher value for this indicator suggests less inequality) and again this does not support the general income inequality hypothesis.

All of these significant measures of income inequality are also highly correlated with mean and median income and a simple analysis of these bivariate correlation coefficients cannot disentangle the relative influence of absolute and relative income on SMRs. The Gini coefficient and Robin Hood index have often been found to be significantly associated with death rates but here, although the correlation coefficients are in the expected direction, they are not significant. They are, however, both heavily influenced by the extreme values given for inner and outer Greater London (Figure 2.1). When these are removed from the analysis the bivariate correlation coefficient for the Gini coefficient increases to 0.356 but is not significant, while that for the RHI increases to 0.648 and is significant ($p < 0.01$, 2-tailed).

Figure 2.1: Scatterplots of SMR versus measures of absolute and relative income



The numbers of the regions correspond to the order in which they appear in Table 2.2. For example, region 11 is Greater London (inner)

Table 2.5: Regression analysis of mortality on indicators of income inequality, controlling for median income

Income inequality measure	ß (Regression coefficient)	Standard error	*t*-value	Significance	Adjusted R^2
Midspread	-0.000173	0.001	-0.193	0.850	51%
Gini	-0.227	0.255	-0.89	0.391	54%
RHI	-0.353	0.486	-0.726	0.482	53%
Decile ratio	-0.208	0.238	-0.876	0.398	54%
Poorest 10%	6.035	5.916	1.020	0.328	55%
Ratio of 50:10	-1.405	2.854	-0.492	0.631	52%
Ratio of 90:10	-0.298	0.409	-0.729	0.480	53%

NB The R^2 for a model with median income alone = 55%

Table 2.6: Partial correlation coefficients between SMRs and measures of income inequality, controlling for median income

Income inequality measure	Partial correlation coefficient with SMR controlling for income (*p* is one-tailed)
Inter-quartile range	-.06 ($p = .425$.)
Gini coefficient	-.25 ($p = .195$)
Robin Hood index	-.21 ($p = .241$)
Decile ratio	-.25 ($p = .199$)
Poorest 10%	.28 ($p = .164$)
Ratio of poorest 50% to 10%	-.14 ($p = .316$)
Ratio of poorest 90% to 10%	-.21 ($p = .240$)

When the measures of income inequality were each entered into separate ordinary least squares (OLS) regression models that also control for median income, none of the coefficients reached significance (Table 2.5) and there was no improvement over a statistically significant model that contains median income only.* The partial correlation coefficients are given in Table 2.6, suggesting that median income influences some of the observed relationship between each of the various measures of income inequality and SMRs. It is interesting to note now that the direction of influence of the Gini coefficient and the Robin Hood index has now changed (compare with Table 2.4) and is not supportive of the income inequality argument. The strength of the other coefficients has been reduced (apart from the decile ratio) and none are significant.

* The dependent variable, SMR, is made up of the ratio of two variables; observed, and expected deaths based on national age-specific death rates. Poisson regression with an offset could have been used here to deal with such a complex response variable. However, because we are dealing with regions with large population denominators, using the SMR ratio as the response and estimating with ordinary least squares is not problematic.

Comparing attitudinal questions and SMRs

Table 2.7 shows the bivariate correlation coefficients between SMRs and each of the questions in Group 1. Only community spirit appears to be consistent with what we would expect if there was a relationship between social capital and health (ie as the regional proportion who think that their area is characterised by a sense of community spirit increases, then the SMRs decrease) but the association is very low. None of the coefficients are statistically significant. Unsurprisingly, there is a strong statistically significant positive correlation between each of the three indicators showing that, at a bivariate level, regions which have a high proportion of community spirit also score high on perceptions of friendliness and levels of close relatives in the area. The association between the friendliness of an area and the presence of close relatives is stronger than the relationship between friendliness and community spirit. This suggests that perceptions of neighbourhood friendliness are based on contacts around the family rather than around the notion of a wider friendly community. This supports observations made elsewhere that community networks and ties are very strongly influenced in some areas by informal family ties rather than by more formal community networks (Campbell et al., 1999: 155). When the responses to these questions are each included in separate regression models that also control for median income, none of the coefficients reach significance but the 'friendly

Table 2.7: Correlations between SMRs and questions in Group 1

	SMR	Community spirit	Friendly people	Close relatives
SMR	1.000			
Community spirit	- .077	1.000		
Friendly people	.294	.722**	1.000	
Close relatives	.325	.763**	.916**	1.000

Table 2.8: Regression analysis of mortality on questions in Group 1, controlling for median income

	ß (Regression coefficient)	Standard error	*t*-value	Significance	Adjusted R^2
Community spirit	-6.538	23.257	-.281	0.783	51%
Friendly people	55.65	40.6	1.371	0.196	58%
Close relatives	18.227	14.567	1.251	0.235	57%

NB The R^2 for a model with median income alone = 55%

Table 2.9: Partial correlation coefficients between SMRs and questions on sense of community, controlling for median income

	Partial correlation coefficient with SMR controlling for median income (*p* is one-tailed)
Community spirit	-.08 ($p = .392$)
Friendly people	.37 ($p = .098$)
Close relatives	.34 ($p = .117$)

neighbourhood' and 'close relatives' components do improve the overall model slightly (Table 2.8). The partial correlation coefficients in Table 2.9 indicate that there may be an independent association between SMRs and the friendliness of a neighbourhood, whereby SMRs are higher in more friendly areas. However, this is a perverse result for those who believe in the health-promoting value of social capital; it suggests that as social capital rises, so does mortality. This may reflect the consequences of 'negative social capital' where sometimes the 'ties that bind' are too tight to allow individuals to make their own choices in life that are optimal for their long-term wellbeing (Portes and Landholt, 1996; Lynch et al., 2000a).

We also produced bivariate correlations between the aggregated responses to Group 2 of the attitudinal questions and SMRs. SMRs were significantly associated with problems concerning vandalism, graffiti, crime, dogs, litter and the proportion of respondents who feel secure in their own home. As these problems increase (including feeling insecure at home) then so does the SMR. However, when SMRs were regressed against each of these questions alongside median income in individual models, none of the coefficients were significant ($p < 0.05$). Problems associated with crime nearly reach significance and increase the R^2 value of the model from 55% (median income only) to 62%. Vandalism, graffiti, dogs and litter also increase the proportion of variance explained. None of the partial correlation coefficients between the Group 3 questions and SMRs were significant apart from crime, but the coefficients for relationships with problems with vandalism, dogs and litter approached statistical significance. The implication is that certain elements of neighbourhood cohesion may be related to SMRs independently of median income, but the relationship is not especially strong.

We also pursued, through correlation analysis, the relationship between SMRs and attitudinal questions on the quality of, and access to, various local services. In general, we found little evidence of strong correlations between these elements of the social environment and SMRs. Where there were such associations, they tended to become insignificant once median income had been taken into account.

Discussion and conclusions

Using 1997 SEH data, this chapter has indicated that there is no real evidence for a relationship at the regional level in England between all-cause SMRs and several measures of income inequality. If the data for inner and outer greater London are removed from the analysis, then a bivariate relationship in the expected direction is found for the Robin Hood index. However, when median income is introduced as a control in this relationship via linear regression analysis, the independent influence of the index on all cause SMRs is no longer present (results not shown).

Mixed results were found for the influence of various aspects of social capital and social cohesion on the regional SMRs. A positive association, independent of mean income, may exist between the friendliness of a neighbourhood and SMRs. This relationship, however, did not quite reach conventional levels of statistical significance in the partial correlation or regression analyses. The association was such that higher SMRs were found in more 'friendly' regions. The results also indicate that certain elements of neighbourhood cohesion, particularly problems associated with crime, vandalism,

dogs and litter, may be independently related to SMRs indicating that SMRs were higher where these neighbourhood elements were more problematic. Again, regression results were not statistically significant and a significant partial correlation was only found for problems related to crime.

The bivariate correlation coefficients for the Group 3 and Group 4 questions indicate that higher SMRs are significantly associated with negative perceptions of leisure facilities, the general appearance of an area and problems accessing a corner shop. Regression and partial correlation results, however, again show the importance of income in mediating between these relationships. In summary, there was very little evidence to suggest that the proxy measures of social capital and cohesion captured in the four groups of questions were related to SMRs independent of mean income. In the Wilkinson hypothesis, the relationship between income inequality and health outcome is mediated by measures of social cohesion (Wilkinson, 1996, 2001). This chapter has found little evidence for either an independent income inequality effect on health or an independent social capital-social cohesion link with health.

Given that others have found a statistically significant link between income inequality, social capital and health, why should the results here be so different? There are a number of possible reasons. First the data are derived from a national survey rather than a census. The survey may be prone to systematic measurement bias that may render it non-representative at the regional level. Unfortunately, due to the fact that income is not currently collected in the UK census, the only sources that can be used to validate the income data here are also derived from surveys, usually of a substantially smaller sample size (eg GHS, BHPS).

Second, the data have not been adjusted for tax, benefits and household composition but as Judge (1996) indicates this is much more likely to over-estimate the levels of inequality within the data, rather than to reduce them.

Third, the levels of income inequality may be too small to detect an effect of income inequality on health. In explaining the lack of income inequality influences on Canadian mortality, Ross et al. (2000) suggest that the relationship may be non-linear and that there are ecologically diminishing returns for areas characterised by low inequality such as those found in Canada. This argument cannot be applied to regional data for England because the measures of income inequality found here are more on a par with that of the US. In the UK, levels of income inequality increased from the mid-1970s to the 1990s but middle age and older age mortality declined dramatically. As Lynch et al. (2000b) stress, historical patterns of education and welfare provision, rather than contemporary levels of social capital, are most likely to explain this anomaly in the relationship between income inequality and absolute mortality. It may be that the consequences of increased inequality have yet to be seen in absolute regional mortality rates and as Chapter 1 contends, there is some evidence that relative mortality (ie mortality inequality across the social gradients) has actually increased during this time period.

Fourth, Wilkinson himself has continually stressed the importance of geographic place defined in terms of economic and social development and, more vaguely, geographic scale. He stresses that absolute living standards are far more important in poorer countries than relative wealth and the income inequality thesis cannot therefore be applied globally. Furthermore, as you move from larger to smaller areas, median income becomes much more important in explaining mortality than does income distribution. While England is obviously classed as a developed nation, the regional scale of analysis used in this book may not be relevant for capturing the effects of income inequality. The geographic level may be too small given the importance of median income in these results. This argument, however, contradicts the findings found by others for a relative income and relative deprivation effect operating at a much smaller geographical level than the region (Ben Shlomo et al.,1996; Boyle et al., 1999; Stanistreet et al., 1999).

Fifth, returning to our original aim of a UK comparison with the work of Kawachi and co-authors (Kawachi et al. (1997b; 1999a), there are very clear differences between the spatial units used. In the US the states may well be much larger than any of the English standard regions and, conversely, they may contain much smaller populations; Texas and Alaska are much bigger than regional units in England but the former are very sparsely populated. However, the comparison does not rely solely on size or population, but on whether the administrative units are meaningful contexts. The US states are important symbolic entities, with which people identify, and which are governed by elected representatives. There is an argument, therefore, that a sense of attachment to

place matters to their residents. In addition, they may pursue their own policies with respect to public expenditure and taxation, so that the kind of mechanisms postulated by Kaplan et al. (1996) (eg differential investment in human capital) may operate. There are indeed clear contrasts between US states in terms of the progressiveness or otherwise of their social policies (Staeheli et al., 1997), but whether these contrasts are an expression of income inequalities, of comparative levels of social capital, or of something else altogether, is debatable.

The situation in the UK is entirely different. Regional governance has always been weakly developed and the standard regions have until recently been no more than convenient units for the collection of data, with no effective powers and no democratic accountability. They are, consequently, not units which 'matter' to people, nor can they pursue genuinely autonomous social policies (notwithstanding recent reforms of regional governance). It is true that they are smaller than American states but this has not obviously contributed to the development of a sense of 'community'. Where there is strong evidence of regionalist sentiment it is confined to the peripheral regions of North East England and the South West. It is therefore even more difficult to specify a plausible mechanism whereby social capital, place and health might be connected than is the case in the US. We are thus led to the conclusion that the spatial units for which such an analysis is conducted must be ones that have meaning for individuals. This is certainly not the case for the standard regions of England though it may be relevant to US states.

On this point, we concur with Lochner et al. (1999), who also highlight the importance of geographical scale of aggregation. They stress that social capital can be influential at a number of scales but argue that different elements of social capital may be important at varying scales:

> *'For example, at the level of the local community, social capital depends much more on the day-to-day interactions between neighbours than on distal social policies. In contrast, the level of social capital at the state or country level is more likely to reflect the influence of culture, social and economic policies, and other macro-social forces.'* (Lochner et al.,1999: 269)

The mixed results for the influence of social capital in this chapter support the view that an overly simplistic view of the concept – particularly at such a large geographical scale – is not advantageous. At the time of our study data were not available for areas smaller than standard regions on the issues with which we are concerned here. However, the recent Citizen Audit (Pattie et al., 2004) has gathered data on aspects of social capital in a sample of local authorities. In future work we will seek to explore the relationships between social capital and health for the districts represented in that study. In the remainder of this book we explore the possibility that the effects of social capital will be evident for smaller areas such as electoral wards. We first demonstrate how we devised small-area measures of social capital.

Chapter 3

Small-area indicators of social capital: an evaluation of some possibilities for direct measurement

Introduction

Many studies of social capital and health have perforce had to measure their social capital indicators for large spatial units. If we want to develop analyses which are meaningful in relation to the contexts in which people live their daily lives, however, it is clearly desirable to produce measures of social capital for small areas. As indicated in Chapter 1, the kind of systematic social observation of community norms pioneered by Sampson and Raudenbush (1999) in Chicago is not feasible because it would entail vast commitments of resources if extended beyond a limited set of areas. However, if we focus on the structural component of social capital, then there are several possibilities for constructing spatially – disaggregated indicators of the proportion of the population who engage in the kind of activities thought to be conducive to the formation of social capital. Here, we briefly review some of the possibilities, before examining whether one particular measure – the proportion of blood donors in the population – might be taken as a valid index of social capital.

Appropriate data on structural components of social capital are not routinely available for small areas, so we evaluated several alternatives. Some indicators of social capital (such as participation in associational life) are available from national social surveys in England (see Appendix 1) At best, the data are only available at the regional level and it is implausible that there would be no variation within large spatial reporting units such as standard regions. This partly accounts for the fairly inconclusive results described in the previous chapter because no allowance could be made for intra-regional variability. An alternative approach to generating small-area data would be through direct measurement by conducting a local survey. This approach would be costly and would also date rapidly. There are some good examples from the literature on health inequalities. Although such surveys generally achieve little beyond coverage of a limited set of areas, or a crude sub-district partitioning, the results from them could be used as a check on estimates derived in the manner described in Chapter 4. 'Over-sampling' in national surveys might provide another approach but this too would be costly. In view of the fact that other contextual information would also be collected it would also have a degree of sensitivity which would be likely to preclude wide release.

Alternative approaches might explore the distribution of members or supporters of organisations with a civic or altruistic purpose. Many organisations offer individuals the chance to demonstrate their support for a particular humanitarian (Amnesty), environmental (Greenpeace, Friends of the Earth) or social welfare (Shelter) objective. Such organisations recruit and campaign nationally rather than being rooted in just part of the country (Jordan and Maloney, 1997). Their lists of subscribers/donors are large, permitting the construction of stable ratios at a small-area level. However, while the patterns thus revealed might be intrinsically interesting, some would question their validity as measures of social capital. If Putnam's thesis is accepted, then participation must involve face-to-face interaction to generate social capital. This is not always the case with such organisations; even if they involve face-to-face interaction this is confined to only a small fraction of their membership. More generally, individuals presumably have different reasons for responding to these national campaigning organisations; moreover, it is conceivable that organisations themselves will 'manage' the distribution of members, quite possibly targeting their resources according to their own perceptions of localities where individuals are likely to be more responsive to their particular message. The pattern of membership of such organisations could be viewed as one index of the distribution of a section of the civically

minded (ie those willing to write a cheque for a cause), but we would have no theoretical grounds for preferring one membership list over another and it is therefore questionable whether such sources constitute an appropriate index for our purposes.

We also considered voter turnout. This has been used in previous studies of geographical variations in health. Whitley et al. (1999) used constituency-level data on abstention rates in seeking to account for spatial variations in suicide rates. However, after adjusting for variations in an index of social fragmentation (derived by Congdon (1996), and incorporating private renting, mobility of the population, single-person households, and unmarried persons), abstention rates were not significantly associated with suicide rates. Indices of deprivation, in this ecological study, were associated more strongly with the pattern of suicide than were abstention rates.

We were seeking a ward-level measure and for this purpose we considered data on the results of local government elections, which were made available by the Centre for Local Government Elections at Plymouth University. However, we decided against using this data. First, the data consists of counts of voters and of those on the electoral roll, but no disaggregation is possible and so all one can do is calculate a proportion (turnout). No standardisation for age and sex composition is possible. Moreover, turnout is a measure of the extent to which those registered actually exercise their vote. It is not a measure of the proportion of residents in an area who vote and there is evidence that a minority of the population, especially in disadvantaged neighbourhoods with above-average population turnover, do not register to vote (nor are they accurately recorded in the UK Census; however, Pattie et al., 1996, argue that non-registration is closely correlated with turnout). Turnout is therefore not an accurate measure of the degree to which the residents of an area are engaged in the political process.

Second, turnout in local elections can be highly variable. Much depends on local circumstances and, especially at by-elections, there can be considerable fluctuation (eg if a controversial candidate is standing). Voters' motivations for participating in local elections also vary: sometimes these elections may be used to register what are in effect protest votes; conversely, there may be large-scale abstentions if the electorate is dissatisfied with the performance of the government.

Third, like general elections, turnout is managed: the main political parties will make special efforts to get the vote out in marginal wards. Other influences on turnout include marginality, partisanship of the ward, the role of the local media, the size of the electorate, the number of parties contesting an election, and whether or not the ward was a multiple or single-member ward (see 'Turnout at local elections' at www.odpm.gov.uk). For all these reasons we decided against using voter turnout in our modelling strategy.

However, one direct measure is available which we believe is worth investigating further because a priori it passes most tests of a small-area indicator of social capital: the distribution of blood donors. Titmuss (1970: 13) regarded the arrangements for blood donation and transfusion as 'one of the most sensitive universal social indicators which, within limits, is measurable and tells us something about the quality of relationships and human values'. He was, of course, introducing his seminal, international comparative study of arrangements for blood donation. He did not map in any detail the geographical distribution of blood donors although he did provide statistics (pp263-75) for the then Regional Hospital Boards, giving estimates of the proportion of the population who were active donors for several years between 1951-65.

At the time of Titmuss's work it was not feasible to link the donorship data to small-area census statistics but this is now possible. Because there are over four million registered blood donors in England we can create stable ratios down to the level of small areas, such as wards. Blood donation in the UK is usually an entirely altruistic act, carried out by individuals without reward and without even the guarantee that their fellow citizens will themselves donate. Unlike voting, or membership of associations, a blood donation is not a partisan matter. The motivations for donation, revealed by those responding to Titmuss's study, were ones of general social obligation, not ones arising from a concern that donors or their families might require blood. There are small numbers of people who donate via private organisations for financial reward but they are not included in the analysis presented here.

In principle, subject to some constraints on health grounds, the majority of the adult population can donate blood and a large network of fixed and mobile collection stations means that opportunities to donate are

widespread. The costs of doing so are also minimised by workplace collections and by flexible timing of sessions. Therefore the question we ask is whether, given this, blood donation rates constitute a reasonable index of social capital (as has been suggested by some authors: Macintyre and Ellaway, 2003: 38).

There have actually been few studies of blood donation since Titmuss's work. The most relevant for our purposes are those by Piliavin (1990) and Piliavin and Callero (1992) which make some connections, albeit implicitly, with the social capital literature. Their work was prompted by the changing environment for blood donation in the US. There were two main aspects of this: a move, by most blood collection agencies, to an unpaid volunteer system, and the onset of AIDS, which led to more stringent testing and exclusions of potential donors. AIDS was also held to be associated with deterrence of potential donors (due to fear of contracting AIDS in the act of donation) and withholding of blood in order to participate in autologous or directed donations. The changed context for donation had had various effects on the gender, socio-economic, and racial composition of donors. Interestingly, Piliavin (1990: 446) argued that these demographic findings could result from 'differential targeting of recruitment efforts and scheduling of mobile visits'. Constraints on the opportunity to donate were also mentioned, the inference being that the strategies and energy put into recruitment differed from place to place (a conclusion for which there appears to be some support in our own work).

In later work, on the recruitment, motivation and retention of donors, Piliavin and Callero (1992) made an implicit connection with social capital by posing the question why some communities consistently met – or exceeded – expectations for blood mobile collections while others failed to do so. They suggested that 'differences in donation rates result largely from differences in social structure, particularly that aspect of social structure reflected in established community norms' (Piliavin and Callero, 1992: 180), and tied the origins of social norms to the 'interactions of many people over time in a community'. Their study of individual motivations had led them to the conclusion that 'continued blood donation is associated with the perception that others expect one to donate' (p183). This implied a need to investigate community norms and, by implication, the character of the places in which people live. Their conclusion was that 'dimensions of the social structure that go beyond individual differences are important for a complete explanation of blood donation' (p184). In other words, contextual factors were important.

Their discussion has relevant parallels with the social capital literature because they write of geographically specific norms, which they thought were likely to affect whether or not individuals gave blood. Their predictor variables included age, duration of residence in a community, community size (as a measure of density of social ties), staff judgements of past successes in collecting blood, perceived levels of Red Cross advertising and reported numbers of friends who gave blood. They detected a strong effect of community norms on personal norms, the implication being that if a relatively strong normative structure supporting blood donation was perceived, individuals were more likely to develop a sense of personal moral obligation. Consequently, they concluded that at the community level, 'towns with a strong normative structure with respect to donating blood had better records of performance in blood mobile operations' (p190). They also emphasised the impact of management factors in the blood collection service: good organisation and publicity created a perception of considerable community support, which in turn led individuals to develop their own personal commitment to donation.

The parallels between the social capital literature and their concept of 'community norms' are obvious, but two points are noteworthy. First, the perceived community norms are in part an outcome of decisions taken by blood collection agencies. They can become self-fulfilling prophecies, as resources are (understandably) targeted on areas because they are perceived as likely to generate results. Second, the process whereby perceived social norms become established is somewhat opaque; area of residence is alleged to have effects on whether an individual donates blood, but precisely how someone internalises community norms remains unclear.

Apart from Piliavin et al.'s work we are aware of only one other study of geographical variability in altruistic donation of this kind. Grubesic (2000) explored the geographical distribution of those registered as potential organ donors in Ohio by mapping the distribution of those registered drivers who have an organ donor sticker on their driver's licence. This generated county level rates for Ohio which were modelled in a regression analysis.

Donorship rates were strongly and significantly related to income and education but negatively related to the proportion of the population who were black: counties with a high percentage of African-American residents had lower potential donorship rates. Geography was an important component in that proximity to a strong and active organ procurement organisation influenced the proportion of potential donors. Our study explores similar issues to that of Grubesic in that we investigate links between area socio-economic conditions and the probability of blood donation.

In the rest of this chapter we discuss our analysis of the distribution of blood donors, including steps taken to clean the blood donor dataset and a modelling exercise undertaken to develop an effective index and to explore correlates and possible determinants of the geography of blood donation. We adopt an explicit multilevel approach to modelling that recognises that people are nested within places. On the basis of this analysis, we are in a better position to draw conclusions as to whether the distribution of blood donors can be regarded as a valid and independent measure of social capital. In Chapter 5 we also compare the direct blood-donor indicator with synthetic estimates of volunteering, voter turnout and social deprivation.

