Are Poor People Healthier in Rich or Poor Areas?

The Psychosocial Effects of Socioeconomic Incongruity in the Neighbourhood

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Abstract

This thesis contributes to the understanding of how health is affected by the interaction between neighbourhood and individual socioeconomic status. It has been found that residents in high status neighbourhoods are healthier than those in low status neighbourhoods, controlling for individual status. Here it is hypothesised that such an association may not be found amongst low status individuals, because such individuals may have more detrimental psychosocial exposures in high status neighbourhoods than in low status neighbourhoods. For low status individuals, these detrimental psychosocial exposures, such as lacking social support and frequent status comparisons, may counteract positive material exposures in high status neighbourhoods.

To test this hypothesis, three studies were conducted in this thesis. The first is an analysis of the difference in the association between neighbourhood status and health across individuals of different socioeconomic status, using a sample of mothers from England in the Millennium Cohort Study. The second study is similar and uses the same dataset, but instead of health, psychosocial factors were analysed. The third study, specific to London, uses data from the 2001 census to investigate the health impact of living in a low status city block within a wider neighbourhood of high status.

In the first two studies, it was found that the positive association between neighbourhood status and health is weakest amongst the lowest status mothers, and whilst high status mothers were most likely to lack local friends and be depressed in low status neighbourhoods, there was an indication that in certain contexts the lowest status mothers were most likely to lack local friends and be depressed in high status neighbourhoods. In the third study, it was found that low status city blocks within high status neighbourhoods were more likely to have poor average health than those within low status neighbourhoods.

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Author's Declaration

I, Christo Albor, confirm that the work presented in this thesis is my own. Where information has been derived from other sources I have indicated it clearly.

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Introduction

'Are poor people healthier in rich or poor areas?'

This is the question that I address in this thesis. Specifically, I am interested in the question as it relates to neighbourhoods in high-income countries. To some, the answer to this question may seem obvious through their intuition alone - living in deprived surroundings must be detrimental to health, regardless of who you are. Researchers in the disciplines of public health and epidemiology may arrive at the same answer, based on several studies that have shown independent detrimental health effects of area deprivation after controlling for individual socioeconomic characteristics (Pickett and Pearl, 2001, Riva *et al.*, 2007). Nevertheless, the generalisation of such area health effects to poor people are challenged by four studies with 'unintuitive' findings (Yen and Kaplan, 1999, Veugelers *et al.*, 2001, Roos *et al.*, 2004, Winkleby *et al.*, 2006).

All of these studies investigated the association of neighbourhood socioeconomic characteristics with mortality rates in North America; two were conducted in the US (Yen and Kaplan, 1999, Winkleby *et al.*, 2006) and two in Canada (Veugelers *et al.*, 2001, Roos *et al.*, 2004). These studies differ from most other investigations into the relationship between neighbourhood socioeconomic status and mortality rates, as the authors stratified their analyses by individual socioeconomic status. All studies had findings which showed higher mortality rates for people of low socioeconomic status when they lived in rich neighbourhoods as opposed to poor neighbourhoods. These findings were opposite to those for people of high socioeconomic status. In order to find out how these unintuitive findings came about, this doctoral project was developed.

Health Inequalities: Material vs Psychosocial Causes

An anticipated criticism of the practical implications of this investigation is the very small number of people to whom it applies. Poor people[1] are much more likely to live in poor neighbourhoods than rich neighbourhoods. However, in the development of this thesis, I

1 Note that throughout this thesis I refer to poor people and low status people interchangeably. In cases where I refer to income-poor people, I specify this.

am not exclusively focused on the health of poor people who live in rich neighbourhoods, residents that I refer to as 'socioeconomically incongruous'; my primary aim is to contribute to the debate on the major causes of socioeconomic inequalities in health in the UK - more simply referred to here as 'health inequalities'. As such, in the body of this thesis, I have appraised relevant studies and designed my analyses in the framework of the causes of health inequalities.

In **Chapter 1**, I outline the prominent theories for the causes of health inequalities. In this chapter I focus on the differences between the 'material' and the 'psychosocial' explanation of inequalities in physical health and health behaviours. The material explanation is that progressive accumulation of material disadvantage incurs an incremental physical toll to health combined with a reduced capability to take up healthy behaviours. The psychosocial explanation is that sustained psychological exposure to stressful events modifies the body's neuroendocrine regulation, to the extent that physiological risk to chronic disease is gradually increased, whilst neurological responses to appetite and addiction are up-regulated. Socioeconomic status is an indicator for past and present risks to both material and psychosocial disadvantage, thus explaining current health inequalities.