Towards a geography of blood donation in England: data sources

The National Blood Service (NBS) records basic personal characteristics (date of birth, gender, blood group), geographic information (address, postcode) and donation characteristics (eg total number of donations, date of last donation) for some 4.4 million registered donors in England. Covering some 10% of the adult population, this dataset could, in principle, provide a good proxy for social capital available from the micro-scale of enumeration districts upwards. Linkage to the census is feasible if the individual's postcode is compared to a grid reference, which can then easily be assigned using digital boundary data, to any given spatial unit. We were supplied with an anonymised dataset containing basic information on donors for October 1999. It included donor postcode, gender and age (to the nearest year), date of last donation, donor activity code (relating to status of donor and frequency of donation) and a code relating to the regional collection centre with which the donor is associated. The NBS (formerly the National Blood Authority) was created out of 14 formerly separate regional organisations in 1993 and their databases were not unified until much more recently. The database supplied to us gave details of 10 regional collection centres.

These donorship data are essentially administrative records of the process of giving blood. It is clearly possible to derive simple counts of the number of donors, disaggregated by age and sex for small areas. But to derive an effective measure it is vital that account is taken of the 'potential' number of donors. To derive a ratio measure, we need a denominator of the number of people in an area to go with our numerator of the counts of donors. The only effective national source for these data was the (1991) population census. Given that the underlying aim was to use the derived indicator for analytical and policy purposes, we decided that the ward scale was sufficiently detailed for our purposes, there being some 10,000 wards in England and Wales with an average of 2,000 households. This is in comparison to the much coarser district scale with over 400 units, and the overly fine 113,000 enumeration districts. Before we could begin to develop our measures, considerable data cleaning had to be undertaken.

With a dataset of this size and nature, infelicities were to be expected. Postcodes were missing or incorrectly recorded; many donors were resident in recently established postcodes; changes in postcode areas also posed problems for linking the data to the census areas. Additionally, there were inconsistencies in the data, notably the continued presence on the register of individuals whose date of birth indicated they were over 65, the age limit for donation. Although this could easily be due to the transposition of digits at data entry (eg 1952 becoming 1925), we had no grounds on which to justify inclusion of those apparently aged over 65, and we have had to assume (in the absence of evidence to the contrary) that such errors are randomly distributed. One final data provision issue, affecting wards near the Welsh border, was that the Welsh Blood Service declined to provide information on the age and sex of donors, and so all we have is the total number of donors.

A number of decisions were taken about which registered donors should be included in the analysis. The file initially received from the NBS contained data on 4,403,539 donors. There is no indication that donors are ever removed from the database. Instead, donor activity

categories are simply updated. This may mean that the list includes those too old to donate, deceased donors, or donors who have left England. The aim of this project was to produce a robust small-area indicator which would contribute to the social capital debate. We were trying to identify the civically minded and altruistic and so we focused on identifying active and recent donors, with certain age restrictions designed to minimise local distortions (due to the distribution of students or the retired). Consequently, we decided on a range of criteria for inclusion in this study. These are summarised here and explained more fully in Appendix 2.

Age restrictions: we included only donors aged between 25 and 64 to avoid distortions due to retirement and migration or due to large localised concentrations of donors, such as university halls of residence (the latter were dispensed with via exclusion of all those with what the Post Office class as 'large user' postcodes).

Active donors: in addition to those classed by the NBS as 'active' we included a number of categories of people who were willing to donate but were prevented from doing so for various reasons.

Exclusions: these mainly related to those recorded as over age (there is a upper age limit of 70 years) and to those recorded as having transferred between areas; the latter could (for reasons explained in Appendix 2) be double counted. Many donors were still on the register but had been 'withdrawn' and we believe these to be elderly or, in many cases, no longer alive.

Those who could not be matched, through their postcode, to census data: there were about 78,000 such individuals. They were not evenly distributed. For the 10 donor collection centres the proportion of unmatched postcodes varied from 5.7% (Manchester) to 0.8% (Newcastle) and our analysis had to take account of this.

The result of these various decisions and exclusions was a final dataset containing information on some 1.79 million currently registered donors, and defined as those whose year of birth and date of last donation was known, who were aged at least 25 at the date of last donation, and who had given blood in or since 1995. We could calculate from this dataset the age-sex-specific donorship rates for each area by applying national age-sex-specific rates to the 1991 census data. Then a ratio was formed of the observed to the expected rate. One immediately noteworthy feature of this was that rural wards generally appeared as above average for donorship rates. There are, however, a number of problems with this simple standardised ratio approach. First, blood collection has not been a national service, and there is considerable variability between regional collection centres in the proportions of the population registered as donors. We were able to derive regional units by allocating each ward to its 'dominant collection centre', ie the collection centre with which the majority of its donors are associated. The 'rural excess' is not found in all regions, such as the East and West Midlands. In using donorship as a surrogate for social capital, we need to allow for those regional differences, perhaps reflecting the unique histories of development of each regional collection centre.

Second, the implicit assumption behind the standardisation approach is that the map of donorship is undifferentiated by age and sex, being fundamentally the same for each group. Third, the simple ratio approach does not allow us to identify significantly high and low places, and to do so taking account of the varying number of people, the denominator, in each place. Finally, we want to compare the donorship with other variables to understand the correlates of high and low rates, but this is technically difficult when the response variable is a complex ratio. All these problems can be tackled by adopting an explicit model-based approach.

Modelling donorship: specifying and estimating multilevel models

We know from the cleaned data for each individual their age, sex, donorship status and the ward in which they live. Unfortunately we do not have any additional socio-economic information on donors and, moreover, we only know information on those who are donors and not on those who do not give. However, we can use data from the population census, suitably grouped into age and sex categories, to derive the proportion who give blood. Here we have used eight categories overall with four age groups (25-34, 35-44, 45-54, 55-64) for each sex. The underlying structure of the resultant data is shown in Table 3.1, with (a) giving some example values and (b) giving the symbolism that we will use in modelling. This is a two-level data structure with information on groups of people (the age-sex categories) at level 1 and wards (signified by a four-letter alphabetical code) at level 2.

Table 3.1a: Structure of the data to be modelled – data extract as a table

Age-sex group	Ward	Proportion donating	Count of potential donors	Sex group	Age group	Carstairs index
1	AAFA	0.01	77	Male	1	-2.01
2	AAFA	0.04	99	Male	2	-2.01
3	AAFA	0.02	103	Male	3	-2.01
4	AAFA	0.03	139	Male	4	-2.01
5	AAFA	0.09	81	Female	1	-2.01
6	AAFA	0.06	11	Female	2	-2.01
7	AAFA	0.03	96	Female	3	-2.01
8	AAFA	0.03	99	Female	4	-2.01
	⋮					
1	TTFZ	0.05	79	Male	1	0.61
2	TTFZ	0.16	76	Male	2	0.61
7	TTFZ	0.19	42	Female	3	0.61
8	TTFZ	0.07	58	Female	4	0.61

Table 3.1b: Data extract with modelling symbolism

Cell (i)	Ward J	Prop P_{ij}	Denom n_{ij}	Cons X_{0ij}	Fem j X_{1ij}	Age2 X_{2ij}	Age3 X_{3ij}	Age4 X_{4ij}	Index W_{1j}
1	1	0.01	77	1	0	0	0	0	-2.01
2	1	0.04	99	1	0	1	0	0	-2.01
3	1	0.02	103	1	0	0	1	0	-2.01
4	1	0.03	139	1	0	0	0	1	-2.01
5	1	0.09	81	1	1	0	0	0	-2.01
6	1	0.06	11	1	1	1	0	0	-2.01
7	1	0.03	96	1	1	0	1	0	-2.01
8	1	0.03	99	1	1	0	0	1	-2.01
	⋮								
1	8,844	0.05	79	1	0	0	0	0	0.61
2	8,844	0.16	76	1	0	1	0	0	0.61
⋮	⋮								
7	8,844	0.19	42	1	1	0	1	0	0.61
8	8,844	0.07	58	1	1	0	0	1	0.61

For each of the eight groups we know the number who have donated and the number of potential donors, and therefore we can readily calculate the proportion that give blood. We can also measure contextual socio-economic variables at the ward level, and one of these, the Carstairs index (Carstairs and Morris, 1991), a frequently used measure of deprivation, is shown in the table. The dominant collection centre is also measured at this ward level.

Table 3.1b shows the same data with the modelling symbolism that we are going to use. As this is the first appearance of a type of modelling we are going to use frequently in this research, we need to consider its form in some detail. We will specify a relatively simple model, estimate and interpret it, before going on to show how the model can be developed. There is a two-level structure where cells (indexed as i) representing eight age-sex categories are nested in 8,844 wards (indexed as j). The response variable, whose variation we are aiming to model, is the proportion who denote blood, P_{ij}. The predictors at the cell level are the age sex-categories (X_{ij}) and the predictor at the ward level, the Carstairs index, is $W_{j.}$ The age-sex predictors are 'indicator-coded' in such a manner that males aged 25-34 are taken as a base category (X_{0ij} given 1) and female and other age groups are contrasted against this base. An initial model was fitted that initially used only the main effects for age. The level 1 micro-model is given as:

$$E(P_{ij}) = \beta_0 X_{0ij} + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \beta_3 X_{3ij} + \beta_4 X_{4ij}$$

Where:

- $E(P_{ij})$ is the (E)xpected proportion giving blood in cell i for ward j, the response
- β_0 is the intercept, the national proportion of males aged 25-34 giving blood
- β_1 is the differential proportion for women who give blood as compared to men
- β_2 is the differential proportion for those aged 35-44 who give blood as compared to those aged 25-34
- β_3 is the differential proportion for those aged 45-54 who give blood as compared to those aged 25-34
- β_4 is the differential proportion for those aged 55-64 who give blood as compared to those aged 25-34.

The model so far is a so-called fixed effects one, in that we have simply estimated the national average proportion of giving and have not allowed this to vary from place to place (Subramanian et al., 2001a). This can be remedied in a 'random-intercepts' model which allows the proportion to vary from ward to ward. The intercept of the micro-model (β_0) is indexed to form the within-place equation:

$$E(P_{ij}) = \beta_0 X_{0ij} + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \beta_3 X_{3ij} + \beta_4 X_{4ij}$$

then a macro, between-wards model needs to be specified:

$$\beta_{0j} = \beta_0 + \mu_{0j}$$

In this higher-level model, the terms are as follows:

- β_{0j} is the differential donation in ward j
- β_0 is the national rate of giving for the base category of young males
- μ_{0j} are differentials for wards after taking account of the 'composition' of the wards in terms of the differential distribution of age-sex groups and their potentially different involvement in blood donation.

The level-2 random terms, μ_{0j}, represent the place differences in the donor rate. The distribution of these differences is summarised in a multilevel model by a level-2 variance term, σ_0.

There are a number of further technicalities before we can estimate and interpret this relatively straightforward model. First, it is a logit reformulation of this micro-model that is estimated in which the response is not the proportion but the log-odds of giving blood (that is $\text{Log}_e(P_{ij} / 1- P_{ij})$). But it is a simple matter to convert back to proportions. Second, the response is a ratio that has a

Table 3.2: Multilevel model of blood donorship; main effects for age and sex, simple between-place variation, extra-binomial variation between cells

Terms	Logits	Standard errors	Relative odds	Probability
Fixed part				
Male 25-34 β_0	-2.9170	0.004419	1	0.05
Female β_1	0.1686	0.002289	1.18	0.06
Age 35-44 β_2	0.4527	0.003061	1.57	0.08
Age 45-54 β_3	0.5016	0.003197	1.65	0.08
Age 55-64 β_4	-0.1741	0.004133	0.84	0.04
Random part *Level 2 : between wards* σ_0	0.1054	0.001843		
Random part *Level 1: between cells*				
m25-34	1.9180	0.03217		
m35-44	1.7900	0.03186		
m45-54	1.8980	0.03270		
m55-64	2.8220	0.04408		
f25-34	2.6810	0.04395		
f35-44	2.0130	0.03597		
f45-54	2.0630	0.03581		
f55-64	2.2090	0.03541		

variable denominator, and this inbuilt heterogeneity has to be explicitly modelled. This is accommodated in the model by including parameters for extra-binomial variation for each cell. The resultant two-level logit model with extra-binomial variation was estimated in the MLwiN package using a second-order Taylor series expansion and predictive quasi-likelihood (Goldstein and Rasbash, 1996).

The results of this initial phase of modelling are shown in Table 3.2. The logit of donorship for the base category of young males is -2.917 and this is equivalent to a proportion or probability of 0.05 ($e^{2.917}$ / (1- $e^{-2.917}$)). Females have a significantly higher rate than males (0.1686 is more than twice the standard error of 0.002289). This equates to a relative odds of 1.18 (derived as $e^{0.1686}$), that is 18% higher than the base category which is arbitrarily set at 1.0. Those aged 35-44 and those aged 45-64 have significantly higher rates than the base category (some 57% and 65% higher respectively), while the oldest age category is some 16% lower. The between-ward level-2 variance term, σ_0 at 0.1054, is very highly significant with a chi square with 1 degree of freedom of over 3,270. There is clearly a very significant difference between wards in blood-donation after taking account of the differential composition of wards in terms of their age-sex characteristics. The level-1 between-cell variances for each of the eight age-sex groups are all in excess of an expected value of 1, if there was a pure binomial variation. Moreover, the size of the excess is highly significant in relation to the estimated standard errors. The most likely cause is mis-specification of the micro-model, implying that there are other

Table 3.3: Multilevel model of blood donorship; (a) age-sex interactions, simple between-place variation, extra-binomial variation between cells (b) additionally with dominant collection centres

Terms	Model (a) logits	Standard errors	Model (b) logits	Standard errors
Fixed part				
M25-34 $ß_0$	-3.02400	0.004838	-3.20000	0.011610
Female $ß_1$	0.39600	0.004363	0.39630	0.004379
Age35-44 $ß_2$	0.55960	0.004242	0.56010	0.004271
Age45-54 $ß_3$	0.64070	0.004381	0.64130	0.004402
Age55-64 $ß_4$	0.09664	0.005340	0.09670	0.005369
F*Age35-44 $ß_5$	-0.22730	0.005812	-0.22750	0.005850
F*Age45-54 $ß_6$	-0.29160	0.006051	-0.29190	0.006073
F*Age55-64 $ß_7$	-0.51170	0.007614	-0.51210	0.007644
Birmingham $ß_8$			0.06822	0.016350
Brentwood $ß_9$			0.31250	0.015090
Manchester $ß_{10}$			0.08223	0.014720
Newcastle $ß_{11}$			0.16230	0.017380
Tooting $ß_{12}$			0.18060	0.014810
Soton $ß_{13}$			0.25880	0.018060
Bristol $ß_{14}$			0.30950	0.014410
Colindale $ß_{15}$			0.10790	0.016820
Leeds $ß_{16}$			0.17010	0.019810
Random part *Level 2 : between wards F0*	0.10601	0.001835	0.09497	0.001669
Random part *Level 1: between cells*				
m25-34	1.807	0.02993	1.797	0.02976
m35-44	1.805	0.03170	1.832	0.03206
m45-54	1.832	0.03168	1.838	0.03166
m55-64	2.058	0.03298	2.061	0.03296
f25-34	2.024	0.03440	2.022	0.03431
f35-44	2.055	0.03616	2.068	0.03630
f45-54	2.124	0.03638	2.103	0.03596
f55-64	2.280	0.03617	2.261	0.03582

'individual' factors that there affecting donorship in addition to simply age and sex. Importantly, however, the estimate of the between-ward variance is after this extra-binomial variation has been taken into account.

This initial model presumes that there is a sex effect and a set of age effects but they do not interact. In other words, it is presumed that the same gender gap is found at all four age groups. This can be evaluated in a model with interaction effects, in which all the other terms are kept the same but the micro-model fixed part now includes interactions:

$$E(P_{ij}) = \beta_{0j}X_{0ij} + \beta_1X_{1ij} + \beta_2X_{2ij} + \beta_3X_{3ij} + \beta_4X_{4ij} + \beta_5X_{1ij}X_{2ij} + \beta_6X_{1ij}X_{3ij} + \beta_7X_{1ij}X_{4ij}$$

where:

β_0 is still the intercept, the national proportion of males aged 25-34 giving blood;

but β_1 is now the differential proportion for women who give blood as compared to men for the 25-34 age group;

and β_2 is now the differential proportion for men aged 35-44 who give blood as compared to those aged 25-34;

while the new terms give the differing differential by age-groups for females; thus:

β_7 is the differential proportion for females aged 55-64 who give blood as compared to males aged 25-34.

The results are given in Table 3.3a (model 2): all the new interaction terms were highly significant. The pattern is most easily appreciated by looking at Figure 3.1 which shows the logits transformed into relative odds with the base category of young men set at 1. In general, females are more likely to give blood than males, with the

Figure 3.1: Relative odds of blood donorship by age and sex; based on model 2 with age-sex interactions

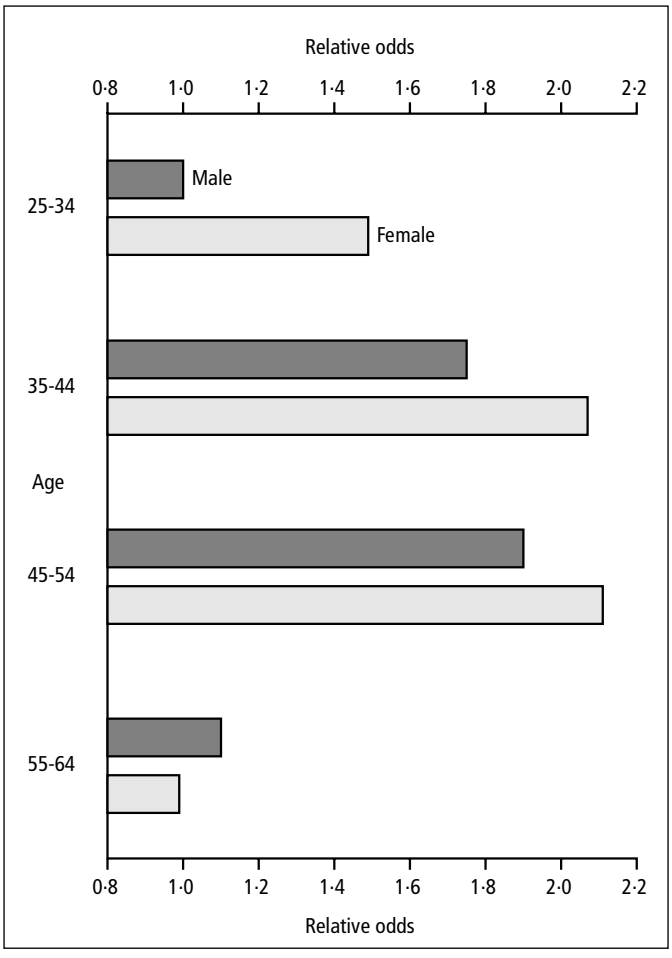
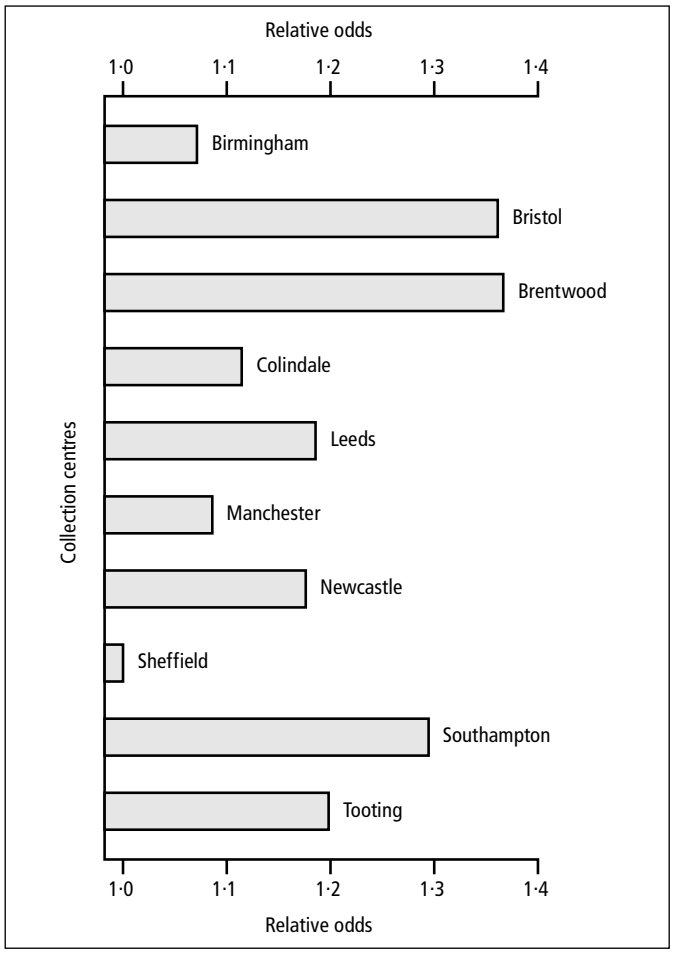


Figure 3.2: Relative odds of blood donorship by dominant collection centre; based on model 3 after taking account of age-sex composition



greatest relative excess in the youngest age group; the exception is the oldest age-group where males are more likely to give than females. In general, donorship increases with age for both sexes, but again the oldest age-category is an exception. These developments of the fixed part of the model do not result in a substantial change in the between-ward variation which remains large and significant. There has been a reduction in the extra-binomial variation for the male 55-64 and female 25-34 age-groups which previously had the greatest unexplained binomial variation. This unexplained variation, however, remains substantial.

This model is further extended through the inclusion of a dummy variable for each of the 10 dominant collection centres contrasted with the base category of Sheffield (Table 3.3b). Such a model will allow us to see the relative effectiveness of each centre taking account of the differential age-sex composition of the areas they serve. This model will also allow us to take account of the differential effectiveness of the centres in estimating the between-place variations. The estimated logits are given in Table 3.3b and are most easily appreciated as relative odds in Figure 3.2. In comparison to the odds of the base category of Sheffield being set to 1, both Bristol and Brentwood achieve a rate that is some 36% higher. Indeed, Sheffield is something of an anomaly as each and every other centre has a significantly ($p < 0.01$) higher rate. None of the other fixed-part terms change substantially with the anticipated exception of the base which now represents the log-odds of donorship in young men in Sheffield. The level-2 random part shows that there is a slight reduction in the between-ward variation but that this is still highly significant. The level-1 random part remains effectively unchanged; we would expect this as the ward-level indicators for collection centre cannot account for within-ward, between-cell extra-binomial variation.

We further extend this model by allowing the collecting centre to be differentially effective for different age-sex groups (model 4). This is achieved by creating a set of interactions between the collection centre indicator variables and the age-sex dummies. Again Sheffield is taken as the base, but given the complexity of the results, we do not give logit estimates, but instead tabulate predicted percentages of uptake (Table 3.4). Effectively this model is fitting a separate age-sex relationship for each and every collection centre. The table is arranged so that columns and the rows are ordered by declining performance, so that the top left-hand of the table represents the best performance. Although the size of the differentials may vary, the overall rankings of centres are highly consistent, with the best three being Bristol, Brentwood and Southampton, while the bottom three are Birmingham, Manchester and Sheffield, but the differences between centres are smaller than between age groups. Again there has been little change in the between-ward variance, which remains highly significant.

However, before proceeding to examine the ward differentials in more detail, it was thought important to guard against any possible errors in the data, particularly as the numerator variable represented the position at the end of the 1990s, while the denominator represented the position in 1991. (In fact, because we included a number of individuals whose last donation was any time after 1995, the numerator refers to the 1995-1999 period.) Nevertheless, there could be wards that have grown rapidly since 1991 which now have high donorship numbers in the numerator, but only have small populations. Similarly, but less likely, a ward could have experienced substantial population decline so that our estimate of the donorship rate is too low. The 2001 census data were not available to us at the time we carried out this exercise. An examination of the estimates

Table 3.4: Predictions of percentage donorship rates by age group and dominant collection centre based on model 4

Centre	f45-54	f35-44	m45-54	m35-44	f25-34	m55-64	m25-34	f55-64
Bristol	10.96	10.40	9.40	8.58	7.56	5.89	5.02	5.56
Brentwood	10.84	10.06	9.45	8.67	7.74	5.76	5.51	5.26
Soton	10.22	9.66	9.24	8.57	6.79	5.93	4.70	5.40
Tooting	9.31	8.86	8.44	7.71	6.78	5.29	4.71	5.12
Leeds	9.16	9.01	8.88	7.80	6.60	5.20	4.59	4.13
Newcastle	8.56	9.97	8.71	8.44	6.53	4.32	4.54	3.36
Colindale	8.38	8.80	7.09	7.31	7.04	4.27	4.51	4.48
Birmingham	8.55	8.38	7.67	6.85	5.94	5.04	3.96	4.40
Manchester	8.07	8.17	8.08	7.64	6.02	4.64	4.56	3.59
Sheffield	8.19	8.09	7.22	6.63	5.69	4.06	3.73	3.69

of μ_{0j}, the ward differentials, showed that there were indeed a number of wards with rather extreme high and low values that did not follow a normal distribution, an underlying assumption of the model. As the aim was to model the rate and show how the patterns differed for different groups (rather than to have an estimate of every ward in the land), it was decided to omit from the modelling process the most extreme 100 highest and lowest wards, and model the remaining 8,644. This exclusion of wards results in the between-place variance reducing to 0.075, but this still represents a very highly significant ward variance (with a chi-square of 2,948 for 1 degree of freedom in comparison to a 0.05 chi-square value of 4) and the residuals now approximate a normal distribution.

So far we have been presuming that wards have an overall effect so that they are consistently high or low in their effect on donation, but it is possible that places that are high for blood donation for males are relatively low for females. We did seek to determine the extent to which the donor 'map' for women corresponds to that of men, but found no evidence that there were any ward differences that were differentiated by gender.

Our final model (model 5) then explored how blood donor rates vary geographically. The level-2 random part is again expanded but this time separate coding is used to differentiate ward differences by age groups, so that we are modelling separately the between-place variation for each age group. In essence we are allowing for there to be a different pattern of donorship for each age category, and we are interested in which pattern has the most variability and how similar the pattern for one age category is to the others: Table 3.5 (a) is the variance-correlation matrix of the these ward differentials for each age group. The main diagonal gives the variances (on a logit scale) and it can be clearly seen that the older age groups show greater between-place variances. In some areas there is high differential blood donation by the 55-64 group, in other places it is relatively low. These differences are statistically significant; even the smallest difference, that between the 25-34 and 35-44 groups, is significant at $p < 0.01$.

On the off-diagonal elements of the table there is the correlation between each differential map. Given that all the correlations are positive and the minimum is 0.5, this implies that there is considerable similarity between the maps. Thus if a ward is high for one age group, it tends to have high blood donation for the other age groups. The greatest similarity is found for the maps for 45-54 and 55-64 age groups, with a correlation of 0.8; adjacent age groups are the most highly correlated in their differentials. In summary, there is evidence of an age-differentiated geography of donation, but the positive correlations suggest that there is an underlying single map, and that we can use a single overall differential to capture this variability. We discuss Table 3.5(b) later, in the context of an assessment of the effects of deprivation on ward-level donation rates, but (to anticipate) there is some evidence that introducing deprivation as a predictor has the effect of reducing some of this between-ward variability.

The series of models have shown that there is a highly significant geography to blood donation and that this geography is differentiated by age but not by gender.

Table 3.5: Variance-correlation matrix: between-ward differentials in donorship

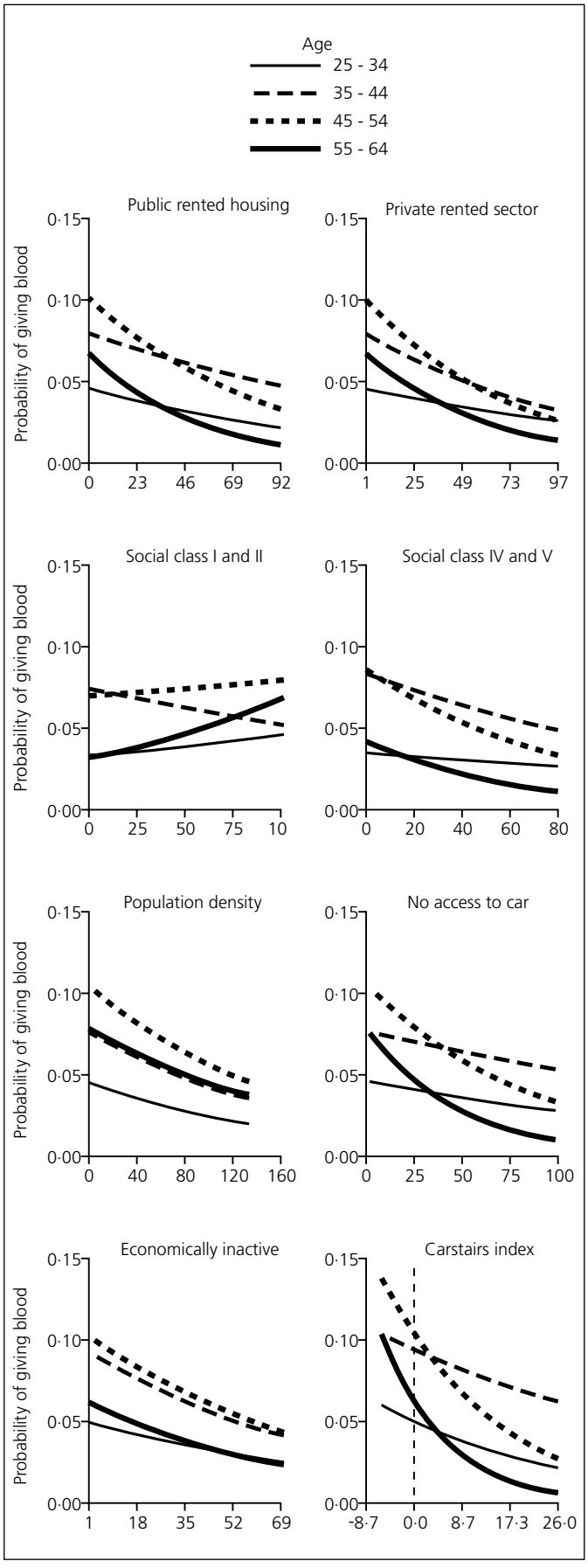
a) With no ward-level predictors

	25-34	35-44	45-54	55-64
25-34	0.084			
35-44	0.74	0.090		
45-54	0.63	0.71	0.111	
55-64	0.59	0.49	0.80	0.156

b) Including economically inactive and Carstairs index

	25-34	35-44	45-54	55-64
25-34	0.072			
35-44	0.71	0.084		
45-54	0.54	0.71	0.076	
55-64	0.47	0.47	0.69	0.073

Figure 3.3: Correlates of blood donorship, differentiated by age group



Moreover, this geography has persisted after:

- Taking account of the demographic composition of the ward in terms of age and sex and their differing levels of giving
- Controlling for the specific collection centre that is mainly responsible for collecting blood from that ward
- Omitting 100 particularly high and low wards as outliers due to possible numerator/denominator problems.

We now consider a number of ward-level variables as possible correlates of blood donation. The specification is a development of the previous model, with a micro-model consisting of age-sex and dominant centre main effects and interactions:

$$E(P_{ij}) = \beta_{0j}X_{0ij} + \beta_{1j}X_{1ij} + \beta_2X_{2ij} + \beta_3X_{3ij} + \beta_4X_{4ij} + \ldots$$

and four between-ward macro models at level 2 representing age-differentials:

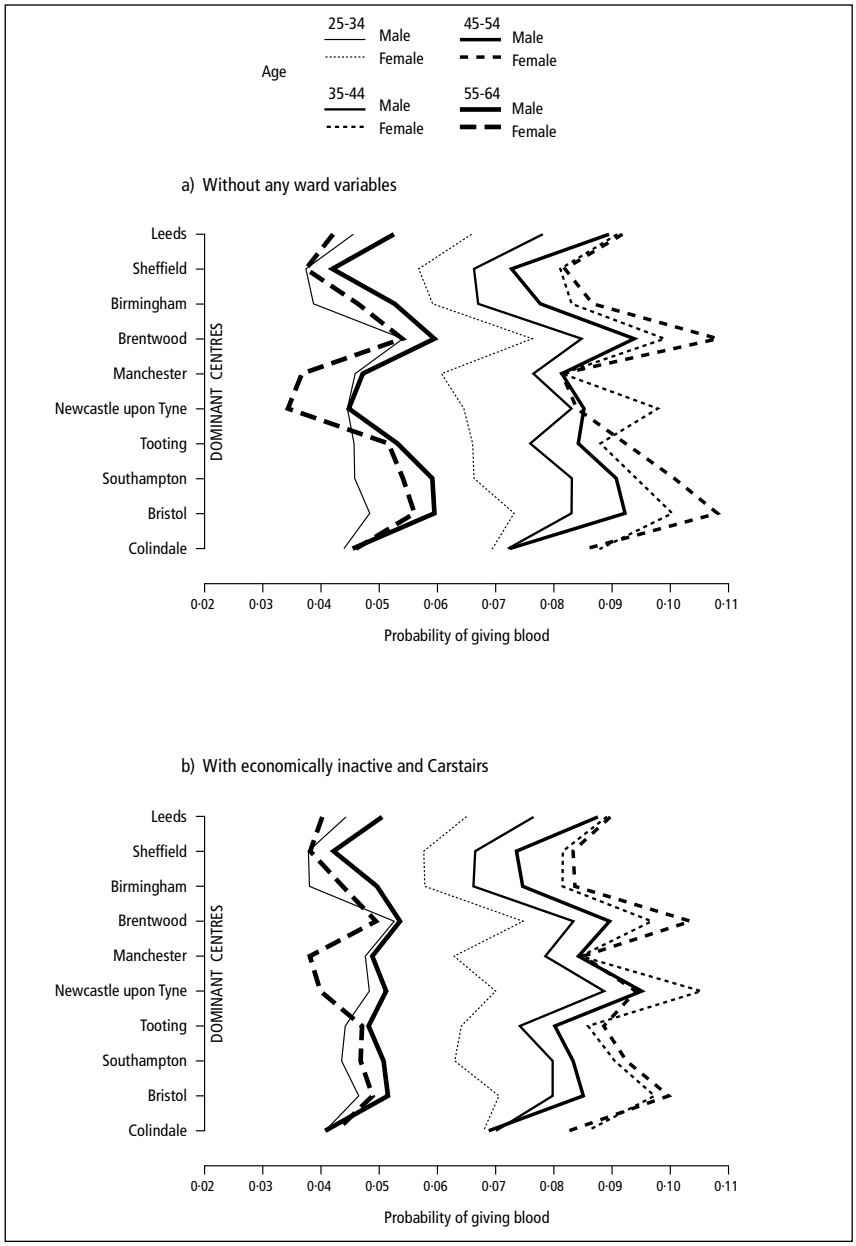
$$\beta_{0j} = \beta_0 + \alpha_0W_{1j} + \mu_{0j}$$
$$\beta_{1j} = \beta_1 + \alpha_1W_{1j} + \mu_{1j}$$
$$\beta_{2j} = \beta_2 + \alpha_2W_{1j} + \mu_{2j}$$
$$\beta_{3j} = \beta_3 + \alpha_3W_{1j} + \mu_{3j}$$

The key new feature of this model is the inclusion of a ward-level predictor, W_{1j}, in each of the four age-differentiated macro models. Consequently, the α terms will estimate the relation between blood donation and the ward predictor variable after taking account (via the micro-model) of the contribution to a ward's rate of donation attributable to demographic composition and dominant centre. Moreover, the inclusion of four separate α terms allows the effect of the ward predictor to be different for each age group. Finally, the ward-level residuals (μ_j's) represent the differences in giving between wards for each age group after taking account of the contribution of the ward-level predictor variable. The α terms represent how closely blood donorship is related to the predictor variable, while the μ_j's, or more correctly their respective variances and covariances, assess the extent to which there is a remaining distinctive geography to blood donorship.

Figure 3.3 shows the main results of a set of models involving eight different predictor variables in representing 1991 socio-economic characteristics of wards. In fact four separate models were fitted, each including a pair of ward-level predictors, so that the size of effects for any one

predictor are conditional on the other. The vertical axis on all the graphs has been drawn to a common scale so that it is possible to compare directly the size of effects. The plotted probabilities apply to the base category in the model, that is a male aged 25-34 who lives in a ward whose collection of blood is organised through the Sheffield centre. The first pair of variables represents non-owner-occupied housing. It is clear that blood donation declines as both public and private rented sector housing in a ward increases. This decline is most marked for the two older age groups. The next pair of variables are the high and low social class character of the ward. Blood donation generally increases as the percentage of social class I and II in a ward increases, but this is not the case for the 35-44 age group, which declines. However, overall and in comparison to other predictors, the effects are rather small. Blood donation generally declines as a ward's makeup in terms of social class IV and V increases. The exception is the 25-34 age group, whose donation appears unaffected by differing low social class.

Figure 3.4 Age-sex and dominant centre effects before and after taking account of ward variables



Our initial analysis suggested that donation rates were higher in rural areas and this is confirmed with the graph that shows a decline in giving as population density increases. Moreover, the graph suggests that this decline is consistent for each age group. Given the lack of an income variable in the UK census, private vehicle ownership is often taken as a measure of relative wealth. However, the lack of car ownership is high in rural and low in highly urban areas for reasons unrelated to wealth, so we have taken account of population density in deriving the relative effects of access to cars. It is clear that donation does decline with reductions in car ownership, and the decline is particularly marked for the two older age groups.

The final pair of graphs shows the results when the percentage of economically active (aged 25-64) is included in the model as well as the Carstairs index of deprivation.* The graphs shows that donation declines as economic activity increases in a ward after taking account of deprivation, and this is the case for all four age groups. The effects for the Carstairs index of deprivation are the most substantial we have found, with donation being lowest in the most deprived areas. The decline in donation rate with increased deprivation is most marked for the two older age groups. Figure 3.4 shows the age-sex and dominant-centre effects before and after taking account of the economically inactive and Carstairs variables. A number of features are noticeable. The lower rates of donation for young men, and the oldest group for both sexes are more consistent for all centres in the conditional model. The Brentwood and Bristol centres show high rates

* The latter is based on summing *Z* scores of the following four person-level variables from the 1991 census: male unemployment, households with no car, overcrowding (over 1 person per room), and head of household's social class categories IV and V.

of donation and they are joined by the Newcastle centre when account is taken of ward levels of deprivation and economic activity. Table 3.5b shows the between-ward variance-correlation matrix for the four age groups after taking account of inactivity and deprivation. While there is now approximately a similar degree of between-place variation for each age-group, the variance has not been reduced to an insignificant level. Consequently, even when variables with the strongest relationships with donation are included in the model, there remains unexplained between-place variation. The positive correlations continue to suggest that while there is some evidence for different maps for different age groups, there is also an underlying similarity so that some wards are generally places with a high donorship for each age group, while others are generally low.

To further explore this between-ward variation, attention now focused not on ward socio-economic conditions but on using different types of place to account for the remaining variation. We used two classifications of types of place, that of the 14 'groups', and the finer 43 'clusters' of the ONS ward classification (Wallace and Denham, 1996). The differential donation was again modelled in a multilevel model, so that we are assessing ward-level differences after taking account of age-sex and donation centre variations. Table 3.6 shows the results for 'groups' when the type of place with the lowest levels of donation, that for 'inner city estates' is set to 100. The table presents the ward groups ordered by odds ratio with a point estimate and upper and lower 95% confidence limits. Clearly there is a substantial difference between these types of places, with 'rural areas' having a level of giving two and half times greater than inner city areas. Importantly, the patterns revealed are not a simple deprived-affluent dichotomy. For example, relatively low levels of donation are found in wards characterised by 'metropolitan professionals' and relatively high levels of donation are experienced in 'deprived industrial areas'.

Table 3.6: Odds ratios for blood donation by ONS ward group

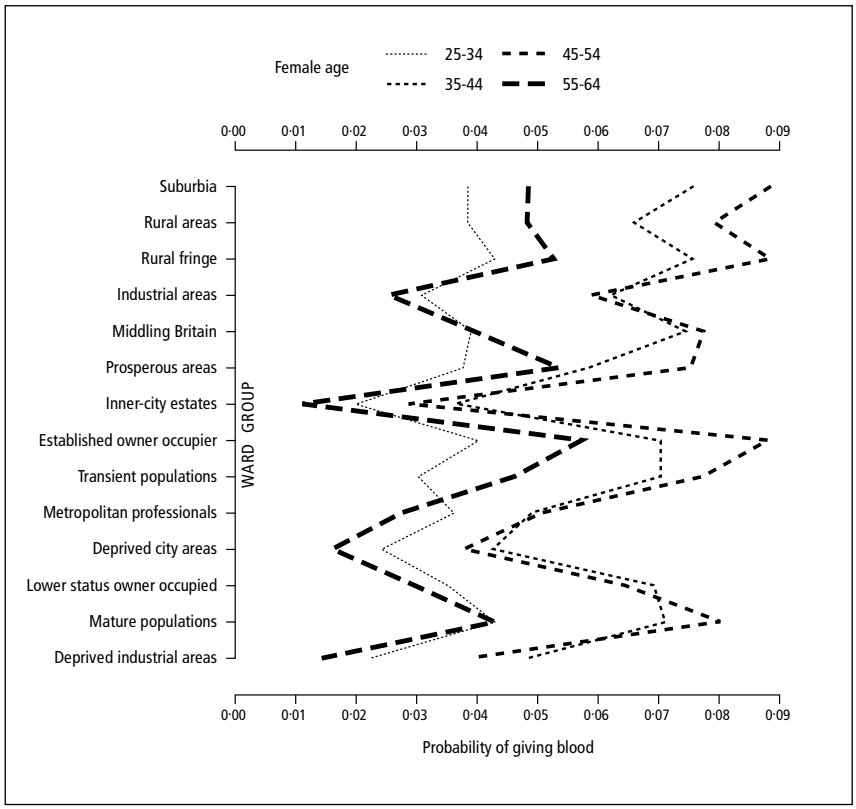
ONS groups	Odds	95% CI Lower	Upper
Inner city estates	100	–	–
Metropolitan professionals	123	116	130
Mature populations	124	117	131
Transient populations	170	160	180
Rural fringe	171	162	180
Deprived city areas	192	182	202
Established owner-occupier	212	197	228
Middling Britain	219	208	231
Industrial areas	223	212	235
Suburbia	224	212	236
Lower status owner occupier	230	219	243
Deprived industrial areas	241	229	254
Prosperous areas	249	236	262
Rural areas	252	240	266

Table 3.7: Odds ratios for blood donation by ONS ward cluster

ONS clusters	Odds	95% CI Lower	Upper
Ethnic groups in industry	100		
London public housing	103	92	115
Inner London	114	102	127
High-rise housing	118	103	136
Heavy industry	132	119	147
Textile towns' terraces	132	116	151
Cosmopolitan London	137	123	153
Young singles	137	122	155
Low amenity housing	139	125	155
Scottish – public housing	162	144	182
Scottish inner city	163	138	193
Miners' terraces	165	143	191
Traditional manufacturing	175	158	194
Primary production	185	166	205
Better-off manufacturing	189	170	210
Margins of deprivation	191	172	212
Growth points	193	174	215
Urban achievers	195	175	216
Declining resorts	208	187	232
Mixed economies	218	197	242
Transient populations	230	206	257
Concentrations of affluence	233	211	259
Classic commuters	234	211	259
Welsh coalfields	235	212	261
Affluent villages	235	212	260
Industrial towns	236	213	262
Remoter coast and country	237	213	264
Expanding towns	241	217	268
Agricultural heartland	242	218	269
Coastal – very elderly	243	219	270
Accessible countryside	244	220	270
Established prosperity	245	221	271
Retirement areas	249	224	277
West Midlands manufacturing	249	225	276
Remoter retirement areas	249	225	277
Better-off retired	250	226	277
Small towns	255	229	283
Outer suburbs	259	234	286
Town and country	269	243	298
Edge of town	273	247	302
Industrial margins	275	248	304
Green belt	284	257	314
Leafier suburbs	284	257	314

The more detailed results for clusters are given in Table 3.7, with inner-city ethnic areas, inner London and high-rise areas having the lowest levels of donation. While the highest levels of giving are found in 'leafier suburbs' and in 'green belt' clusters, relatively high rates are also found in wards labelled Welsh coalfields, West Midlands manufacturing areas, and 'industrial margins'. Again the differences are not simply ones of affluence and poverty. Relatively low rates are found in clusters with young and mobile populations; high rates are found in wards with older populations and rural areas. In both models, however, there remain highly significant between-ward variations even when account is taken of groups and clusters respectively. These differences between ward groups were found to be highly consistent by age groups so that for all age groups inner-city estates had the lowest levels of donation, as shown in Figure 3.5.

Figure 3.5: Probability of giving blood by age group, differentiated by ward type, females



Conclusions

Data on blood donation presents a rich source of information on variations between places in the propensity for individuals to engage in altruistic activity. The numbers involved mean that it is straightforward to produce indicators from the data for small geographical areas. But is it a valid indicator of social capital? Portes (1998; 2000) is concerned that social capital is a circular concept which is measured by its outcomes. From this perspective the pattern of blood donation (and indeed almost any kind of the structural components of social capital, including voter turnout or memberships of associations) could be an outcome of social capital rather than an index of it, reflecting problems of reverse causation. There is no way of determining whether blood donation rates are a genuine measure of levels of social capital in communities, or whether they measure the distribution of individuals who (for one reason or another) are more inclined to be altruistic.

There are parallels, perhaps, with Heath et al.'s (1991) discussion of electoral behaviour. They argued, against studies claiming to discern associations between voting behaviour and people's optimism/pessimism about the economy, that an individual's political beliefs could determine their degree of optimism about the economy. Thus, discovering an association between perceptions of the economy and voting behaviour was simply a way of re-describing political beliefs and behaviour, not explaining them. In the same way, voluntary association and blood donation may attract and recruit individuals who are predisposed to be more trusting of their fellow citizens. Consequently, using data on such associations to index social capital may at worst be tautological and at best may simply re-describe a pattern of recruitment to voluntary associations that is strongly structured on class lines.

We cannot, therefore, escape from this problem of reverse causation with the dataset we have available. To solve this problem we would need to know much more about the characteristics of blood donors. For example, could they be a self-selecting minority whose attitudes set them apart from the rest of society? However, this seems unlikely given the numbers involved. None of the national survey datasets we are using ask questions about blood donation. The large audit of citizen participation recently conducted (Pattie et al., 2004) simply asks whether people would be willing to donate blood but not whether

(and how frequently) they have done so. We cannot therefore use these sources to assess whether there is anything distinctive about active blood donors.

In the absence of evidence to the contrary the key advantage of blood donation as an index is that it is independent of other sources of statistical information on the outcomes of social capital, such as trust, and thus is capable of meeting some of Portes' criticisms. It might be regarded as a structural rather than a cognitive component of social capital. Unlike some other possible direct measures, reviewed earlier, it is not so subject to unique local influences and it is organised nationally (albeit through regional collection centres). However, the distribution of donors may reflect perceptions, on the part of the NBS, of which places are likely to offer potential for recruitment. We were unable to explore this possibility but it represents an interesting area for future work.