Presently, there is debate as to which of these two explanations can account for the majority of health inequalities in the UK. This is an important debate for the public health of the UK, as policies that are designed to tackle health inequalities from a material perspective can, and do, differ to those that would be made using a psychosocial perspective. This is because the material mechanisms that are proposed to cause health inequalities have been interpreted as best mitigated by anti-poverty strategies, whereas proponents of psychosocial explanations for health inequalities call for strategies that reduce societal inequalities across the full socioeconomic spectrum.

To dwell on the material-psychosocial debate may appear to be a departure from the subject of the thesis question: how local socioeconomic incongruity affects the health of poor people. However, throughout this thesis and especially in Chapter 4, I bring this research question into the context of the material-psychosocial debate. I do this by developing theories based on two distinct psychosocial mechanisms that might explain the unintuitive findings in the four North American studies of mortality. The first is that poor people have higher mortality rates in rich neighbourhoods due to the stress of comparing themselves with rich people more regularly - the 'status comparison theory'. The second is that the higher mortality rates are due to the lack of the stress-buffering effects of social support from neighbours of the same socioeconomic status - the 'social support theory'. Importantly, these detrimental psychosocial mechanisms act in opposition to the health benefits of the material advantage of rich neighbourhoods, therefore observations that mortality rates of poor people reflect these theoretical psychosocial disadvantages in rich neighbourhoods could be interpreted as support for a stronger contribution of psychosocial factors over material factors in determining health.

In **Chapter 2** I review the epidemiological literature that has investigated whether poor people are healthier in rich or poor neighbourhoods. In my review I include studies that test for any differences in the association between neighbourhood socioeconomic status and mortality or general physical health amongst poor people compared to rich people; I refer to these differences as 'cross-level interaction effects'. By including such studies I evaluate not just the weight of the evidence that finds that rich neighbourhoods disadvantage poor people over that which finds that rich neighbourhoods advantage poor people, but also the evidence which find that the health advantage of rich neighbourhoods is attenuated for poor people compared to rich people. This allows the consideration that material and psychosocial mechanisms may balance each other to different extents, without one necessarily overpowering the other.

After reviewing and evaluating the literature, in **Chapter 3** I describe how some limitations can be minimised in the methods that I use for conducting research to find cross-level interaction effects in the context of White female adults in England, using the Millennium Cohort Study. The rationale for choosing this cohort study is explained in the beginning of this chapter. In the main body of this chapter, I present the results of analyses on the outcomes of general physical health and health behaviours. At the end of this chapter, I discuss how my findings contribute to the literature that is reviewed in Chapter 2, and any implications for the material-psychosocial debate.

There is a potential criticism of the logic behind the application of findings from the review in Chapter 2 and the analyses in Chapter 3 towards the material-psychosocial debate. This is that any observed health benefits for poor people associated with poor neighbourhoods may not necessarily be the result of a psychosocial process. This is the focus of **Chapter 4**. In this chapter I present the results of analyses similar to those in Chapter 3, also using the Millennium Cohort Study, but instead of investigating health and behaviour differences, I investigate indicators specific to the psychosocial theories of status comparisons and social support. Additionally, I test whether any of these indicators are significant mediators of the health and behaviour findings from Chapter 3.

Local Segregation: Living in Poor Enclaves within Rich Neighbourhoods

After investigating the primary aim of the thesis regarding the material-psychosocial debate, more direct applications that can be drawn from investigating the thesis question remain. Specifically, there are important implications for the present population of poor people in England who live in rich neighbourhoods. As pointed out above, there is potentially a small minority of these people in England because of the socioeconomic segregation of the population. However, when socioeconomic incongruity is considered from the community perspective instead of the individual perspective, the phenomenon of being poor in a rich neighbourhood may not be so uncommon. In other words, although being the only poor person on an affluent street in a rich neighbourhood may be a relatively rare situation, the segregation of poor communities into enclaves within rich neighbourhoods has become relatively more common in urban England. I refer to the two types of status incongruity as 'socioeconomic isolation' and 'socioeconomic segregation'.

The secondary aim of this thesis is to explore the health implications of socioeconomic segregation for poor people. This is the focus of **Chapter 5**. In this chapter, I start by introducing the causes of socioeconomic segregation and outline its current levels. Note that I refer to the specific case of 'local' segregation, which is distinct from the wider geographical phenomenon of segregation where people may be divided by class lines between different sides of a city. In local segregation, the division is between parts of a neighbourhood, that is most typically illustrated by the location of a block of rented social housing within a city ward where residents are predominantly private owner-occupiers. To investigate the secondary aim of this thesis, I analyse census data from London that is aggregated at two levels: the neighbourhood, and smaller parts of neighbourhoods - what I refer to as ‘city blocks’. In discussing the findings of this analysis, I explain the specific role of housing tenure on mediating health in the context of socioeconomic segregation, and reflect on the potential of neighbourhood affluence for influencing the capability of poor people to choose their housing tenure.