The key issue for this project is whether the patterns of blood donation offer novel insights into the distribution of social capital or whether they are simply old wine in new bottles. To address this question, we undertook a large-scale model-based investigation. The modelling is based on a very large data set of all wards in England in which the age and sex of at least 95% of the donors is known. After omitting a hundred wards at both extremes, 8,644 wards remained for which we know the uptake for each of eight age-sex groups and the dominant centre which serves that ward. The multilevel modelling allowed the assessment of between-ward differences after taking account of a ward's demographic makeup and the differential effectiveness of the centres. We found that different age-sex groups did indeed have different levels of donation, with the lowest rates being found for young males and for the oldest age group of both sexes. There were also differences between centres but these were not as marked between age-sex groups.

After taking account of all these effects, there remained substantial between-ward variation that was differentiated by age but not by sex. Older age groups showed greater between-ward variations. These variations in donation were related to standard socio-economic measures but could not be reduced to them. Blood donation was low in wards with high percentages of rented housing, low social class, no access to car, high population density and high deprivation. The effects of these variables on donation were generally more marked for the two older age groups. When types of place were included in the models, substantial differences in donation were found. But this was not a straightforward dimension reflecting affluence, for relatively high rates were found in industrial areas and places that are often regarded as deprived in material terms. Donation is also low in areas with a relatively high turnover of population and high in rural areas and places with a high proportion of older people.

Thus we have found that blood donation does vary from place to place and that this is not reducible to the age and sex composition of the population in an area; variations are strongly related to, but not reducible to, standard socio-economic measures. In subsequent chapters we first compare the pattern of blood donation rates with that of various other direct and indirect measures of social capital (Chapter 5) and we also explore its utility in models of the effect of social capital on health outcomes (Chapter 6). Prior to that, we describe the method we have used to devise small-area estimates of aspects of social capital.

Chapter 4

Developing small-area measures of social capital through synthetic estimation techniques

Introduction

We have suggested that modelling the impact of social capital on individual health requires ecological measures of social capital for small areas. In the previous chapter we pointed to the limitations of direct measures of social capital, showing that various potential candidates were, in fact, social constructs, which probably say as much about the management practices of the organisations producing them as about the altruistic dispositions of the populace. Even the most promising such measure, blood donation, has limitations as a measure of social capital.

If direct measurement is so difficult, an alternative would be to draw on national survey datasets in which questions are asked about elements of social capital. However, the data are only available at the regional level, and we cannot just assume that regional or national data are representative of a local area – were regional averages to apply uniformly across a region, there would be no need to seek data on local-scale variations. As a consequence there is a temptation to seek fine disaggregation of such data but, as explained in the discussion of direct measurements of social capital, the sampling design of national surveys is insufficiently robust to permit disaggregation below the scale of 14-25 regions – and, paradoxically, any attempts at such disaggregation could only be validated with local survey data.

We propose an alternative, which is rooted in a multilevel analysis of the determinants of aspects of behaviour which are believed to contribute to the formation of social capital. We draw on national survey datasets which gather data on issues such as the extent to which individuals are involved as volunteers in their communities, the extent to which they believe their neighbourhood is characterised by a sense of 'community', and so on. These can be used to generate regional-level estimates for such variables. They can also be used to analyse both individual and contextual components of civic or altruistic behaviour. It is reasonable to postulate that the likelihood of engaging in such behaviour is the result of an interplay between, on the one hand, autonomously made personal decisions and individual characteristics, and on the other hand, the diverse contextual influences stemming from the settings within which an individual's behaviour takes place. Thus, in order to explain variations in the propensity of individuals to participate in social or altruistic activities, we require a modelling strategy which can capture both individual and area effects simultaneously, and which can analyse interactions between the two.

The first stage in generating estimates of local variations in aspects of social capital is therefore to develop multilevel models which explain variations in the behaviours which contribute to social capital formation. The process may be characterised as 'modelling nationally, and predicting locally' because the initial models which specify the determinants of social capital are estimated using multilevel data derived from national datasets, but these models produce coefficients which can then be applied to socio-economic data at the local scale. The basic principle is well summarised by the following quote:

> *'Synthetic estimation is a label that has been given to the product of a class of devices that yield estimates of a target statistic for specific subnational areas, using descriptive data for the specific area in combination with average values of the target statistic for national or regional territory.'* (Simmons, 1977)

Via a process described in greater detail by Twigg and Moon (2002) we use the survey data to produce local

estimates of dimensions of social capital, which take account of these individual and ecological influences on behaviour. We can therefore make allowance for within-region variation in relationships between contextual influences and individual behaviour, and in turn this allows us to produce predictions of elements of social capital for small areas in a more sophisticated way than simply applying regional proportions to socio-economic data.

The outline of the chapter is therefore as follows. First, we describe the data that exist in the surveys we are using, and we outline – as an example – a model of the determinants of volunteering. This indicates significant variations between places in the relationship between individual and area characteristics which influence the probability of volunteering. Then we proceed to show how this can be used to generate predictions of the variations between places in elements of social capital.

Data sources

Several national surveys ask questions about issues of relevance to social capital. These include the General Household Survey (GHS), the British Household Panel Survey (BHPS) and the Survey of English Housing (SEH). These are large surveys that allow us to gain insight into several dimensions of social capital. Here, we discuss briefly each survey dataset before exemplifying our strategy for producing small-area estimates of social capital from the GHS.

Survey of English Housing: this was originally conducted for the Department of the Environment (now Department of Transport, Local Government and the Regions) and surveys over 28,000 respondents. As well as its primary purpose, which is to ask about the quality of housing, it also asks individuals about aspects of their local environment (see Chapter 2, Table 2.1). These include: how satisfied people are with the area as a place to live; quality of local services; the nature of local problems (graffiti, litter, crime etc); access to various services; social relationships; and the extent to which individuals are involved in their neighbourhoods.

General Household Survey: this continuous, annual survey has occasionally included questions on voluntary work. Detailed questions are asked about the organisations for which work is done, and the frequency and extent of volunteering. The definition of voluntary work excludes work undertaken for a trade union or political party. It has a slightly different form of words to the SEH, which excludes political parties but not trade unions. Questions on volunteering were asked in 1987 and 1992, permitting pooling of responses to cover some 31,000 individuals over the two survey sweeps. This increases the reliability of survey estimates derived from statistical models of volunteering.

The most recent GHS included a module on aspects of social capital, which is broadly comparable (in terms of the questions asked) with the SEH. It has been shown that there are significant variations between places in the propensity to be active in the neighbourhood organisations or in perceptions of a sense of community (Coulthard et al., 2002). However, that analysis was not a multilevel one. It presented an aggregate picture, whereas we would be interested in investigating whether the relationship between individual characteristics, and the probability of specific behaviours or attitudes, varied between places. The 2001 GHS dataset was not available to us at the time we carried out our analysis, however.

British Household Panel Survey: this also asks people questions about their involvement in a large range of social interest groups, among which a distinction is made between organisations in which the respondent is a member and organisations in which he/she is active. Trade union activity and political parties are included here in contrast to SEH and the GHS. Questions are also asked about political support and behaviour. The BHPS includes a large range of organisations and so it is possible to examine the extent of overlapping memberships. There are also a few questions about perceptions of neighbourhood quality. The BHPS also has the advantage that it is a panel survey of the same people so that one can track changes over time in patterns of membership and activity within a number voluntary organisations, clubs and societies. Over 9,000 individuals were surveyed in Wave 1 of the BHPS.

A range of possibilities exists, then, for construction of various indicators of social capital. Each survey has advantages and disadvantages for the estimation of these measures. The GHS is particularly useful on the geography of volunteering, while the BHPS asks very detailed questions about the type of organisations to which people belong, making a distinction between active and non-active membership. This therefore allows close approximation to concepts of social capital. The SEH

is less specific on broader aspects of volunteering but focuses on aspects of neighbourhood volunteering and the measurement of 'community' characteristics and again uses a large sample design.

As we have noted previously, it is the simultaneous individual and contextual nature of the influences on social capital-related activities that provide the basis for the development of the small-area multilevel synthetic estimation approach. For the remainder of this chapter we use GHS data and the example of 'core' volunteering to outline this method. By 'core' volunteering we refer to rates of volunteering that involve an individual undertaking voluntary work on at least 11 days in the course of a year.

An example: estimating variations in 'core' volunteering

We have suggested that any altruistic activity such as volunteerism may be influenced by individual characteristics (eg age, socio-economic status and gender), by contextual characteristics (the nature of the place in which he/she lives) and by interactions between these variables. Lynn (1997) has summarised many of the individual factors that help explain variation in rates of voluntarism but various authors have suggested that we need to take account of the area characteristics that are associated with high or low levels of voluntary activity (Parry et al., 1992). In essence, there may be specific contexts or local-based cultures that have an independent impact on an individual's propensity to volunteer. Thus, the overall likelihood that an individual will act as a core volunteer in their local community will partly reflect individual characteristics (age, gender, ethnicity, material circumstances) and it will also reflect ecological or contextual influences. We therefore need a modelling strategy which can capture both individual and area effects simultaneously, and which can analyse interactions between the two. For example, given what we know about perceptions of community spirit and neighbourhood incivility, we might suggest (following Campbell, 1993) that areas which have in recent years displayed particularly low levels of social cohesion have certain characteristics in common. An individual living in such a location might therefore be still less likely to become involved in the community than would be predicted on the basis of individual characteristics alone.

Methods

The presence of both individual and ecological influences on volunteering indicates the applicability of a multilevel approach to explaining this activity. Furthermore, the hierarchical nature of the GHS data (arising from a multistage clustered sampling design) requires a robust modelling approach that takes into account problems associated with within-place autocorrelation.* MlwiN multilevel software is used in the analysis presented here (Goldstein et al., 1998). This software is designed to take into account such autocorrelation and provides more reliable estimates of standard errors.

There are thus substantive and methodological reasons for the use of multilevel models in the analysis of national survey data on voluntary activity. A comprehensive model of a particular activity should enable the prediction of that behaviour as the outcome of processes operating at different 'levels' – individual or ecological. Importantly it will also take simultaneous account of those influences: the effect of a process at any one level can be assessed given the process at play at the other levels. Furthermore, between-level interaction effects can be accommodated, as can an understanding of the nature of residual unaccounted variation at each level. Finally, due to the use of precision-weighted estimation in model fitting, the approach is relatively robust to variation in model precision resulting from differences in the number of observations in each sampling unit.

At the time of writing, questions had been asked on volunteering in two sweeps of the General Household Survey. The voluntary work schedule used in 1987 was virtually identical to that used in 1992 and, in the few instances where differences occur, responses can be filtered and re-coded to ensure compatibility across the surveys. Results from both surveys were 'pooled' to provide over 31,900 responses to questions on voluntary activity. The results described here relate to an investigation of what we have termed 'core' volunteering whereby our dependent variable records whether or not an individual participates in voluntary activity (excluding trade union or political party work) for 11 or more days a year. This does not imply 11 consecutive days, but refers to the number of days on which volunteering took place over a 12-month period.

* Sometimes summarised in the phrase 'near things are more alike than far things'; this violates a basic assumption of many statistical tests that observations should be independent.

As the aim of the exercise was to generate small-area estimates of the prevalence of 'core' volunteering, the response variable was defined in terms of a binary outcome based on whether or not a respondent could be defined as such a volunteer. The multilevel structure adopted attempted to model individual volunteering operating at three levels: the individual, the unidentifiable postcode sector (ie the primary sampling unit (PSU) used in the survey) and the standard statistical region. The rationale for the inclusion of individual-level variables has been outlined above. PSUs were used as crude analogues of the local community, the areas providing the context for individual voluntarism. Standard statistical regions offer an identifiable level at which to take account of broader 'regional' variation. Due to the nature of the GHS data file, we were unable to use any intermediate geographical 'level' between the size of PSU and standard region. The GHS file of individual results, for example, does not disclose the local authority in which the respondent lives.

Characteristics of both individuals and the higher-level context of PSU were derived from the GHS. It is important to note here, however, that the choice of individual-level variables was heavily constrained by the requirements of the subsequent prediction phase of the process, which is discussed later in the chapter. The main focus of model calibration was not geared towards the usual goal of explanation but was instead driven by the nature of local-area counts of population that allow the national-based models to be applied locally (ie to electoral wards). In terms of local area counts, the UK Census Sample of Anonymised Records is not suitable for this purpose as its level of geo-coding* is too coarse.

However, it is possible to use complex cross-tabulations of routine local base statistics from the UK census to provide counts of the numbers of individuals in each ward who fall in particular socio-demographic categories. The most detailed such cross-tabulation available at the census ward level and relevant to volunteering is age (grouped into several age bands), marital status and gender. Other important contextual variables such as tenure and social class are not available in a small-area cross-tabulation which also contains age and gender, thus losing the basis for age-sex standardisation.

* This refers to the potential for spatial aggregation or disaggregation; the SARs are only available for individual local authorities, or combinations thereof.

The choice of variables from the GHS to use at the higher level (ie PSU) was similarly constrained by the need for variables whose definitions were compatible with data in the 1991 Census of Population. Here the model coefficients relate to percentages for ecological areas (eg percentage unemployment across PSUs) and not to types of individuals (eg single male, aged 18-24) and hence the previous problems associated with cell counts in census cross-tabulations do not apply. Unfortunately, the census does not, in England, routinely provide data for postcode sector units, nor does the GHS identify the ward of residence of its respondents. Two consequences arise. First, the PSU and the local government ward have, perforce, to assume a degree of analytical equivalence; both are of roughly similar size and both can be taken to offer some reflection of the local contextual setting for volunteering. Second, the ecological variables for each PSU must be estimated by using the characteristics of the individual GHS respondents in the relevant PSU; this is possible because, although no PSU is named, the GHS discloses whether individuals live in the same PSU. Using survey derived percentages in the model has obviously introduced possible sources of error but by pooling data from two sweeps of the GHS, more reliable estimates of the ecological effect have been generated. Over the two GHS sweeps there are a total of 993 PSUs. The minimum number of respondents in any one PSU was 4 and the maximum number was 66 (average = 33.8, standard deviation = 6.1). Our multilevel model therefore generates estimates of the impact of local context (eg the unemployment rate across the PSUs) on rates of core volunteering and in the prediction part of the process. These estimates are applied to the ward geography (ie unemployment data as derived for census wards).

A number of candidate contextual or ecological variables were tested but the final set included in the model was limited to those that were theoretically sensible (ie those capturing the socio-structural characteristics of the neighbourhood), those which were either independently statistically significant ($p < 0.05$), or those which were significant in a cross-level interaction.

The form and content of the explanatory part of the final multilevel model of core volunteering was determined therefore both by the nature of the GHS and by the availability of relevant population counts and ecological percentages for the local areas on which the predictions were ultimately to be based (ie local government ward).

In summary, the resultant multilevel model provides estimates of the chances of undertaking core volunteering by gender, age, marital status and of all the significant interaction combinations. The model also provides estimates of how these chances are affected if an individual lives in a certain type of area (eg percentage of household classed as public sector renting or percentage high social class). The model also contains estimates for statistically significant 'cross-level' interactions. For example, the area effect of wealth (as captured through multiple car ownership) tends to reduce the overall likelihood of volunteering but this effect is unevenly distributed across the age groups; the effect is reversed for those in the middle age groups who live in an area of high multiple car ownership. It is these regression estimates of individual, area and cross-level effects that are re-worked with small-area census data to generate local predictions. These predictions are also adjusted to take into account the regional residuals that are generated within the models. Before this subsequent process is described in more detail, we summarise the substantive findings from the multilevel model of core volunteering.

Results from the multilevel model of core volunteering

The structure and results of the final multilevel regression model are summarised in Table 4.1. Out of the 31,914 individuals, 4,759 are classed as core volunteers (14.9%). The multilevel logistic model used to investigate the relative impact of individual and area characteristics comprises 31,914 individuals nested within 983 primary sampling units (PSUs) within 15 standard regions. In this table the regression coefficients are presented as logits ($\log_e$ of the odds) alongside their standard errors and associated *p* values. Part A of the table lists the results for the individual influences on core volunteering, while Part B lists the results for the ecological variables and the cross-level interactions.

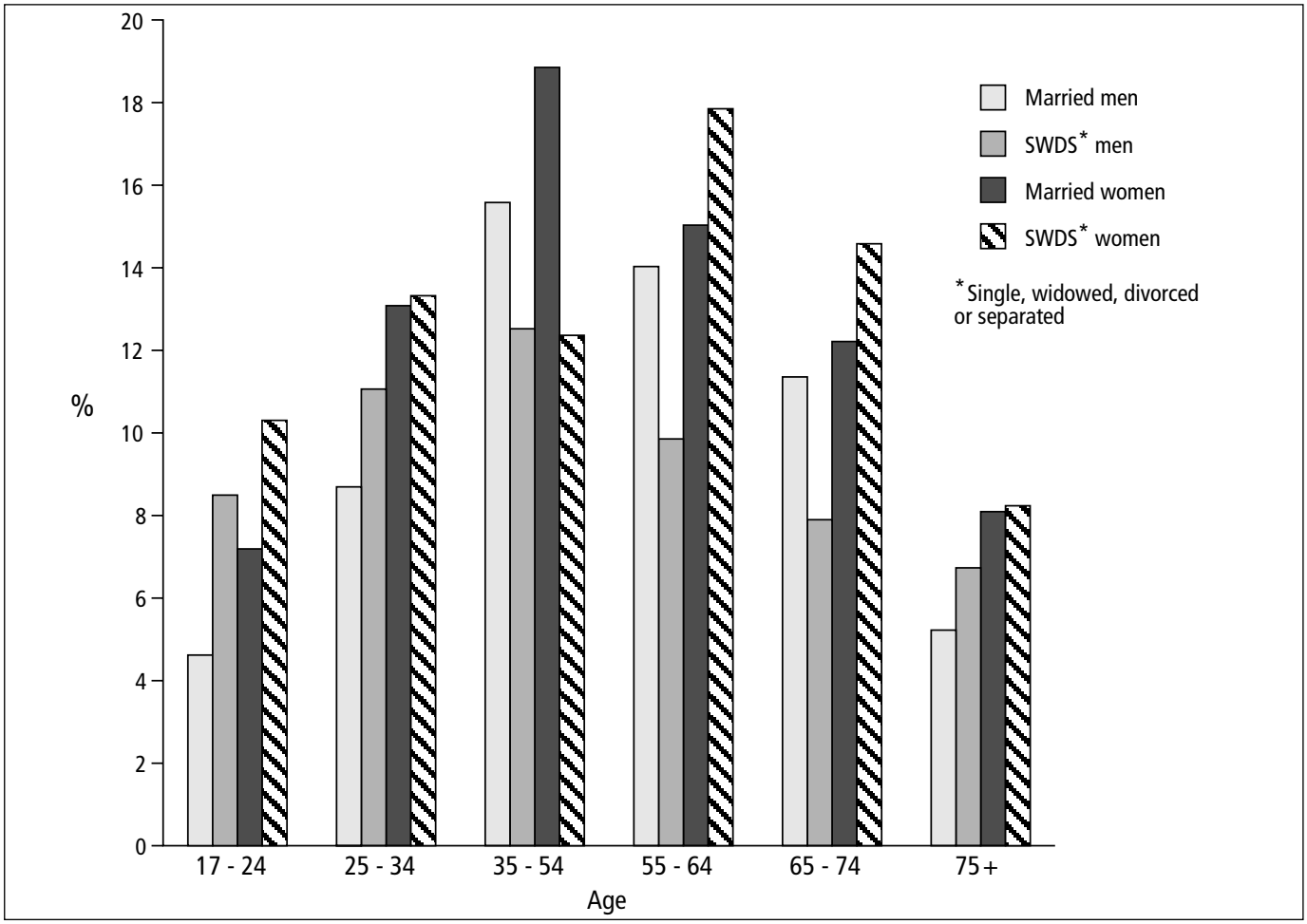
The constant value in Part A represents the logit for the base category or stereotypical GHS respondent. This person is female, aged 25-34, married or cohabiting, and lives in an area that has average values (across PSUs) for the proportions of non-whites, high social class (ie social class I or II), local authority or housing association tenure, and multiple car ownership. If we take an antilogit of this constant value of -1.874, then the model indicates that the chances of participating in core volunteering for this stereotypical person is estimated at 13.3%. The results for the individual variables indicate the differential effect of changing any one of the stereotypical characteristics. If the respondent is male, but otherwise the modal respondent, then the probability of being a core volunteer is reduced to 8.9%.* To illustrate the salient points, individual results have been converted to graph form in Figure 4.1. The key substantive points are:

Table 4.1: The structure and results of the multilevel model of core volunteering

Multilevel structure:	15 Standard Regions		(Level 3)
	⬇		
	983 Primary Sampling Units		(Level 2)
	⬇		
	31,914 Individuals		(Level 1)
Response variable:			
'Core' volunteer – more than 11 days of volunteering per year	Yes or No?		
Part A Individual Effects	Logit	Standard error	*p*
Constant	-1.874	(0.066)	<0.000
Male	-.4506	(0.077)	<0.000
Single	.0218	(0.085)	0.797
Single male	.2409	(0.096)	0.012
Aged 35-54	.4289	(0.065)	<0.000
Aged 55-64	.1588	(0.080)	0.048
Aged 65-74	-.0776	(0.087)	0.371
Aged 75+	-.5269	(0.087)	<0.000
Aged 17-24	-.6484	(0.134)	<0.000
Male 35-54	.2244	(0.087)	0.010
Male 55-74	.3722	(0.107)	<0.000
Single 35-54	-.5154	(0.108)	<0.000
Single 55-74	.1798	(0.122)	0.140
Single 17-24	.3610	(0.159)	0.023
Single male 55-74	-.8390	(0.186)	<0.000
Part B Ecological – Level 2 variables and cross-level interactions			
Non-white	-.0079	(0.003)	0.014
Social class I/II	.0153	(0.002)	<0.000
LA/HA tenure	-.0043	(0.002)	0.004
Multiple car ownership	-.0023	(0.002)	0.304
Single x non-white	.0137	(0.004)	<0.000
Aged 55+ x non-white	-.0111	(0.005)	0.016
Aged 35 x mult cars	.0060	(0.002)	0.006

* This is derived by taking the antilogit of the sum of the constant value and the value for MALE – ie the antilogit of -(1.874 + 0.4506).

Figure 4.1: Percentage engaging in core volunteering by age, gender and marital status

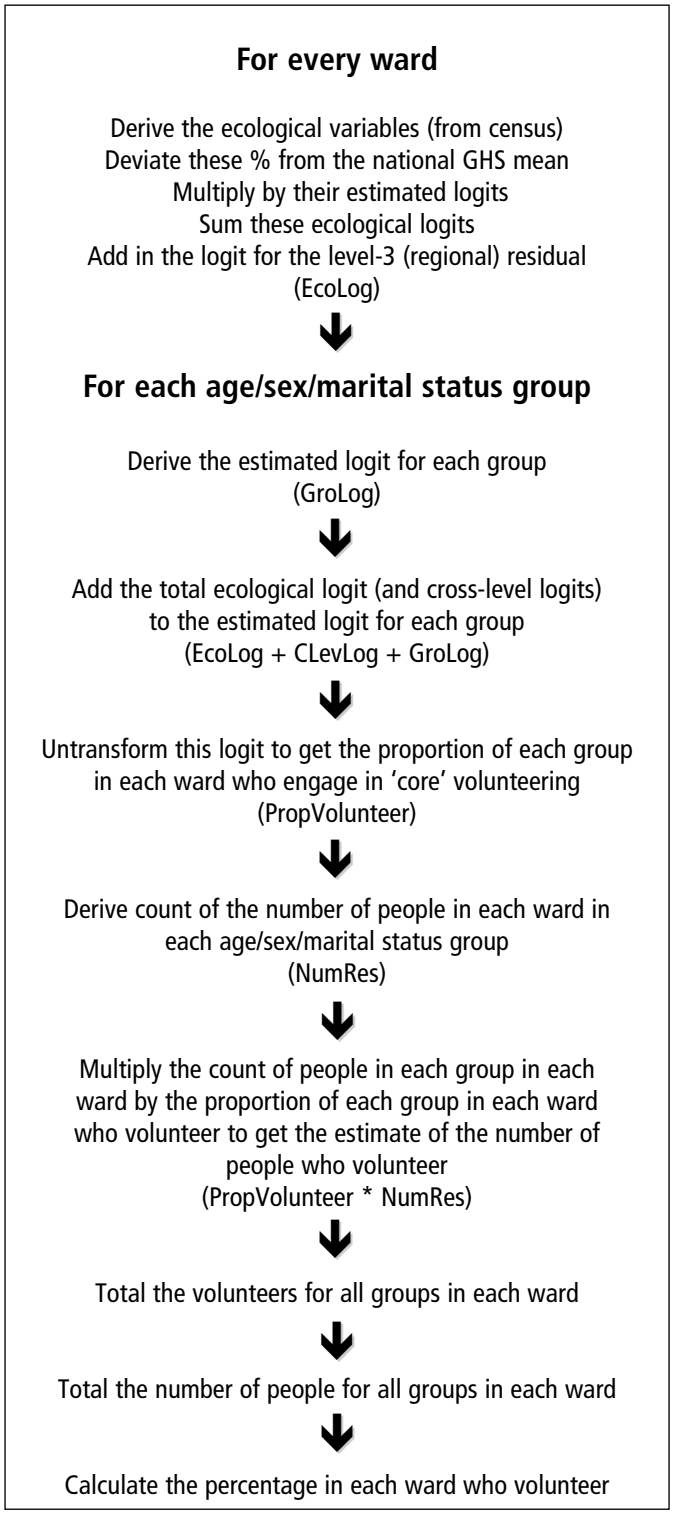


- Apart from the 35-54 age group, single women (including widowed, divorced and separated) show consistently higher rates of volunteering than any other gender-marital status group. While some women within this single group will have family commitments there will be others that do not and this may suggest a greater propensity to volunteer
- In the 35-54 age group, married women have the highest participation rate with nearly 20% engaging in core volunteering. This is the highest rate recorded across all gender/marital status groups. Assuming that married or cohabiting women are more likely to have children than single women, this level of participation may reflect increased opportunities for volunteering associated with school or other child-related activities
- Lowest rates are found among younger respondents. The lowest percentages are given for married men aged between 17 and 24 (< 5%)
- Across both married groups, voluntary activity tends to peak between the ages of 35 and 64. For single groups, men tend to have highest participation rates between the ages of 25 and 54. For single women, the peak occurs between the ages of 55 and 74
- For single men and women, lowest rates of volunteering are found in the oldest age category (75+). Young (17-24) married men and young married women have lower rates than their 75+ counterparts.

Part B of Table 4.1 lists the statistically significant logit results for the effects of ecological variables (ie variables relating to the PSU areal unit) and cross-level interactions. The logit for social class I/II, for example, indicates that as the percentage of high social class in an area increases, then the likelihood of volunteering also increases. We have indicated that the probability of volunteering for the modal person (ie a married woman aged 25-34 who lives in a PSU with an average percentage of social class I/II etc) is 13.3%. If the percentage of high social class in the area is increased by 10% then the chances of volunteering are increased to 15.2%. Conversely, the likelihood of volunteering is reduced to 11.6% if the percentage of high social class is decreased by a similar amount.

Areas with high rates of multiple car ownership – often regarded as an indicator of wealth – seem to be associated with a decrease in voluntary activity (albeit small – approximately 0.05% for the modal respondent for one unit increase in this ecological variable). The model indicates, however, through the cross-level interactions that this reduction is only present among the younger age groups. For those individuals who are over 35 the ecological effect of multiple car ownership is to increase levels of participation (and so this is consistent with the evidence that volunteering increases as area socio-economic status rises). Similarly, the likelihood of participating in core volunteering is reduced if there are high area percentages of non-whites and rented tenure status. The cross-level results suggest, however, that the area effect of ethnicity is attenuated if you are single but compounded if you are aged over 55.

Figure 4.2: Generating predictions of core volunteering



Generating predictions of core volunteering across English wards

Moving from a position of knowledge about the probability of individual behaviour to predictions of small-area prevalence involves linking local census data to the estimates derived for the explanatory part of the model. In essence this requires a recognition that individual probabilities are for particular types of individuals in areas with particular characteristics. With census data on the number of individuals of each type in each area, and the ecological characteristics of each area, it is possible to re-work the multilevel equations for volunteering to generate area-specific predictions. A flow diagram is shown in Figure 4.2 to list the stages that are involved in this prediction process. The procedure essentially involves generating logit estimates of the proportion of people in particular age-sex-marital status groups who volunteer, untransforming the logit form to a more familiar proportion, and applying that proportion to census data. Working principally with the individual and level-2 components of the multilevel model, the approach also incorporates use of the level-3 residual. These figures, derived from the level-3 (regional) residual part of the model, indicate, for each region, the specific variance unaccounted for by the explanatory part of the model. They allow adjustments to be made to the estimates to take account of the specific circumstances in each of the 15 standard statistical regions identified in the GHS.

Table 4.2 lists the regional residuals in ascending order of logit value. A negative value indicates that the model is over-predicting for individuals within that region and therefore the effect of the logit value when added to the overall logit for any one individual is to reduce the probability of that person engaging in voluntary activity.

For example, the constant indicates that there is a 13.3% chance that the stereotypical individual (as defined above), living in a typical area (as defined by the ecological

Table 4.2: Regional residuals and their differential effect on the stereotypical respondent

Probability of stereotypical individual engaging in core volunteering across all regions = 0.133 (13.3%)		
Region	Logit value	Probability for base person
West Midlands metropolitan	-0.190	0.113
Inner Greater London	-0.126	0.119
North metropolitan	-0.124	0.119
North non metropolitan	-0.087	0.123
Yorks and H'side non met	-0.052	0.127
North West non metropolitan	-0.024	0.130
Yorks and H'side metropolitan	-0.019	0.131
East Midlands	0.020	0.135
East Anglia	0.030	0.137
SE outer metropolitan	0.046	0.138
Outer Greater London	0.054	0.139
North West metropolitan	0.063	0.141
West Midlands non metropolitan	0.090	0.144
Rest South East	0.136	0.150
South West	0.183	0.156

variables) will engage in core volunteering. If, however, the stereotypical individual lives in the West Midlands metropolitan region – which has the largest regional negative residual – this probability is reduced to 11.9%. Such differential probabilities are listed alongside the logit value in Table 4.2. Apart from the residual for inner Greater London, all of the negative residuals are found in the central or the northern part of England suggesting some element of a north-south divide in rates of voluntarism. Given the age-gender-marital status composition of the individuals in these regions and the ecological characteristics of their small areas, rates of voluntarism are below the overall average predicted by the model. In contrast, positive residuals are predominantly found in southern regions and some eastern and central regions.

While there does not seem to be a division based on whether the respondent lives in a metropolitan or non-metropolitan region, it is interesting to note that the largest negative residual is found in the metropolitan part

Table 4.3: The social capital indicators for which multilevel synthetic estimates have been produced

Survey	Question topic (indicator of social capital)
GHS	Participating in any voluntary activity over last year (non-political or trade union)
	Participating in voluntary activity for 11 days or more over last year (non-political or trade union)
BHPS	Active in political party, trade union or an environmental group – **Political Activity**
	Active in two or more social activities (including parents' association, tenants' group, religious group, voluntary group, other community group, social or sports club, women's institute) – **Social Activity**
	Active in two or more altruistic activities (including tenants' group, religious group, voluntary group, other community group and women's institute) – **Altruistic Activity**
	Thinks that local friends are important
	Feels that they belong to the neighbourhood
	Willing to work with others to improve the neighbourhood
	Talks regularly to neighbours
	Frequently meets people locally
	Voted in the last general election
SEH	Feels that the local area is friendly
	Feels that the local area has 'community spirit'

of the West Midlands and the third highest positive residual is found in the non-metropolitan section of this region. This is not inconsistent with the view that a key geographical divide in Britain is not based solely on geographical location (eg 'north' vs 'south' but is instead based on what type of place one lives in (eg 'urban' vs 'rural') regardless of geographical location.

Repeating the procedure for other indicators

We repeated this process for a range of indicators from the surveys introduced at the start of this chapter (ie the SEH, the GHS and the BHPS), thereby generating estimates of several possible surrogates for social capital. The full list of variables for which this process has been applied is shown in Table 4.3. We have reworked some of the responses to the survey questions to provide more meaningful indicators of social capital.

For example, we have already discussed how we made a distinction between core volunteering (ie 11 or more days over the last year) and volunteering that does not have any time definition attached (ie any amount over last year), and indeed estimates have been produced for both. Also, in the BHPS respondents were asked if they were active in a number of social activities, listed as parents' association, tenants' group, religious group, voluntary group, other community group, social group or sports club and women's institute. We have used a 'cut-off' of two or more such activities to class an individual as participating in 'social activities'. We have also taken a sub-group made up of tenants' group, religious group, voluntary group, other community group and women's institute and termed these 'altruistic activities'. Again a cut-off of being active in two or more of these groups is used to define an individual as participating in such altruistic activities.

Of course, the mere production of these indicators does not say anything about their utility in capturing geographical variation in social capital. We provide more detail on their evaluation in the following chapter by comparing our estimates with measures produced through direct observation in other studies. The result of this analysis is that we have confidence that our indicators do provide valid small-area estimates of local variations in elements of social capital.

Conclusions

The approach described has been tried and tested in other contexts, such as the prediction of health-related behaviours (Twigg and Moon, 2002). It is cost effective when compared with alternatives, and it is capable of updating as new versions of national surveys become available. The models developed are constrained to some degree by the requirement for compatibility with a particular breakdown of census data for the purposes of prediction. In this sense they are less complex models than might have been developed had the objective been to produce full statistical explanations of the behaviours and attitudes being explored. They are therefore 'fit for purpose', but in other (statistical) senses they are limited. Nevertheless, we can plausibly argue that we can produce measures at a scale that is more relevant to the contexts in which people lead their daily lives than, say, an American state or a British standard region.

However, developing small-area indicators is helpful only if those indicators themselves are meaningful. The main advantage of our synthetically derived indicators is in demonstrating that an investigation of an aspect of individual behaviour must be sensitive to the context in which an individual lives. Thus we are able to generate coefficients of the probability of an aspect of individual behaviour which take into account the interaction between individual and ecological characteristics. This is methodologically superior to the approach taken by Burrows and Rhodes' (1998) work on the 'geography of misery' (work which also sought to apply data from national surveys to census data for small areas) because they simply apply regional averages to the population characteristics of areas within regions. The implication of such work is that the relationship between ecological and individual characteristics is invariant over space. In contrast, our work explicitly models the way that the relationship varies between places.

Chapter 5

Direct and indirect measures of social capital: an evaluation

Introduction

In this chapter we present an evaluation of the validity of our direct and indirect measures of social capital. We begin with a brief description of the performance of the original multilevel models used in the process of synthetic estimation. If the original regression models are not effective at predicting the element of social capital in question, then the resultant estimates must be treated with caution.

Second, we compare the indicators with each other, looking for similarities across indicators. Exploratory factor analysis revealed two key dimensions of variability in social capital in our indicators, one comprising altruistic activities, the other relating to informal sociability. Next, we tested for correlations between our estimates and composite measures of social deprivation such as the Carstairs index, as well as direct indicators such as voter turnout and blood donation. Associations with voter turnout and blood donation were relatively weak, but the strong associations between our estimates and social deprivation imply that our estimates added little to other measures of socio-economic differentiation.

Third, we have access to other sources of social capital indicators for sub-regional units that have been collected in the course of other projects. Though carried out for different purposes, these surveys had asked questions which were comparable with (if not always identical to) those on which our estimates were based. One of these (the HDA-funded study by Stafford et al., 2004) produced data for a sample of wards which corresponded closely to our synthetic estimates. The second project was the ESRC-funded Citizen Audit for Britain (Pattie et al., 2004) which has produced some data on aspects of social capital for a sample of English local authority districts. Where variable definitions are comparable, we aggregated our estimates to permit comparisons to be made. The strengths of the resulting correlations gave us confidence that our estimates capture something of the variability between places in activities contributing to social capital formation. In summary, we are confident that we have tested our estimates against a range of directly measured datasets and this puts us in a good position to evaluate their validity.

We do not describe the pattern of indicators here, partly for reasons of space (a selection of maps of some indicators is provided in Mohan et al., 2004). Some relevant points can be made here regarding the patterns revealed. Some indicators seem to correspond closely to population density – such as political participation, where there appears to be higher levels of participation in rural areas. Other indicators do not reveal such an association even when we might have expected it. Thus one might expect volunteering to be low in rural areas because of distance constraints, but in fact it is generally above average in such areas, with the exception of some remote localities. Our indicator of the proportion who feel 'part of the community' does show some association with large cities (ie large cities seem to be places where the proportion is lower) but this is not uniformly the case. Furthermore, it appears that areas of comparable socio-economic status scored differently on this estimate depending on which region they were in. In other words the estimates of aspects of social capital do seem to pick up aspects of intra-regional differentiation and they are not simply a function of material circumstances.

The predictive power of the multilevel models

The multilevel models used in the process of synthetic estimation have a common, but relatively limited, set of individual-level explanatory variables. The predictive power of these variables is not constant across the models and

Figure 5.1: Calculating the 'percentage correct predictions' statistic

The social capital indicator 'voting in the last general election' has an observed mean value across the survey of 0.786 (1,882 who answered 'no' – allocated '0' in the logistic model and 6,909 responding 'yes'– allocated '1' in the model)

The predicted values from the multilevel model fall in the range between 0 and 1. These are reclassified so all below 0.786 are taken as 0 and those above as 1. We can now compare our predicted group membership with actual group membership:

		Observed behaviour: *Voting in general election* 0	1	Totals
Predicted behaviour:	0	1,155	2,105	3,260
Voting in general election	1	727	4,804	5,531
Totals		1,882	6,909	8,791

this must be considered when evaluating our synthetically estimated end products. All of the initial multilevel models are of a logistic form and the calculation of R^2 (ie 'goodness of fit') values comparable to that used in a normal model is problematic but there are a number of alternatives. Here we use a comparison of *predicted* group membership with observed group membership to obtain the 'percentage correct predictions' statistic. This is based on the contingency table mapping observed values of '0' and '1' versus predicted values of '0' and '1'. In a logistic model the predicted values are probabilities falling between 0 and 1 but we can use a cut-off point to decide group membership. This process is exemplified in Figure 5.1 for the social capital indicator defined as voting in the last general election.

Our model correctly predicted 1,155 of those who did not vote in the general election, and 4,804 of those who did. Overall, the model correctly predicted 67.79% ((1,155+4,804)/8,791) of the observed values on the basis of a combination of individual and area predictors.

The percentage correct prediction values for all of the indicators are shown in Table 5.1. These are listed in rank order. All the models apart from 'community spirit' have percentages above 60%.* The percentages indicate that we should perhaps place more reliance on the estimates towards the top of the list (eg 'altruistic activity' and 'voting') rather than those near the bottom (eg community spirit), because when the models are re-run with the goal of prediction, using individual data, they predict a higher proportion of observed values than those lower down the list.

* We decided that any model generating a percentage less than 55% would not be sufficiently reliable to use in the estimation process and other indicators were rejected because of this selection criterion.

Key dimension of the synthetic estimates: correlation and factor analysis

We begin first by describing the associations found across the estimates using correlation analysis. Table 5.2 indicates that there are strong positive associations between the small-area estimates of voluntary activity and the other activity related measures of social capital (political, social and altruistic activity). The association with political activity is less (r = .657) than that with social and altruistic activity (r = .911 and .881, respectively) and the pattern is similar for core volunteering. There are also strong positive associations between all of these activity related measures and the estimates of 'willing to work with others to improve the neighbourhood' and, to a lesser extent, with the small-area estimates of 'community spirit' and 'belonging to the neighbourhood'.

Table 5.1: The 'percentage correct predictions' statistics for each of the synthetic estimates

Indicator	Percentage correct predictions statistic (%)
Altruistic activity	68.3
Voting in the general election	67.8
Willing to work with others to improve the neighbourhood	65.4
Social activity	63.5
Volunteering	62.5
Feels belongs to neighbourhood	62.5
Political activity	61.9
Meets or talks to neighbours/ others most days	61.1
Talks regularly to neighbours	61.0
Local friends are important	60.3
Community spirit	56.4

Table 5.2: Correlations between each of the social capital estimates

	Vol act.	Core vol	Pol act.	Soc. act.	Alt. act.	Belongs to n'hood	Friends imp	Work with others – n'hood	Talks regul'y	Freq'ly meets friends	Voted in 1997	Think area is friendly	Comm spirit
Voluntary activity	1												
Core volunteering	.981*	1											
Political activity	.657*	.604*	1										
Social activity	.911*	.913*	.691*	1									
Altruistic activity	.881*	.898*	.623*	.964*	1								
Belongs to neighbourhood	.402*	.478*	-.013	.409*	.433*	1							
Local friends are important	.255*	.289*	.165*	.342*	.348*	.637*	1						
Willing to work with others to improve the neighbourhood	.766*	.757*	.539*	.811*	.744*	.603*	.497*	1					
Talks regularly to local friends and neighbours	-.055*	-.022	-.077*	.002	.054*	.599*	.798*	.323*	1				
Frequently meets local friends and relatives	-.761*	-.774*	-.397*	-.608*	-.558*	-.277*	-.064*	-.435*	.197*	1			
Voted in the 1997 general election	.270*	.367*	-.043*	.297*	.405*	.809*	.555*	.455*	.556*	-.145*	1		
Think that the area is friendly	.248*	.318*	-.047*	.253*	.264*	.856*	.470*	.451*	.599*	-.113*	.649*	1	
Community spirit	.570*	.619*	.304*	.542*	.507*	.809*	.581*	.664*	.528*	-.489*	.606*	.749*	1

* Pearson's product-moment correlation coefficient is statistically significant; $p \leq 0.001$.

Again, the strength of the association tends to be lower for 'political activity', especially for this latter association where the coefficient is actually a weak negative figure. Interestingly, those areas that have high estimates of activity related social capital measures tend to have low estimates of 'frequently meeting friends and neighbours' and very little association with 'talking regularly to friends and neighbours'.

This seems to suggest that the pattern of the more formal associational activities contributing to the production of social capital is very different from those relating to interaction and support among local friends. Also, estimates of voting in the 1997 general election do not map in a straightforward way onto all the other social capital indicators. For example, relatively strong correlations are reported for most of the measures picking up strong community ties (ie 'community spirit', 'thinking that the area is friendly', 'belonging to the neighbourhood', 'thinking that local friends are important' and 'talks regularly to local friends and neighbours') but there are relatively weak positive correlations with all the activity related measures apart from political activity where a very weak negative association is found. Another anomaly is that the estimates of 'frequently meets local friends and relatives' does not mirror the pattern exhibited by these other measures of community ties. This aspect of community social capital seems to be operating independently of the other measures. It is the only measure that has a negative correlation with 'community spirit'.

To explore further the main dimensions of variability in our set of indicators, a factor analysis was undertaken using the principal components method to extract factor loadings; blood donation and voter turnout were also added. Three main factors emerged (Table 5.3). If we confine discussion to high positive loadings (those greater than 0.8), we see that six variables (core volunteering, voluntary activity, social activity, altruistic social activity, and willingness to work together to improve the neighbourhood, and 'community spirit') all scored highly on factor 1 (which explains more than 50% of the variance). The loading for the variable 'belonging to the neighbourhood' is only a little lower at 0.74. These variables relate to aspects of active participation in public life which involve people in making an effort to meet and cooperate or interact with others. The only variable with a negative loading on this factor was 'frequently meeting friends and neighbours', which suggests that areas with high scores on the list of social capital indicators tend to score low on informal sociability. This is an apparent puzzle but we should recall that the voluntary and social activities referred to here may not take place in the immediate neighbourhood and so there is no a priori reason to expect a correlation between them and informal, neighbourhood-based social interaction.

This argument is supported by examination of factor 2, which explains much less of the variance than does factor 1 (24% as opposed to 53%) and the loadings of variables on it are therefore lower. We therefore focus on the pattern of negative and positive loadings. First note the negative loadings for several variables (political, social and voluntary activity) which require engaging with others in relatively formal settings. In contrast, positive loadings are given for informal relationships with people ('talks regularly to neighbours', 'frequently meet friends and neighbours', 'friends are important'), and for perceptions of neighbourhood characteristics ('friendly area', 'belongs to neighbourhood', 'community spirit'). This second dimension appears to encapsulate the importance of close ties to, and informal encounters with, friends and neighbours. The polarisation between the two factors suggests that areas which score highly on these characteristics – friendliness of the neighbourhood, sense of community and neighbourhood – tend to be places which score low on the more 'organised' social

Table 5.3: Factor analysis of synthetic estimates, blood donation and voter turnout – component matrix

	Component		
	1	2	3
Core volunteering	.908	-.351	-.07
Voluntary activity	.872	-.442	-.03
Community spirit	.830	.263	-.132
Political activity	.601	-.512	.324
Social activity	.884	-.354	.142
Altruistic activity	.866	-.294	.146
Belongs to neighbourhood	.739	.565	-.163
Friends are important	.597	.461	.453
Willing to work with others to improve neighbourhood	.865	-.09	.130
Talk regularly to neighbours	.294	.733	.466
Frequently meet friends and neighbours	-.729	.305	.291
Voted in general election	.595	.605	-.143
Friendly area	.526	.570	-.225
Voter turnout	.551	.140	-.08
Standardised blood donorship ratio	.273	-.08	-.672

capital activities. This might highlight an important point about the processes generating social capital. There is not a direct correspondence between these formal and informal elements and it may be that those who go out of the immediate community to participate in group activities do not need to place as much importance on local neighbourhood-based networks to provide stocks of social capital. However, participation in such activities may depend on having the resources (money, time, a car) necessary to access opportunities.

Factor 3, which explains only 8% of the variance, seems to suggest that areas which score highly on blood donation tend to be localities where friendliness, and communicating with neighbours, are relatively low (and vice versa). The implication appears to be that blood donation is sui generis and unrelated to the synthetic estimates we have derived. The direct measure of voter turnout did not load significantly on any of the three factors.

Correlations between the synthetic estimates and voter turnout, blood donation and social deprivation

We have suggested that the various synthetic estimates capture different dimensions of social capital, and to aid the validation of this claim we can look at the association of the estimates with direct measures of voter turnout (representing civic participation) and blood donation (to capture levels of altruism). In addition, the estimates may also reflect the underlying pattern of social deprivation and we explore this by correlating our results with the ward-based Carstairs indexes of social deprivation.

Table 5.4 lists the Pearson correlation coefficients between each of our synthetic estimates and voter turnout, blood donation and Carstairs index. There appears to be a relatively weak but statistically significant correlation between all synthetic estimates and voter turnout with the direction being positive apart from 'frequently meeting local friends and relatives'. All of the positive associations are above .3 but below .45, apart from 'talks regularly to local friends and neighbours' where the reported coefficient is very weak at .186. There is a similar pattern in terms of direction with blood donation but the positive correlations are much weaker, ranging from .013 to .363. Again there is a negative association with 'frequently meets local friends and neighbours' and is of a similar strength (r = -.240) to that reported for voter turnout. There appears to be more congruence between our estimates and voter turnout than between the estimates and blood donation but the more striking finding is that associations between our estimates and social deprivation are much stronger than those with voter turnout and blood donation. Again, 'frequently meeting friends and neighbours' does not fit into the general pattern of negative association found between deprivation and all of the other estimates.

In other words, social capital tends to be high when deprivation is low (and vice versa) with the exception of this one indicator. Particularly strong negative associations (all greater than -.6) are found for both categories of voluntary activity, social and altruistic activity, 'belongs to neighbourhood' and 'community spirit'. The associations are much less strong (r < -.5) for political activity, 'local friends are important', 'talks regularly to local friends and neighbours', 'voted in the 97 election' and 'think that the area is friendly'. Here, again we see a division in the pattern between some of the activity based measures and the measures of less formal aspects of community social capital.

Table 5.4: Correlations between the estimates of social capital and voter turnout, blood donation and Carstairs index

	Voter turnout	Blood donation	Carstairs index
Voluntary activity	.358*	.219*	-.769*
Core volunteering	.391*	.226*	-.794*
Political activity	.272*	.013	-.432*
Social activity	.387*	.107*	-.670*
Altruistic activity	.378*	.106*	-.638*
Belongs to neighbourhood	.439*	.363*	-.658*
Local friends are important	.347*	.151*	-.416*
Willing to work with others to improve the neighbourhood	.404*	.230*	-.679*
Talks regularly to local friends and neighbours	.186*	.146*	-.172*
Frequently meets local friends and relatives	-.239*	-.240*	.746*
Voted in the '97 general election	.422*	.292*	-.472*
Think that the area is friendly	.301*	.333*	-.479*
Community spirit	.448*	.356*	-.735*

* Pearson's correlation coefficient is statistically significant, $p < 0.05$

Correlations between the synthetic estimates and direct observations

Ideally, we would like to test our synthetic estimates against data from other studies which have asked comparable questions at small-area level. Here we report correlation exercises for electoral wards and for local authority districts.

Correlations for electoral wards

A related project in the HDA's programme of studies of social capital and health (Stafford et al., 2004 – UCL study) has conducted a survey of 255 wards, of which 178 were in England and Wales and could therefore be matched to our synthetic estimates. The questions asked were broadly similar to those on which we based our synthetic estimates. There are strong correlations between many of our indicators and those in the UCL study (Table 5.5). There are some differences between the pattern of associations shown here and that revealed in the factor analysis. For example, our measures of organised associational activity correlate strongly with UCL's measures of 'community spirit', 'belonging to neighbourhood', and proportion of people 'seeing friends who live locally', whereas these sets of variables loaded on different components in the factor analysis of our synthetic estimates (see Table 5.3).

However, our measures of organised voluntary or social activity did not correlate strongly with the UCL survey's figures for the proportion of people who considered their neighbourhood to be friendly. We also found strong correlations between our measures of informal sociability and sense of community and the UCL indicators.

Some of the strongest correlations are found between the UCL indicator of the proportion who consider the neighbourhood to be friendly and our estimates of the proportions of people who talk regularly to neighbours (0.71), feel they are in a friendly area (0.73), or feel they belong to the neighbourhood (0.68). Others where the pattern of associations is strong ($r > 0.5$) include the UCL indicators of community spirit – five of our estimates have correlations with this indicator exceeding 0.5. The UCL measure of belonging to the neighbourhood also has strong associations with our estimates of belonging to the neighbourhood, voting in the last general election, and neighbourhood friendliness. This pattern of associations implies we can be reasonably confident that our estimates are capturing dimensions of social capital and sense of community that are consistent with those picked up by other social surveys.

The exception to this general verdict relates to the UCL question about the perception of people who would feel comfortable borrowing money from a neighbour. There are only two statistically significant correlations between this indicator and our synthetic estimates, namely those of 'talking regularly to neighbours' and 'frequency of meeting neighbours and friends'. None of the others approach statistical significance and this does place some question marks against the role of more organised associational activity in engendering trust.

Correlations with measures at the local authority scale

The ESRC Democracy and Participation programme conducted a Citizen Audit for Britain (Pattie et al., 2004) involving 12,000 respondents in a sample of 109 local authority districts in the UK, of which 93 could be matched directly with our own data once we had aggregated the raw counts for our estimates appropriately. There were, of course, differences in the phrasing of questions as is indicated by Table 5.6, which provides correlations that were significant at the 5% level between our estimates and the Citizen Audit. The strongest correlations are between our estimates of voluntary, altruistic, political and social activity, and the Citizen Audit's measure of the average number of groups in which people were involved (this survey did not distinguish the type of groups in which respondents were active). Additionally, our estimates of the proportions engaged in volunteering and altruistic activity were strongly associated with trust in local government, offering some support to social capital theorists. There was also consistency between our estimates of 'belonging to the neighbourhood' and 'voting in the last general election', and the Citizen Audit's measure of attachment to the neighbourhood.

However, the associations between our indicators of neighbourhood friendliness and the Citizen Audit's measure of neighbourhood attachment were not statistically significant, although there was a positive correlation between neighbourhood friendliness and the Citizen Audit's indicator of 'attachment to region'. Statistically significant negative associations were also observed between our estimate of 'meeting friends and neighbours' and the Citizen Audit's measures of trust and group participation. This is less surprising if we refer back

Table 5.5: Correlations between responses to UCL social capital questions and Portsmouth's indicators, and blood donorship rates, for 178 wards in London

		UCL SOCIAL CAPITAL INDICATORS						
	Correlations	pspirit	paffil	pfrdvrec	pfrdrec	pborrow	pneighfrd	ptunion
PORTSMOUTH INDICATORS	volact 63	0.43**	0.35**	-0.00	0.26**	-0.14	0.07	0.03
	corvol62	0.46**	0.41**	0.05	0.31**	-0.13	0.13	0.00
	polact62	0.17*	0.02	-0.21**	-0.10	-0.11	-0.39**	0.35**
	socact64	0.45**	0.34**	-0.02	0.26**	-0.13	0.03	0.14
	altact68	0.50**	0.39**	0.04	0.29**	-0.08	0.12	0.12
	blngnh62	0.55**	0.60**	0.40**	0.51**	0.12	0.68**	-0.12
	frndmp60	0.40**	0.43**	0.27**	0.32**	0.11	0.48**	0.05
	imprnh65	0.59**	0.48**	0.19**	0.41**	-0.01	0.36**	0.04
	tlkreg61	0.39**	0.40**	0.42**	0.37**	0.26**	0.71**	-0.09
	freqmt61	-0.23**	-0.24**	0.13	-0.15*	0.22**	0.06	0.01
	votgen68	0.55**	0.58**	0.31**	0.44**	0.12	0.45**	0.04
	frndly66	0.50**	0.55**	0.45**	0.51**	0.16*	0.73**	-0.16*
	stdbdratpc	0.35**	0.43**	0.28**	0.36**	-0.05	0.41**	-0.19*

* sig at 90% ** sig at 95%

From UCL survey (Stafford et al., 2004):

PSPIRIT Proportion of people reporting 'community spirit'
PAFFIL Proportion of people reporting a sense of 'belonging to neighbourhood'
PFRDVREC Proportion of people seeing friends who live locally in past week
PFRDREC Proportion of people seeing friends who live locally in past month
PBORROW Proportion of people who feel v comfortable/comfortable borrowing money from neighbour
PNEDIGFRD Proportion of people who consider their neighbour to be a friend
PTUNION Proportion of people in political party, trade union etc

Portsmouth indicators:

From GHS
CORVOL62 People engaged in 'core' volunteering (vol work on 10+ days in last year)
VOLACT63 People who did any voluntary work last year

From BHPS
POLACT62 Active in a political party, trade union, or an environmental group
SOCACT64 Active in two or more of seven 'social' activities (parents' association, tenants' group, religious group, voluntary group, other community group, social group or sports club, women's institute)
ALTACT68 Active in two or more of five 'altruistic' social activities in the list above (tenants' group, religious group, voluntary group, other community group, women's institute)
BLNGNH62 Feels belongs to neighbourhood
FRNDMP60 Local friends are important
IMPRNH65 Willing to work with others to improve neighbourhood
TLKREG61 Talks regularly to neighbours
FREQMT61 Frequently meets people locally
VOTGEN68 Voted in last general election

From Survey of English Housing
FRNDLKY66 Feel this is a 'friendly' area

Blood donorship rate
STDBDRATPC Standardised blood donorship rate, as a percentage

Table 5.6: Statistically significant correlations between Portsmouth's synthetic estimates (aggregated to the scale of local authorities) and measures produced by the Citizen Audit

	QUESTIONS IN CITIZEN AUDIT				
PORTSMOUTH SYNTHETIC ESTIMATE	Attachment to neighbourhood	Attachment to the region	Attachment to UK	Trust in local government	Groups people active in
Belongs to neighbourhood	.502		.501		
Voting in general election	.579				
Core volunteering				.576	.608
Volunteering				.584	.630
Political activity					.573
Social activity					.668
Altruistic activity				.534	.625
Frequency meeting friends and neighbours				-.567	-.562
Friendly area		.517			

to the loadings from our factor analysis (Table 5.3), and it may relate to the different spatial scales at which these behaviours operate: group involvement is not necessarily confined to a local neighbourhood, whereas meeting friends and neighbours is. But why should the correlation be so strongly negative? We speculate that the issue is partly one of who participates in more formal, group-based associational activity. We suspect from our modelling exercises which generated the synthetic estimates that the more formal kinds of associational activity, to which social capital theorists devote so much attention, are more likely to involve people of higher socio-economic status, whereas informal sociability will be more characteristic of localities of lower socio-economic status where social relationships are less stretched over time and space. This is consistent with other recent studies (eg Williams, 2002, 2003).

So what is being picked up here is really an aspect of socio-economic differentiation. This is consistent with the view that social capital measures behaviours, relationships and attitudes more characteristic of relatively prosperous communities (eg Muntaner and Lynch, 1999) and to investigate this we need to conduct more detailed analyses to determine the associations between contextual factors and involvement in various forms of activity.

Conclusions

In this chapter we have analysed the pattern of relationships within our synthetic estimates to show how they overlap with and relate to one another. We have compared them, using correlation techniques, with data gathered via surveys of electoral wards and local authorities. We have also analysed relationships between our indicators and direct measures (voter turnout, blood donation) and measures of social deprivation. We seem to have identified two main dimensions of social capital: one relating to relatively formal kinds of associational activity, and one relating to strong community ties. But this also implies that Putnam's model (Putnam, 1993b, 2000) with its emphasis on formal, associational activity is not necessarily correlated with high levels of community spirit.

The strength of the correlation coefficients is reassuring as it suggests that our method of producing estimates is generating valid results. Indeed, the consistency between our estimates and those of social trust provided by the Citizen Audit is possibly the most reassuring evidence from the point of view of social capital theorists. However, correlation cannot demonstrate causality, and it is just as plausible to suggest that people who trust get involved in associational activity as it is to say that associational activity produces trust.

In terms of explaining these patterns, when we look at the correlations between our estimates and deprivation indicators, as well as direct measures (voting, blood donation), it is notable that there are strongly negative correlations between our measures and deprivation indices. This is especially the case for volunteering and some forms of associational activity. This might imply that the main dimensions of social capital are largely controlled by or related to deprivation (the opposite inference, that involvement in associational activity leads to deprivation, seems implausible). Alternatively, it might imply that the kinds of social capital characteristic of disadvantaged communities are not captured well by measures of formal, associational activity. The implication of the strong relationship between deprivation and our estimates is that a modelling strategy must be devised which seeks to elucidate whether social capital or deprivation has the most impact on health outcomes. We now turn to our analysis of relationships between social capital, place and health.

Chapter 6

Modelling the relationship between social capital, place and health

Introduction

Generating the various indicators of social capital at the electoral ward level provides us with an opportunity to explore, in more detail, the ecological influence of social capital on individual health outcome. We undertook this task by using the Health and Lifestyle Survey (HALS), which represents one of the most comprehensive studies of the health of the adult national UK population to date (Cox, 1988). The original sample from England, Wales and Scotland of 9,003 was initially interviewed in 1984/85 and the original respondents were 'flagged' to provide the subsequent date and cause of death. The present analysis is based on the English sample of 7,578 individuals followed to 2001; we do not include 239 individuals who have been lost to follow-up (Cox et al., 2001). Consequently, we evaluated the importance of the synthetic estimates of social capital in affecting whether a person lived or died, taking account of individual demographic, lifestyle and social circumstances, as well as ecological measures of deprivation.

Included in HALS were a number of questions relating to individual aspects of social capital as well as the socio-economic circumstances of the respondents. Also, the authors were supplied with identification details of the respondent's ward of residence that allowed the areal indicators of social capital (as generated through the synthetic estimation process) to be attached to individual survey data.

We report on a number of different model sequences and discuss the conceptual justification for each in terms of the causal pathway between population health and social capital. In the first sequence of modelling the approach is largely exploratory and the modelling is undertaken as follows:

- The first stage assesses the influence of individual measures of social capital (ie derived from HALS) on the risk of dying after controlling for a number of individual confounders (ie age, sex, tenure, social class and health-related behaviours)
- Second, the importance of areal (ie ecological) indicators of social capital on the risk of death is assessed (after controlling for the individual confounders used in Stage 1)
- Third, the importance of areal measures of material deprivation is contrasted against the relative influence of the area social capital indicators
- Finally, cross-level interactions are explored to test, for example. whether the effect of social capital varies for different social classes, tenure groups or age groups.

In essence the above approach reports the overall impact of area social capital once all individual and household variables have been taken into account and reports how the effect of social capital may be attenuated once area deprivation enters the equation. However, this largely exploratory approach does not test for potential mediating pathways between, for example, individual health-related behaviours and area social capital as suggested by Lindstrom et al. (2003).

We therefore present a second set of modelling results where the impact of area social capital is investigated, conditional only on individual age and sex; this therefore summarises the maximum possible effects of social capital. We then introduce individual health-related behaviours to investigate possible mediating effects. Similarly, we report the changes in social capital model coefficients between the 'maximum effect' model and a model conditional on individual material circumstances (ie after the inclusion of class and tenure).

Modelling approach and results

A multilevel logistic modelling approach was used to analyse the simultaneous influence of both individual and ward-level characteristics on the risk of dying. The 7,578 respondents were nested within 396 electoral wards and 198 constituencies and several suites of models using MLwiN (Goldstein et al., 1998) were developed to investigate the research objectives listed above. Although the analysis focuses on individual and ward-level characteristics, the geographical level of constituency is retained in the models to reflect the clustered sample design of HALS. During sample selection, parliamentary constituencies were stratified according to population size and the 198 constituencies were selected with probability proportional to size of the electorate. Two wards were then selected from each constituency, again with probability proportional to electorate size, resulting in a balanced multilevel design at the highest levels.

In the logistic models parameters were estimated using second-order Taylor expansion with predictive quasi-likelihood (PQL). This estimation procedure is considered superior to first or second order marginal quasi-likelihood (MQL) if the number of observations within clusters is not always large (see Goldstein, 1995, Chapter 7). While the quality of parameter estimates may be more accurate still for small clusters using Markov Chain Monte Carlo (MCMC) methods (Gilks et al., 1996), this method is computationally intensive. We did, however, check our estimates using MCMC methods but no major differences were revealed when compared to second order PQL results.

The results of the first sequence of models are shown in Table 6.1. The logit values are given with their associated *p* values and in model A the logit value of -2.763 is given for the constant in an age- and sex-adjusted base model. Here the constant refers to the stereotypical respondent who is female and was aged 46 in 1984. By taking the antilogit of this value, it is estimated that the probability of dying during the period since the original HALS for this stereotypical respondent is 0.059 (5.9%). In model B we see the effects of adding in the controls of low social class (made up of social classes III (manual), IV and V) and public rented accommodation. The constant in the model now refers to a female, aged 46, from either social class I or II and lives in either owner-occupied housing or private rented accommodation. For ease of interpretation the logits are also expressed as odds ratios (OR) along with their 95% confidence intervals. The odds ratio is a way of comparing whether the probability of a certain event is the same for two groups. An odds ratio of one implies that the event is equally likely between the groups. An odds ratio greater than one implies that the event is more likely (in comparison to the base group) and an odds ratio less than one implies that the event is less likely. An odds ratio of 2.0, for example, increases the risk of dying two-fold. In model B we see that both public renting and low social class significantly increase the odds of dying. The effect for public renting is greater than that of social class. The risk of death for the stereotypical respondent (defined above) is estimated at around 4.0%. However, if this stereotypical individual happens to be low social class then the risk is increased to approximately 5.9%. If she lives in public sector accommodation then the risk is increased to 9.9%.

Model C includes health-related behaviours reported at the individual level. The influence of regular tobacco smoking, unsafe alcohol consumption, unhealthy diet and lack of exercise are all considered. 'Unsafe' alcohol consumption is defined, for women, as the consumption of more than 14 units of alcohol per week and, for men, as the consumption of more than 21 units. This variable is 'missing' for approximately 43% of the respondents and so this unknown category has been included to explore possible non-response bias. An 'unhealthy' diet is defined as engaging in four or more unhealthy diet habits, the details of which are defined in the original Health and Lifestyle Survey. If an individual has not undertaken any vigorous exercise in the two weeks prior to the survey then s/he is classified as 'inactive'.

The results of model C are all significant apart from unsafe alcohol consumption but it is interesting to note that a significant and positive increase in risk is given for the group whose alcohol consumption details are unknown. The constant value indicates that the risk of dying is 2.3% for a female respondent of average age, who is from social class I, II or III non-manual, is an owner-occupier, does not smoke, consumes safe amounts of alcohol, eats a healthy diet and does not smoke. The risk increases to 2.8% for a similar individual but whose alcohol consumption status is unknown. Of all the health-related behaviours, smoking has the greatest impact – the odds of dying are increased to 1.73 for a regular smoker. The odds for individuals classed as inactive are slightly less at 1.60 and for those consuming an unhealthy diet they are given as 1.27. Low social class is similar in impact to

Table 6.1: Modelling the effects of social capital on the probability of death using HALS data

Model		Logit (*p*)	OR (95%CI)
A (Base model: age and sex)			
Constant = -2.763 (risk = 5.93%)			
B (A plus social class and tenure)			
Constant = -3.164 (risk = 4.05%)			
Social class IIIm,IV,V		0.389 (<0.000)	1.46 (1.22-1.79)
Public renting		0.951 (<0.000)	2.59 (1.86-3.60)
C (B plus health-related behaviours (HRBs))			
Constant = -3.742 (risk = 2.32%)			
Social class		0.275 (0.006)	1.32 (1.08-1.60)
Public renting		0.805 (<0.000)	2.24 (1.60-3.13)
Smoking		0.550 (<0.000)	1.73 (1.45-2.07)
Alcohol		0.077 (0.557)	1.08 (0.83-1.40)
Unknown alcohol		0.191 (0.032)	1.21 (1.02-1.44)
Diet		0.238 (0.005)	1.27 (1.07-1.50)
Exercise		0.472 (<0.000)	1.60 (1.33-1.93)
D (C plus individual 'Community')		0.101 (0.257)	1.11 (0.93-1.32)
E (C plus individual 'Reliable friends')		0.053 (0.841)	1.05 (0.63-1.78)
F (C plus individual 'Loneliness')		0.260 (0.072)	1.30 (0.98-1.72)
G (C plus areal deprivation)			
(within the 40% most deprived wards)		0.210 (0.020)	1.23 (1.04-1.46)
H (C plus voluntary activity)			
(24.30-30.20)	% who engaged	0.202 (0.087)	1.22 (0.97-1.26)
(20.10-24.20)	in voluntary	0.239 (0.044)	1.27 (1.01-1.60)
(<20)	activity	0.300 (0.014)	1.35 (1.06-1.71)
I (C plus core volunteering)			
(15.04-18.42)	% core	0.176 (0.138)	1.19 (0.95-1.50)
(11.62-15.03)	volunteers	0.312 (0.009)	1.37 (1.08-1.73)
(<11.61)		0.268 (0.030)	1.31 (1.03-1.67)
J (C plus social activity)			
(7.75-10.18)	% engaged in	0.196 (0.098)	1.22 (0.97-1.53)
(6.01-7.74)	at least two	0.312 (0.009)	1.37 (1.08-1.72)
(<6.0)	social activities	0.307 (0.011)	1.36 (1.07-1.73)
K (C plus altruistic activity)			
(3.08-4.50)	% engaged in	0.150 (0.202)	1.16 (0.92-1.46)
(2.44-3.07)	at least two	0.330 (0.006)	1.39 (1.10-1.76)
(<2.43)	altruistic activities	0.242 (0.048)	1.27 (1.00-1.57)

In models H-S the figures given for the independent variables are percentages. Thus, in model H, 24.30-30.20 refers to wards in which the percentage of the population engaged in voluntary activity is between 24.3 and 30.2%. In model T the values are for the standardised blood donorship ratio around a national average of 100; thus the figure '<77.24' refers to wards in which the donorship rate is below 77.24% of the national expected rate.

Table 6.1: Modelling the effects of social capital on the probability of death using HALS data (cont.)

Model		Logit (*p*)	OR (95% CI)
L (C plus political activity)			
(5.33-6.20)	% engaged	0.060 (0.608)	1.06 (0.84-1.34)
(4.61-5.32)	in political	0.210 (0.075)	1.23 (0.98-1.55)
(<4.60)	activities	0.242 (0.040)	1.27 (1.01-1.60)
M (C plus voted in last election)			
(79.12-80.68)	% who	0.083 (0.460)	1.09 (0.87-1.35)
(77.01-79.11)	voted in	0.112 (0.330)	1.12 (0.89-1.40)
(<77.00)	last election	0.026 (0.827)	1.03 (0.81-1.29)
N (C plus local friends important)			
(62.73-65.36)	% who think	-0.075 (0.496)	0.93 (0.75-1.15)
(59.86-62.72)	local friends	0.097 (0.386)	1.10 (0.88-1.37)
(<59.85)	are important	0.186 (0.108)	1.20 (0.96-1.51)
O (C plus belong to neighbourhood)			
(68.43-70.74)	% who feel	0.085 (0.454)	1.09 (0.87-1.36)
(65.53-68.42)	they belong	0.079 (0.494)	1.08 (0.86-1.36)
(<65.52)	to neighbourhood	-0.071 (0.557)	0.93 (0.73-1.18)
P (C plus work to improve neighbourhood)			
(76.36-79.32)	% willing to	0.097 (0.402)	1.10 (0.88-1.38)
(74.20-76.35)	work to improve	0.226 (0.051)	1.25 (1.00-1.57)
(<74.19)	the neighbourhood	0.084 (0.486)	1.09 (0.86-1.38)
Q (C plus talks to neighbours)			
(70.38-72.65)	% who talk	0.075 (0.504)	1.08 (0.87-1.34)
(67.98-70.37)	regularly to	0.159 (0.163)	1.17 (0.94-1.47)
<67.97)	neighbours	0.041 (0.720)	1.04 (0.83-1.30)
R (Model C plus frequently meets locals)			
(63.87-69.58)	% who frequently	-0.028 (0.808)	0.97 (0.78-1.22)
(59.97-63.86)	meet people	-0.118 (0.316)	0.89 (0.71-1.12)
(<59.96)	locally	-0.226 (0.068)	0.80 (0.63-1.02)
S (Model C feels local area friendly)			
(93.69-94.77)	% who think	0.125 (0.250)	1.13 (0.91-1.40)
(92.23-93.68)	the local area	-0.106 (0.350)	0.90 (0.72-1.12)
(<92.22)	is friendly	-0.169 (0.146)	0.84 (0.67-1.06)
T (Model C plus blood donation)			
(99.58-113.95)	standardised	-0.097 (0.408)	0.91 (0.72-1.14)
(77.25-96.57)	blood donorship	-0.004 (0.975)	0.99 (0.80-1.25)
(<77.24)	ratio	0.049 (0.677)	1.05 (0.83-1.32)

an unhealthy diet but, as in model B, the greatest increase in risk is associated with living in public rented accommodation. Here the odds are given as 2.24, representing a risk of 5.0% for someone living in such accommodation (but otherwise having the characteristics of the base-category individual) compared to the average respondent.

Before moving on to explore the impact of ecological measures of deprivation and the social capital indicators (as generated through the synthetic estimation process), it is first useful to investigate the impact of individually measured aspects of social capital. HALS has a number of questions that could be used as proxies for social capital. Respondents are asked whether they feel 'part of their community' and whether they have 'people that they can rely upon no matter what happens'. They are also asked about how often they 'feel lonely'. To investigate the relative effects of these, each is included in a base model that is also adjusted for class, tenure and health-related behaviours. The results are shown in models D, E and F. None of the three individual-based social capital questions from the HALS achieve conventional levels of statistical significance but the variable related to loneliness has an associated *p* value of 0.072. Here the odds of dying are increased to 1.30 for those who state that they are 'often' or 'always' lonely, compared to those who are 'never' or only 'sometimes' lonely. It could be argued that this variable is really a surrogate for an individual's access to social support rather than stocks of social capital.

Moving on to associations with indicators of deprivation and estimates of social capital for wards, a similar approach to models D, E and F can be taken, whereby each area measure is added separately to a base model containing age, gender, tenure, class and health-related behaviours. While model B investigated the impact of individual material circumstance via social class and housing tenure, model G assesses whether there is evidence for a separate, independent effect for material deprivation measured at the ward level using the Carstairs deprivation index (Carstairs and Morris, 1991). It is impossible to unpack whether this ecological measure of deprivation is capturing a 'miasma' effect (based on the composite result of poor people living near each other) or a 'structural' effect (reflecting poor opportunity structures in the area), but it does provide us with some indication of the relative importance of 'place' deprivation. In the model a dichotomy is used which categorises wards according to whether or not they are among the most deprived 40% wards in the country. Background exploratory work showed that this dichotomy was efficient in capturing the influence of ecological measures of deprivation. Again, we note that residing in one of these deprived wards significantly increases the odds of dying. The risk of dying for the base category individual (an average-aged woman, who owns her own house, from social class I, II or III non-manual and who lives a healthy lifestyle) who resides in a non-deprived ward is approximately 2.2%. However, if the ward is among the 40% most deprived then the risk is increased to 2.7%, representing an odds ratio of 1.23 in contrast to the base category.

The results of adding in all other social capital estimates are shown in models H-T. All synthetic estimates of social capital detailed in the previous chapter have been included apart from 'community spirit'. This indicator has not been included in the analysis as we felt that the initial multilevel model of this variable used in the synthetic estimation process did not have sufficient explanatory power to generate worthwhile predictions (see Chapter 5). The estimates of social capital have been included in the models in the form of ordinal data based on approximate quartile cut-off points. The reasons for using quartiles rather than the actual scores were threefold. First, quartiles are useful for picking up any non-linear relationships between social capital and mortality. Second, a classification system based on equal counts provided us with equal reliability across the resultant standard errors. Finally, because the indicators (apart from blood donation) are indeed synthetic estimates, we did not want to place too much emphasis on the actual score of individual wards. Instead, we have attempted to explore the effects via these relatively broad groupings of social capital activity. Details of these quartile-based class intervals for each social capital indicator are given in the table.

Also, in respect of our index of blood donation, we did consider whether or not we should remove age and sex from the model incorporating this term, as the blood donation rate is already standardised for age and sex. However, there was no significant difference between models incorporating age, sex and blood donation, and those simply incorporating blood donation, and so we have simply reported the former (Table 6.1, model T).

For both volunteering and 'core' volunteering, there appears to be a greater risk of dying associated with

lower levels of activity (models H and I). All categories are significant apart from the third quartiles in both sets of models that include voluntary activity, and for core volunteering the gradient across the quartiles does not appear linear. Here the largest odds are given for the second quartile (1.37). A similar relationship holds for social, altruistic, and political activities, whereby the probability of dying is increased as these activities decrease at an ecological level. Again it must be noted that the third quartiles are not significantly different from the base categories, which represent wards with the highest levels of participation (models J, K and L).

Models M to O indicate that there is very little significant association between risk of death and the levels of voter turnout for the last general election, the numbers who think that local friends are important and those feeling part of the local neighbourhood. None of the terms are significant for voting in the last general election and neither does there appear to be a consistent trend in the odds ratios across the quartiles (model M).

Although not significant at conventional levels (p = 0.108), there may be an effect for living in an area that has the lowest levels of people who consider local friends to be important (model N). Here the odds of dying are increased to 1.20 (confidence interval = 0.96-1.51). While we acknowledge that most of the terms are insignificant in models N and O, it is interesting to note that the overall trend in the odds ratios for these two variables are in opposite directions. For example, as the proportion considering local friends to be important decreases, then the probability of death increases. However, for feeling part of the neighbourhood the opposite is true and the odds decrease as the ecological percentage of this variable also decreases. Again, the relationship between 'willing to work with others to improve the neighbourhood' (model P) and 'talking regularly to neighbours' (model Q) is largely insignificant and in both models the relationship is not consistent across the quartiles.

In contrast there appears to be a consistent relationship across the quartiles for ecological percentages of 'frequently meeting people locally' but the direction does not give support to the positive impact of social capital on health; the trend indicates that the risk of dying decreases as the percentages of this variable also decreases (model R). It should be noted here, however, that it is only the lowest quartile that is statistically significant at conventional levels. None of the terms are significant in model S (which focuses on the overall friendliness of an area) and again the direction of the relationship is not consistent across the gradient of the quartiles. Finally, standardised blood donation rates are investigated in model T (with age and sex in the model) and the results suggest that there is no substantive relationship between altruistic activity as captured through blood donation and health outcome as surveyed via mortality in the HALS.

In models H-T described above (ie the areal social capital models), deprivation has been excluded as a term. When deprivation is included as a dummy in the modelling procedure (ie whether a ward is among the 40% most deprived wards or not, according to the Carstairs index), the effect is for the previous significant relationship between death and the measures of volunteering and social and altruistic activities to become insignificant. Carstairs, as a term, is also rendered insignificant. However, in such models individual social class and tenure maintain their statistical significance. When deprivation is included in the political activity model, deprivation remains significant alongside class and tenure but the relationship between political activity and health does not maintain its significance.

When deprivation is introduced into the remaining models (ie models M to T), all social capital terms remain non-significant, while Carstairs is significant for 'voting in the last general election', 'belonging to neighbourhood', 'working with others to improve neighbourhood', 'talking regularly to neighbours', 'feels that the local area is friendly' and the standardised blood donation rate (model T – with age and sex in the model). It is important to note here that, during model construction for the generation of synthetic estimates, some of the ecological variables included in the models were similar to the individual components of the Carstairs index (ie unemployed males, overcrowding, non-car ownership and low social class). In effect this means that these variables are being entered twice, albeit with different weight, into the equation and this may result in a lessening of the overall effect for the Carstairs index of deprivation. This suggests that, where it is significant, there is a real and independent effect for 'place' deprivation.

The final stage of modelling was to test for possible cross-level interactions between the effect of social

capital and different classes, tenure groups and ages. None of these interactions were statistically significant (data not shown).

These results do not present a very strong case for the effect of area social capital on health when individual material circumstances, health-related behaviours and area deprivation are all taken into account. However, it is possible that both individual material circumstance and/or health-related behaviours are the mediating pathway between social capital and health. We can investigate this supposition by removing these variables from the models and reporting the social capital effects on a base model that contains age and sex only (Table 6.2) and comparing these results with elements from Table 6.1. We can also compare the results with a sequence of models that contain age, sex, health-related behaviours and area social capital (Table 6.3) and models that contain age, sex, class, tenure and area social capital.

Table 6.2, in essence, represents the maximum social capital effects due to the fact that the models are only age-sex standardised. There is a clear, statistically significant gradient for volunteering, social activity, altruistic activity, political activity and voting behaviour with lower levels of activity increasing the risk of mortality in each case (models B-G). While the gradient is also present for models H and N (the importance of local friends and blood donation), the coefficients are not always significant. If the social capital and health link is mediated by health-related behaviours, then we would expect the gradients exhibited in Table 6.2 to lessen or disappear once individual health-related behaviours are included in the models.

The results shown in Table 6.3 indicate that although the gradients remain (and the coefficients are statistically significant) for volunteering, social and political activity, they are less strong than in Table 6.2. Gradients also remain for altruistic, political, and voting activity, 'thinking that local friends are important', 'belonging to the neighbourhood' (models E-I) and blood donation (model N) but terms are not always statistically significant. Table 6.3 also suggests that the effect of the inclusion of area social capital measures on the health-related behaviour coefficients is minimal. In the base model (model A) summarising the effects of health-related behaviours only (after controlling for age and sex), smoking, unknown alcohol consumption, diet and exercise are all significant and remain so in all of the subsequent models. Furthermore, their coefficients are similar across all of the social capital models (models B to N). All of this suggests that there may be some evidence for health-related behaviour having a mediating effect on the relationship between area social capital and health as the impact of social capital is attenuated slightly once health-related behaviours are included in the models. The relationship between health-related behaviour and health remains, irrespective of social capital.

A similar exercise was undertaken using individual material circumstance (class and tenure), and the significant gradients shown in the 'maximum effects' model (Table 6.2) remain only for the two measures of volunteering once class and tenure are entered into the model (results not shown). Again, the gradients for these two aspects of voluntary activity are lessened. While gradients (in the expected direction) remain for social activity, altruistic activity, political activity and the 'importance of local friends', one or more of the terms in the gradient are insignificant. Similarly, an inverse gradient remains for 'frequently meeting locals' and 'feels that the local area is friendly' but none of the terms are significant. The impact of class and tenure remains fairly constant across all models. Again, this suggests that the relationship between area social capital and health may be mediated by individual material circumstances.

Table 6.2: Social capital and health – maximum effects

Model		Logit (*p*)	OR (95% CI)
A (Base model: age and sex)			
B (base plus voluntary activity)			
(24.30-30.20)		0.304 (0.009)	1.36 (1.08-1.70)
(20.10-24.20)		0.454 (<0.000)	1.58 (1.25-1.98)
(<20)		0.722 (<0.000)	2.06 (1.64-2.59)
C (base plus core volunteering)			
(15.04-18.42)	% core	0.301 (0.010)	1.35 (1.08-1.70)
(11.62-15.03)	volunteers	0.513 (<0.000)	1.67 (1.33-2.10)
(<11.61)		0.728 (<0.000)	2.07 (1.65-2.60)
D (base plus social activity)			
(7.75-10.18)	% involved in	0.283 (0.015)	1.33 (1.06-1.67)
(6.01-7.74)	at least two	0.506 (<0.000)	1.66 (1.32-2.09)
(<6.0)	social activities	0.712 (<0.000)	2.04 (1.62-2.56)
E (base plus altruistic activity)			
(3.08-4.50)	% involved in	0.257 (0.028)	1.29 (1.03-1.74)
(2.44-3.07)	at least two	0.572 (<0.000)	1.77 (1.41-2.23)
(<2.43)	altruistic activities	0.639 (<0.000)	1.89 (1.50-2.39)
F (base plus political activity)			
(5.33-6.20)	% involved	0.131 (0.283)	1.14 (0.90-1.45)
(4.61-5.32)	in political	0.309 (0.011)	1.36 (1.07-1.73)
(<4.60)	activities	0.377 (0.002)	1.46 (1.15-1.86)
G (base plus voted in last election)			
(79.12-80.68)	% who voted	0.126 (0.283)	1.13 (0.90-1.43)
(77.01-79.11)	in last election	0.258 (0.031)	1.29 (1.02-1.64)
(<77.00)		0.256 (0.039)	1.29 (1.01-1.65)
H (base plus local friends important)			
(62.73-65.36)	% who think	-0.064 (0.579)	0.94 (0.75-1.18)
(59.86-62.72)	local friends	0.090 (0.449)	1.09 (0.87-1.38)
(<59.85)	are important	0.313 (0.012)	1.37 (1.07-1.75)
I (base plus belong to neighbourhood)			
(68.43-70.74)	% who feel they	0.249 (0.033)	1.28 (1.02-1.61)
(65.53-68.42)	belong to the	0.277 (0.020)	1.32 (1.04-1.66)
(<65.52)	neighbourhood	0.243 (0.053)	1.24 (1.00-1.63)
J (base plus work to improve neighbourhood)			
(76.36-79.32)	% willing to work	0.185 (0.117)	1.20 (0.96-1.52)
(74.20-76.35)	to improve	0.446 (<0.000)	1.56 (1.24-1.97)
(<74.19)	neighbourhood	0.398 (0.001)	1.49 (1.17-1.89)
K (base plus talks to neighbours)			
(70.38-72.65)	% who talk	-0.029 (0.813)	0.97 (0.77-1.23)
(67.98-70.37)	regularly to	0.085 (0.486)	1.09 (0.86-1.39)
<67.97)	neighbours	0.007 (0.950)	1.01 (0.79-1.29)
L (base plus frequently meets locals)			
(63.87-69.58)	% who frequently	-0.281 (0.013)	0.76 (0.61-0.94)
(59.97-63.86)	meet people	-0.455 (<0.000)	0.63 (0.51-0.79)
(<59.96)	locally	-0.648 (<0.000)	0.52 (0.41-0.66)
M (base plus feels local area friendly)			
(93.69-94.77)	% who feel	0.135 (0.253)	1.14 (0.91-1.44)
(92.23-93.68)	the area is	-0.155 (0.209)	0.86 (0.67-1.09)
(<92.22)	friendly	-0.095 (0.452)	1.91 (0.71-1.17)
N (base plus blood donation)			
(99.58-113.95)	standardised blood	-0.062 (0.612)	0.94 (0.74-1.19)
(77.25-96.57)	donorship ratio	0.059 (0.808)	1.06 (0.84-1.34)
(<77.24)		0.257 (0.612)	1.29 (1.02-1.65)

Table 6.3: Modelling the effects of social capital and health-related behaviours on mortality

Model		Logit (*p*)	OR (95% CI)
A (Base model: age, sex and HRBs)			
Smoking		0.653 (<0.000)	1.92 (1.61-2.29)
Alcohol		0.079 (0.550)	1.08 (0.84-1.40)
Unknown alcohol		0.254 (0.004)	1.29 (1.08-1.53)
Diet		0.296 (<0.000)	1.34 (1.14-1.59)
Exercise		0.504 (<0.000)	1.66 (1.37-2.00)
B (A plus voluntary activity)			
Smoking		0.612 (<0.000)	1.84 (1.55-2.20)
Alcohol		0.062 (0.635)	1.06 (0.82-1.38)
Unknown alcohol		0.231 (0.009)	1.26 (1.06-1.50)
Diet		0.256 (0.003)	1.29 (1.09-1.53)
Exercise		0.487 (<0.000)	1.63 (1.35-1.96)
(24.30-30.20)	voluntary	0.241 (0.042)	1.27 (1.01-1.60)
(20.10-24.20)	activity (%)	0.345 (0.004)	1.41 (1.12-1.78)
(<20)		0.518 (<0.000)	1.67 (1.33-2.11)
C (A plus core volunteering)			
Smoking		0.609 (<0.000)	1.84 (1.54-2.19)
Alcohol		0.066 (0.613)	1.07 (0.83-1.38)
Unknown alcohol		0.229 (0.009)	1.26 (1.06-1.50)
Diet		0.263 (0.002)	1.30 (1.10-1.54)
Exercise		0.483 (<0.000)	1.62 (1.35-1.95)
(15.04-18.42)	core	0.231 (0.051)	1.26 (1.00-1.59)
(11.62-15.03)	volunteering	0.413 (<0.000)	1.51 (1.20-1.91)
(<11.61)	(%)	0.520 (<0.000)	1.68 (1.34-2.12)
D (A plus social activity)			
Smoking		0.611 (<0.000)	1.84 (1.55-2.20)
Alcohol		0.077 (0.557)	1.08 (0.84-1.40)
Unknown alcohol		0.235 (0.008)	1.26 (1.06-1.50)
Diet		0.266 (0.002)	1.30 (1.11-1.54)
Exercise		0.486 (<0.000)	1.63 (1.35-1.96)
(7.75-10.18)	social	0.247 (0.037)	1.28 (1.02-1.61)
(6.01-7.74)	activity	0.436 (<0.000)	1.55 (1.23-1.95)
(<6.0)	(%)	0.517 (<0.000)	1.68 (1.33-2.11)
E (A plus altruistic activity)			
Smoking		0.617 (<0.000)	1.85 (1.55-2.21)
Alcohol		0.073 (0.576)	1.08 (0.83-1.39)
Unknown alcohol		0.227 (0.010)	1.26 (1.05-1.49)
Diet		0.268 (0.002)	1.31 (1.11-1.54)
Exercise		0.441 (<0.000)	1.55 (1.23-1.96)
(3.08-4.50)	altruistic	0.493 (<0.000)	1.64 (1.36-1.97)
(2.44-3.07)	activity	0.200 (0.091)	1.22 (0.97-1.54)
(<2.43)	(%)	0.472 (<0.000)	1.60 (1.27-2.02)
F (A plus political activity)			
Smoking		0.644 (<0.000)	1.90 (1.60-2.27)
Alcohol		0.076 (0.564)	1.08 (0.83-1.40)
Unknown alcohol		0.243 (0.006)	1.28 (1.07-1.52)
Diet		0.283 (<0.000)	1.33 (1.12-1.57)
Exercise		0.500 (<0.000)	1.65 (1.37-1.99)
(5.33-6.20)	political	0.081 (0.505)	1.08 (0.86-1.37)
(4.61-5.32)	activity	0.234 (0.053)	1.26 (1.00-1.60)
(<4.60)	(%)	0.255 (0.035)	1.29 (1.02-1.64)
G (A plus voted in last election)			
Smoking		0.645 (<0.000)	1.91 (1.60-2.27)
Alcohol		0.079 (0.546)	1.08 (0.84-1.40)
Unknown alcohol		0.245 (0.006)	1.28 (1.07-1.52)
Diet		0.298 (<0.000)	1.35 (1.14-1.59)
Exercise		0.504 (<0.000)	1.66 (1.37-1.99)
(79.12-80.68)	voting in last	0.117 (0.309)	1.12 (0.90-1.41)
(77.01-79.11)	general election	0.210 (0.074)	1.23 (0.98-1.55)
(<77.00)	(%)	0.161 (0.183)	1.74 (0.93-1.49)

Table 6.3: Modelling the effects of social capital and health-related behaviours on mortality (cont.)

Model		Logit (*p*)	OR (95% CI)
H (A plus local friends important)			
Smoking		0.642 (<0.000)	1.90 (1.59-2.26)
Alcohol		0.074 (0.576)	1.08 (0.83-1.39)
Unknown alcohol		0.240 (0.007)	1.27 (1.07-1.51)
Diet		0.299 (<0.000)	1.35 (1.14-1.59)
Exercise		0.501 (<0.000)	1.65 (1.37-1.99)
(62.73-65.36)	local friends	-0.061 (0.591)	0.94 (0.75-1.18)
(59.86-62.72)	important	0.083 (0.476)	1.09 (0.86-1.37)
(<59.85)	(%)	0.237 (0.050)	1.27 (1.00-1.61)
I (A plus belong to neighbourhood)			
Smoking		0.647 (<0.000)	1.91 (1.60-2.28)
Alcohol		0.074 (0.573)	1.08 (0.83-1.39)
Unknown alcohol		0.249 (0.005)	1.28 (1.08-1.53)
Diet		0.293 (<0.000)	1.34 (1.14-1.58)
Exercise		0.503 (<0.000)	1.65 (1.37-1.99)
(68.43-70.74)	belong to	0.186 (0.106)	1.21 (0.96-1.51)
(65.53-68.42)	neighbourhood	0.212 (0.071)	1.24 (0.98-1.55)
(<65.52)	(%)	0.117 (0.339)	1.12 (0.88-1.43)
J (A plus work to improve neighbourhood)			
Smoking		0.633 (<0.000)	1.88 (1.58-2.24)
Alcohol		0.076 (0.564)	1.08 (0.83-1.40)
Unknown alcohol		0.243 (0.006)	1.27 (1.07-1.52)
Diet		0.288 (<0.000)	1.33 (1.13-1.57)
Exercise		0.497 (<0.000)	1.64 (1.36-1.98)
(76.36-79.32)	willing to work	0.161 (0.170)	1.17 (0.93-1.48)
(74.20-76.35)	to improve	0.352 (0.003)	1.42 (1.13-1.79)
(<74.19)	neighbourhood (%)	0.244 (0.045)	1.26 (1.01-1.62)
K (A plus talks to neighbours)			
Smoking		0.655 (<0.000)	1.93 (1.62-2.29)
Alcohol		0.077 (0.560)	1.08 (0.83-1.40)
Unknown alcohol		0.253 (0.004)	1.29 (1.08-1.53)
Diet		0.296 (<0.000)	1.34 (1.14-1.59)
Exercise		0.504 (<0.000)	1.66 (1.37-2.00)
(70.38-72.65)	talks regularly	0.004 (0.975)	1.00 (.080-1.26)
(67.98-70.37)	to neighbours	0.114 (0.335)	1.12 (0.89-1.41)
<67.97)	(%)	0.007 (0.950)	1.01 (0.80-1.27)
L (A plus frequently meets locals)			
Smoking		0.614 (<0.000)	1.85 (1.55-2.20)
Alcohol		0.063 (0.630)	1.07 (0.82-1.38)
Unknown alcohol		0.237 (0.007)	1.27 (1.07-1.51)
Diet		0.274 (0.001)	1.32 (1.11-1.55)
Exercise		0.492 (<0.000)	1.64 (1.36-1.97)
(63.87-69.58)	frequently meets	-0.174 (0.123)	0.84 (0.67-1.04)
(59.97-63.86)	people locally	-0.322 (0.005)	0.72 (0.58-0.91)
(<59.96)	(%)	-0.461 (<0.000)	0.63 (0.50-0.80)
M (A plus feels local area friendly)			
Smoking		0.654 (<0.000)	1.92 (1.61-2.29)
Alcohol		0.082 (0.531)	1.09 (0.84-1.40)
Unknown alcohol		0.256 (0.004)	1.29 (1.09-1.54)
Diet		0.291 (<0.000)	1.34 (1.13-1.58)
Exercise		0.501 (<0.000)	1.65 (1.37-1.99)
(93.69-94.77)	feel local	0.141 (0.218)	1.15 (0.92-1.44)
(92.23-93.68)	area friendly	-0.113 (0.346)	0.89 (0.71-1.13)
(<92.22)	(%)	-0.099 (0.417)	0.91 (0.71-1.15)
N (A plus blood donation)			
Smoking		0.647 (<0.000)	1.91 (1.60-2.28)
Alcohol		0.075 (0.570)	1.08 (0.83-1.39)
Unknown alcohol		0.249 (0.005)	1.28 (1.08-1.53)
Diet		0.292 (<0.000)	1.34 (1.13-1.58)
Exercise		0.500 (<0.000)	1.65 (1.37-1.99)
(99.58-113.95)	standardised blood	-0.089 (0.459)	0.91 (0.72-1.16)
(77.25-96.57)	donorship ratio	0.005 (0.964)	1.01 (0.80-1.27)
(<77.24)		0.164 (0.175)	1.18 (0.93-1.49)

Conclusions

In this chapter we have modelled individual and ecological data simultaneously to account for variations in individual mortality in a follow-up study, and in this respect our work contrasts with earlier cross-sectional and aggregate studies. We have been able to assess the effect of individual and ecological measures of social capital in models which also contain demographic, health-related behaviour and social-structural variables at the individual level.

The modelling exercise has indicated that our validated estimates of social capital do not account substantially for variations in mortality and, even in those instances where a modest effect is found, the impact is attenuated when a measure of material deprivation is included in the model. The investigation shows that the effect of social capital is also lessened when health-related behaviours or material circumstances are included in age-sex adjusted models, suggesting that they may be part of a possible mediating pathway between social capital and health.

The largely negative results could be because the models are based on estimates, not on observed values, but as the previous chapter has indicated, we have validated our data against real-world observations. Bearing that in mind, the modelling exercises have indicated that there is no real evidence for a strong consistent relationship between health outcome and ecological measures of social capital. There is a great deal of collinearity between deprivation and the measures of social capital and it is impossible to unpack their relative effects in a combined model. Furthermore, the direction of the relationship between the social capital indicators and health is not always consistent, indicating that the positive health advantages of high levels of social capital cannot always be presumed. Throughout all the models the effects of individual social class and tenure remain statistically significant, with tenure having the greatest impact on health outcome. This casts doubt on whether social capital has an ecological influence on health outcomes over and above that of material conditions.

Chapter 7

Conclusions and policy implications

Introduction

We are now in a position to evaluate the contribution of this work to debates relating to social capital, geography, and health. Our point of departure for this project was that we were sceptical about previous studies for two reasons. First, they had been conducted for large spatial units and second, while plausible ecological associations had been demonstrated, the precise causal pathways by which social capital affected health remained unclear. An attempt to replicate ecological analyses of social capital and health for standard regions produced inconclusive results (Chapter 2). We therefore sought to devise measures of social capital for small areas (electoral wards) in England, through a combination of direct measurement and indirect estimates (Chapters 3 and 4). We validated the resultant indicators using directly measured data from several sources (Chapter 5) and we then deployed the indicators in statistical analyses of relationships between individuals and area circumstances, on the one hand, and health-related behaviours and outcomes on the other (Chapter 6). We believe that the key contributions of this work relate to debates about how to measure social capital and to debates about whether levels of social capital for communities or places can be shown to have impacts on health outcomes.

Debates about the measurement of social capital

We devoted much attention to evaluating possible direct measures of social capital before turning towards synthetic estimation. The key problem with direct measures is that the national survey datasets from which they might be drawn contain insufficient responses for disaggregation below the level of standard regions. Notwithstanding this deficiency, the Performance and Innovation Unit's (2002) paper on social capital still uses data at that spatial scale to make some claims about – for example – the alleged effect of social capital on the 'competitiveness' of regions. There are some possibilities for the development of measures at smaller spatial scales but, on closer examination, they all had weaknesses: we think that voter turnout, blood donation and membership of large voluntary organisations all have drawbacks (as well as representing quite different facets of social capital). Other difficulties, such as the problem of standardisation for demographic structures, led us to move away from such measures (Chapter 3).

Our chosen alternative was a procedure we describe as synthetic estimation. This was used to model relationships between individual and area circumstances and the probability of engaging in behaviours conducive to social capital formation, or of expressing attitudes of relevance to dimensions of social capital. The method used is a cost effective way of generating estimates of a number of indicators. The indicators demonstrate different geographical patterns, suggesting that they are not simply reducible to material circumstances. We believe that we can have confidence in these estimates because we have validated them against information gathered for a number of wards and for over 100 local authorities. However, further corroboration would be welcome. We think it would be useful to compare our indicators against directly measured data from other sources so that we can determine whether our estimates are borne out in different contexts.

In the absence of detailed direct observation of community norms, aggregated counts or estimates of this kind are probably the best we can do to produce measures of local variation in social capital. The measures are subject to the well-taken criticisms advanced by Blaxter and Poland (2004) of aggregation (namely, that measures

are really just capturing the sum of the characteristics of residents of areas, and are not, therefore, true contextual constructs), but those criticisms apply to many measures of social capital and to many measures of the properties or characteristics of areas. We feel that their use in this context is defensible as it is the first attempt to conduct analyses of the relationships between social capital and health outcomes at this spatial scale.

This work could usefully be extended by replicating the modelling exercises for survey datasets gathered recently, such as the 2001 General Household Survey (Coulthard et al., 2002) which included several questions relating to participation and social capital. This would allow us to investigate the stability of relationships between individual and area circumstances and social capital: for example, has the relationship between individual and area circumstances and the probability of being a volunteer altered in the decade since 1992, when the GHS asked about this? Extension of the approach to other datasets with appropriate spatial references would also be valuable, an example being the British Crime Survey, which asks questions about sense of community and other relevant dimensions of social capital. The Office for National Statistics is currently reviewing the extent to which additional small-area statistics can be produced for local government wards on the theme of neighbourliness and social capital. We would suggest, on the basis of this work, that they approach routinely collected datasets (blood donation, voter turnout) with some circumspection. However, the synthetic estimation methodology certainly appears to have some value, and we would recommend it as a cost-effective way forward for the development of such indicators.

Debates about the influence of social capital on health outcomes

We pursued a modelling strategy in which the response variable was the probability that an individual who has been included in the 1985 Health and Lifestyle Survey was still alive on re-survey in 1999. The modelling strategy was designed to compare the relative explanatory power of measures of deprivations with that of measures of social capital.

We found that when a range of validated estimates of social capital were included in a model that attempted to account for variations in mortality, there are not substantial effects, and even these are further attenuated when a measure of material deprivation is included in the model. This could be because the models are based on our estimates, not on observed values, but as indicated above, we have taken steps to validate our data against real-world observations. Bearing that in mind, the modelling exercises have indicated that there is no real evidence for a strong consistent relationship between health outcome and ecological measures of social capital. Furthermore, the direction of the relationship between the social capital indicators and health is not always consistent, indicating that the positive health advantages of high levels of social capital cannot always be presumed. Throughout all the models, the effects of individual social class and tenure remained statistically significant, with tenure having the greatest impact on health outcome. When ecological measures of deprivation were included the effect of social capital was reduced. However, there is a great deal of collinearity between deprivation and the measures of social capital and it is impossible to unpack their relative effects in a combined model. This casts doubt on whether social capital has an ecological influence on health outcomes over and above that of material conditions.

It could be argued that these results do not invalidate the thesis that social capital influences health. It may well be the case that at the individual level some aspects of social capital affect health outcomes, but we did not find such an effect for the spatial scale at which our indicators have been constructed. It is well known in the social sciences that results which obtain at one scale do not necessarily hold at another and, in terms of future work, one obvious recommendation would be for similar analyses to be carried out at other spatial scales. It is not clear what this scale would be, however, although the 'rating places' literature (eg Rogerson et al., 1996), and some geographical work on urban-rural shifts in economic activity, both appear to point towards smaller towns and cities (of between 50-100,000 population) as providing congenial environments for healthy living. That is not to say, however, that such places possess high levels of social capital. Experimenting with 'bespoke neighbourhoods' – that is, neighbourhoods the definition of which is not constrained by administrative definitions – might be one way forward.

It could also be argued that the kind of measures we have devised only capture one aspect of social capital – that relating to 'white, middle-class churchgoing nuclear

families', as Mackian (2002: 205) acidly puts it. Other forms of community level social capital (informal exchanges of favours between friends and neighbours, for instance) are not picked up by the national surveys on which we have drawn. Even so, variation in the measures we have devised is largely captured by – and, statistically speaking, explicable in terms of – material factors. In addition, by comparing the influence of social capital directly with those of deprivation and individual circumstances, it appears that the influence of social capital on the probability of dying is small.

Policy implications

If our work suggests that we cannot detect area effects of social capital on health outcomes (insofar as they are measured through variations in the probability of mortality), what are the implications of this work for health and public policy? Many people are agreed on the desirability of enhancing social capital and reducing variations in social capital between places. Though not officially adopted as government policy, there are many recommendations along these lines in the PIU's (2002) work on social capital. However, our work suggests that the public health benefits of such a strategy are not large in comparison with strategies designed to target deprivation (this is because the effects of individual socio-economic characteristics and tenure are the largest observed in our models).

Moreover, our work also implies that engagement in behaviours conducive to the promotion of social capital is more likely to happen as levels of prosperity increase, even for individuals of the same socio-economic status (see our discussion of volunteering in Chapter 4). This suggests that policies to promote social capital must be sensitive to context: they are more likely to have beneficial effects in more prosperous communities and so consideration needs to be given to targeted policies to promote it. Moreover, to the extent that public health policies are predicated on engaging people as volunteers in their communities, the response to such policies will vary.

There is as yet relatively little work on such topics. Williams (2002, 2003) presents summary statistics on regional variations in the proportion of people who volunteer, showing some association between socio-economic conditions and propensity to volunteer. He uses this to argue that there are regional 'cultures' of volunteering. This vague notion is not very helpful because Williams' work cannot distinguish composition and context. In contrast our work (see the discussion in Chapter 4) shows that there are small, but significant, differences between regions in the propensity for individuals with identical socio-economic characteristics to engage in voluntary activity. There is also some evidence to suggest that this is true for blood donation – there is a variable propensity to donate blood which appears to be related to the socio-economic characteristics of places (though we do not have detailed socio-economic data on the characteristics of individual blood donors). These geographical variations could be due to population turnover or health status; alternatively they may reflect differential targeting of recruitment publicity.

These results suggest that our data may offer a useful resource for those in local government, healthcare and the voluntary sector seeking to promote participation and community development. The indicators may be useful in terms of assessing where resources might best be focused to achieve such objectives. Clearly, they only offer broad indications of patterns and could, unless used carefully, lead to league-table journalism in which different communities are compared for their degree of civic-mindedness. They could also prompt an emphasis on the deficiencies of communities, such that they need to be brought up to externally-imposed norms of participation. Morrow (1999: 760) points to the dangers of what she terms 'deficit theory syndrome' – social capital is presented as something which unsuccessful communities lack. This is also undesirable. It should be remembered that a key criticism of the policy emphasis on social capital has been that social capital indicators typically measure behaviours and dispositions which are characteristic of middle-class communities while neglecting others (eg trade union activity). So with these substantial caveats the estimates might provide a useful resource for public policy, though we would suggest that more work be done on validating them against directly measured data.

In terms of health policy, however, we are not convinced on the basis of our results, that increasing levels of social capital for areas will necessarily lead to improved health outcomes. If compared to the influence of deprivation, we do not think that social capital explains much variability in health outcomes. We tend to endorse the criticisms of social capital which imply, along with Hawe

and Shiell (2000) that 'its empirical capacity to explain health patterning is relatively weak at present'. These authors believe that the rhetoric and metaphors of social capital can in principle be valuable for health promotion, since the language facilitates engagement of those who otherwise would have been put off by health sector jargon. However, they also contend that the focus of social capital theorists on the relational aspects of society, and not on political and material aspects, can lead to solutions which are conservative in that they emphasise the need to repair the social fabric from below. Promoting social capital and strengthening social networks can, according to Cattell (2001) 'alleviate the harsher health effects of poverty and deprivation but they are no substitute for a more equitable distribution of resources'. She argues that social capital is a helpful construct for identifying conditions which contribute to the quality of life, but is not adequate, on its own, to explain variations in health outcomes. On the basis of our analysis, which has emphasised the limited explanatory power of ecological measures of social capital at the level of electoral wards in England, we would agree.

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APPENDIX 1

Questions on issues relating to social capital in the national survey datasets

General Household Survey Questions on voluntary work

Question	1987	1992
Have you done any voluntary work in the last 12 months?	✓	✓*
Is the group/organisation a trade union or political party?	✓	
Do you do any voluntary work for a group or organisation that is not a trade union or political party?	✓	
What type of voluntary work in the last 12 months?		
Collecting money	✓	✓
Doing something else to raise money	✓	✓
Visiting people in institutions	✓	✓
Teaching, coaching or training	✓	✓
Giving talks/canvassing, leafleting	✓	✓
Giving advice	✓	✓
Serving on a committee	✓	✓
Organising/helping at a club or group	✓	✓
Administration/clerical/secretarial	✓	✓
Organising/taking part in entertainment	✓	✓
Visiting people in their own homes	✓	✓
Giving other kinds of practical help not mentioned above		
Other	✓	✓
Thinking of the 4 weeks ending yesterday – have you done any of the activities listed above?	✓	✓
If yes – about how much time spent in total?	✓	✓
Over the last 12 months – on about how many days have you done any kind of voluntary work with a group?	✓	✓
Thinking of the days in the last 12 months on which you did voluntary work, on average how many hours did you spend each day?		✓

*NB work for trade unions or political parties was not counted as voluntary work in the 1992 GHS and hence questions regarding these were not included. In the 1987 datafile, the voluntary work total (ie the first question) may contain those who do voluntary work for such organisations.

In the 1987 GHS, voluntary work information is available for 19,529 adults. There are 630 primary sampling units on the file and these nest within 27 regions in England, Wales and Scotland.

In the 1992 GHS, 18,179 people are surveyed about their voluntary work activity. Respondents are selected from 651 primary sampling units across the 27 regions.

Survey of English Housing

Question	1994	1995	1996	1997
How satisfied are you with this accommodation? (very sat, fairly sat, neither sat/dis, slightly dis, very dis)	✓	✓	✓	✓
How satisfied are you with this area as a place to live? (very sat, fairly sat, neither sat/dis, slightly dis, very dis)	✓	✓	✓	✓
On the whole, do you think that that over the past two years this area has got better or worse to live in, or haven't things changed much? (got better, got worse, not changed much, lived < 2)		✓		
….over the next couple of years will area get better etc. (get better, get worse, no change)		✓		
Please could you tell me how good or bad you think your area is for the following things:				
Schools	✓			✓
Public transport	✓			✓
Street lighting	✓			✓
Rubbish collection	✓			✓
Leisure facilities	✓			✓
General appearance (very good, fairly good, fairly bad, very bad, does not apply)	✓			✓
I am going to read out a list of things that can cause problems for people in their area:				
Vandalism	✓	✓		✓
Graffiti	✓	✓		✓
Crime	✓	✓		✓
Dogs	✓	✓		✓
Litter and rubbish in streets	✓	✓		✓
Problems with neighbours	✓	✓		✓
Racial harassment	✓	✓		✓
Noise (serious problem, problem but not serious, not problem)	✓	✓		✓
Generally speaking, how secure do you feel when you are inside your home? (completely safe, fairly safe, not very safe, not at all safe)	✓			✓
Apart from the people in this household – do you have any (other) relatives living in this area? Yes/No	✓			✓
Do you have close relatives in this area who it is important for you to stay living close to? Yes/No	✓			✓
Would you say that there is a lot of community spirit in this area? Yes/No?	✓			✓

Survey of English Housing (cont.)

Question	1994	1995	1996	1997
On the whole, would you describe the people who live in this area as friendly, or not? Would you say that they were: (very friendly, fairly friendly, not very friendly, not at all friendly)	✓			✓
From here, how easy is it for you to get to the following: (using your usual form of transport (95,97))				
A corner shop	✓	✓		✓
A medium to large supermarket	✓	✓		✓
A post office	✓	✓		✓
A doctor	✓	✓		✓
A hospital	✓	✓		✓
A bank or building society		✓		
(very easy, fairly easy, fairly difficult, very difficult, does not apply)				
I would like to ask you some questions about your neighbours. First of all do you get on with: All or most/some/none/no contact with neighbours		✓		
I am going to read out a list of possible problems that people have with neighbours:				
Noise		✓		
Cars other than noise		✓		
Dogs		✓		
Children out of control		✓		
Disputes relating to gardens		✓		
Neighbours entering property without permission		✓		
Neighbours causing damage to your property		✓		
Racial harassment from neighbours		✓		
Verbal abuse		✓		
Threats of violence		✓		
Actual violence		✓		
Drug dealing		✓		
Neighbours running a business from home		✓		
(serious problem with neighbour, a problem but not serious, not a problem)				
Is there a tenants' or residents' association? (Yes/No)		✓		
Do you belong to it? (Yes/No)		✓		
Please look at a list of aspects of your area which might be improved. Which, if any, of the aspects of your area would you like to see improved?				
Amount and quality of housing		✓		
Availability of jobs		✓		
Crime and vandalism		✓		
Local amenities, parks and leisure facilities		✓		
Local health services		✓		

Survey of English Housing (cont.)

Questions	1994	1995	1996	1997
Opportunities/facilities for children/young people		✓		
Public transport service		✓		
Quality of environment		✓		
Schools and colleges		✓		
Shopping and commercial facilities		✓		
None of these		✓		
Could you choose 3 aspects that you think it is most important to improve		✓		
Have you done any unpaid voluntary work (apart from political parties) in the last 12 months. Yes/No?			✓	
If yes – as part of a group? (Yes/No)			✓	
If yes, still doing it? (Yes/No)			✓	
Did the work aim to improve your local area or neighbourhood and the people who live there in any way? (Gives various options, including: – Improving local people's quality of life (eg cultural/sports/health activities) – Activities for local children and youths – Improving the local environment – Tackling crime and improving community safety (eg neighbourhood watch) – Local employment initiatives (eg helping the unemployed get back to work through an unemployment worker centre or work placement group) – Local housing issues – Improving local people's education skills (eg school governor, PTA work, adult education or voluntary training scheme)			✓	
What, if any, are the positive aspects of doing voluntary work for a local group or scheme? Code all that apply: Leads to change Feel a sense of fulfilment Chance to make a difference Enjoy working with others from my neighbourhood Acquire new skills and abilities Enjoy dealing with an important issue Other reason No attractions			✓	

Survey of English Housing (cont.)

What, if any, are the negative aspects of doing voluntary work for a local group or scheme? Code all that apply:	1994	1995	1996	1997
			✓	
Do not feel I/we are taken seriously by authorities				
Do not feel the work is appreciated by others				
The work does not lead to any real change				
The project was not well managed				
I did not get on with the others involved				
Some other reason				
No negative aspects				
If no to doing voluntary work…				
Do you think that you would ever be interested in taking part in any such voluntary activity, that is a group with the aims listed on this card?				
(Yes/No/it depends)			✓	
AIMS as above				
If no to above – are there any particular reasons?				
Code all that apply:				
			✓	
I am too busy and/or have no spare time				
I want to leave the area				
Public bodies are not interested in what people say				
I am not able to get to meetings				
I am generally not interested				
Some other reason				
No particular reason				

The survey geography

Survey year	Known and unknown geography
1994/5	28,746 households (51,355 individuals) in approximately 780 unknown PSUs in 10 DoE Integrated Regional Office Areas (known). Approximately 36 addresses are surveyed in each PSU.
1995/6	28,954 households (51,508 individuals) in approximately 780 PSUs, 10 DoE areas.
1996/7	28,874 households (50,158 individuals) in approximately 780 PSUs in 10 DoE areas. 28 addresses per PSU.
1997/8	28,775 households (50,814 individuals). 15 standard statistical regions, 10 DoE regions.

British Household Panel Survey

Asks respondents whether they are members of or active in: political party; trade union; environmental group; parents' association; tenants' group; religious association; voluntary agency; social group; other community group; women's institute; women's group; other organisation. Covers approximately 10,000 individuals in 5,000 households.

Survey geography: identifiable approximations of named local authorities. Also approximately 520 PSUs (Primary sampling units) for respondents in the original wave.

APPENDIX 2

Data from the National Blood Service: decisions on inclusions and exclusions

Age restrictions

We included only donors aged between 25-64. The upper limit was chosen because donors are not recruited from the over-60s and donors are 'retired' at 70. Though this means that donation can continue beyond 65, it is also possible that retirement might affect donation patterns (for example, through migration). We also excluded people below the age of 25, initially prompted by the discovery of large localised concentrations of donors. When we analysed the distribution by unit postcodes (eg GU31 4BS: a unit postcode would typically contain 20-30 households) we discovered several postcodes containing over 100 donors; one had as many as 170 donors.

Inspection of the ages of these donors revealed that they were mostly aged under 25 and some of the postcodes could readily be identified as university and college halls of residence. Clearly, inclusion of every donor would run the risk of generating anomalously high rates in certain areas. In relation to theoretical propositions about the formation of social capital such areas would also be anomalous. Putnam's causal model implicitly postulates that social capital is most likely to be formed in relatively stable communities and is a function of interactions between residents built up over many years. Short-term migrants, such as students, who are present for only a few years (and then for only part of the year), can hardly be expected to contribute to this process.

We do not have information on whether (and when) donors change their address and so the decision was taken to exclude donors aged under 25, the thinking being that by doing so we would be capturing individuals who were beginning to settle down in their communities (given that graduates often move more than once in the years following graduation, the age of 25 seemed a plausible, albeit arbitrary, cut-off). These exclusions left 3.8 million donors.

Identifying active donors

It should be remembered that we were seeking a measure of altruism and this required decisions about which donors counted as 'active'. The National Blood Survey (NBS) attaches to each donor a 'donor activity code' and in Table A2.1 we summarise these codes and indicate which categories were included in or excluded from our analysis. Active (A) donors were, of course, retained and, as can be seen, the bulk of these had

Table A2.1: Donor activity codes for NBS blood donor dataset

Donor activity code	Definition	*n*	Most frequent year of last donation	% with no date of last donation	Include/ exclude
A	Active	1,691,412	1999	0.9	Included
B	permanently Barred	15,624	1992	23	Included
D	Deleted	310,369	1996	83	Some excluded
E	Enrolled	164,827	1999	84	Included
M	Medical withdrawal	226,945	1996	37	Included
O	Overage	0	–	–	Excluded
P	susPended over-age	7	0	100	Excluded
Q	Quarantined over-age	0	–	–	Excluded
R	Retired	7,398	1997	67	Included
S	Suspended	165,168	1999	11	Included
T	Transfer out	44,361	1991	12	Excluded
W	Withdrawn	1,256,949	1996	6	Excluded
[blank]		14	0	86	Excluded

donated blood in the 12 months prior to supply of the data. Permanently barred (B) donors were included since they were willing to donate but were barred from doing so for an external reason. The same applies to those who have withdrawn for medical reasons (M), to those who had enrolled (E) but not donated yet, and to donors temporarily suspended (S); donors in these categories are retained on grounds of willingness. The small number of 'retired' donors were also included, because it is not clear how a donor under the age of 65 could be 'retired'; in fact, 435 of these were aged under 30, and it is more likely that some of these had been mis-categorised. They were therefore retained.

The most problematic category was that of 'deleted' donors. These are defined as donors who have never given blood (despite having been enrolled), who have not attended sessions and who will not be invited to give blood in future. Despite this published definition, some 17% of these donors have a valid entry for their date of last donation. Since it appears that these donors had given blood since being classed as 'deleted', only those lacking a date of last donation were excluded; this resulted in the removal of 259,116 donors.

Six categories were excluded from analysis. The 'over-age' (O) and 'quarantined over-age' categories were removed by age restrictions. Seven donors in the 'suspended over-age' (S) category had survived, but were excluded because they had no date of last donation. The transfer (T) category is one which predates unification of the national register of donors. Someone who moved between the catchments of the regional divisions of the blood donor service would be categorised by that division as 'transferred out', but they could then re-register elsewhere and thereby appear more than once in the unified database. These donors were therefore excluded. The 'withdrawn' category relates to those donors who have asked not to be invited to donate in the future. This category seems to form a repository for obsolete donors; almost 75% of the blank postcodes in the original data file apply to 'withdrawn' donors. We would expect this because many (especially older) donors would have been registered before the introduction of postcoding in the late 1960s.

In addition to the donor activity code further measures were taken to refine the dataset. A small number (1,925) were identified as having addresses located outside England and Wales. A much larger number (some 78,000) could not be matched through their postcode to the district, ward or enumeration district. Most of these had no postcode; some were in areas where the local postcode geography had changed, posing problems for linking to 1991 census areas. This was especially the case for some areas of new housing development. It was clear that the unmatchable postcodes were not evenly distributed. For the 10 donor collection centres, the proportion of unmatched postcodes ranged from 5.69% in the Manchester area to 0.78% in Newcastle. This meant that our modelling strategy had to take account of variations between collection centres.

Finally, in addition to the age and donor status restrictions discussed above, we imposed further restrictions relating to date of last donation. We removed donors who were under 25 at date of last donation because their address information was unlikely to have been updated since they last donated, and thus referred to them while still young and mobile. We also introduced a cut-off of 1995 for the date of last or most recent donation, excluding anyone who had not donated in the period 1995-1999. The effect of these restrictions is shown in Table A2.2

Table A2.2: Effect of restrictions on numbers included in donor analysis

	Total	Currently not 'large user'
Total (after age and donor activity restrictions)	2,320,702	2,302,468
Donated in or since 1995	1,913,118	1,900,606
Years of birth and of last donation known	2,055,073	2,040,563
… and aged at least 25 years at last donation	1,917,697	1,906,617
… and donated in or since 1995	1,806,398	1,796,210

Notes