The findings from Chapter 5 have a practical relevance for poor people in England who are socioeconomically segregated. Along with the findings from Chapters 3 and 4, they offer some insight into the health and social implications of two housing policies: one that is being implemented, and one that is due to be implemented in the near future. The first policy is the regulation by some local authorities that stipulates that new housing developments must commit to providing some proportion of accommodation for social renters. The second policy is the planned reduction of housing benefit through a new maximum entitlement and a recalculation of Local Housing Allowance, the benefit given to claimants in private accommodation, from the present method of matching the median local rental prices to a new method of matching the bottom 30th percentile of local rental prices. The first policy has the potential of increasing local socioeconomic segregation due to the practice of constructing accommodation for social renters in secluded parts of new developments. The second policy also has the potential of increasing local socioeconomic segregation due to the likely constraint of housing choice for poor residents in rich neighbourhoods.

The final chapter, **Chapter 6**, is a summary of the findings from the investigations in this thesis. I recapitulate the implications of my findings for the material-psychosocial debate, and for understanding the health of socioeconomically segregated poor people, whilst reflecting on the impact of England's housing policies for the health of such people. In this closing chapter, I suggest further interpretations of my findings and how the limitations of my methods make it necessary to consider such alternatives.

Thesis Aims

1) I aim to contribute to the debate on the relative importance of psychosocial and material causes of ill health and unhealthy behaviours, particularly in the context of neighbourhoods and socioeconomic incongruity.

2) I aim to investigate the potential health impact of living in a poor enclave within a rich neighbourhood - a particular form of socioeconomic incongruity that relates to local socioeconomic segregation.

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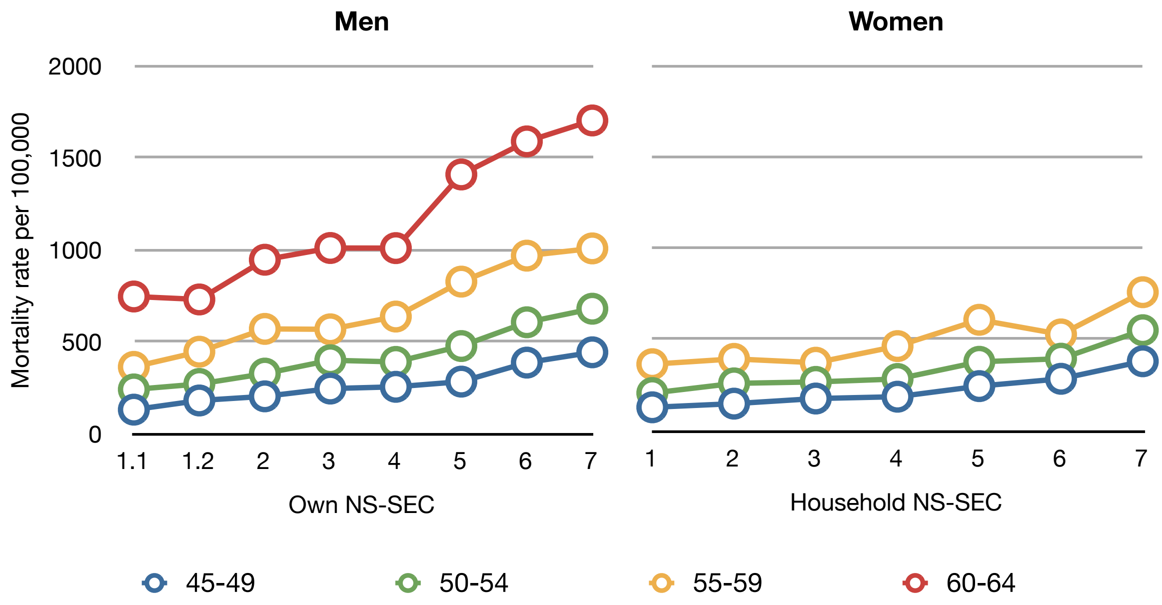
Health Inequalities: Material vs Psychosocial Causes

- **Aim of this chapter**

  The aim of this chapter is to present the current debate about the relative importance of the material and psychosocial causes of the present socioeconomic inequalities in health in the UK - referred to here simply as **'health inequalities'**. I start this thesis with this chapter in order to provide a background for my primary aim, which is to contribute to the debate on the relative importance of psychosocial and material causes of ill health and unhealthy behaviours, particularly in the context of neighbourhoods and socioeconomic incongruity.

As in most high-income countries, the UK's health inequalities are graded; people with the highest socioeconomic status (SES) are the healthiest, with progressively worse health at each step down the socioeconomic strata. This is referred to as **'the social gradient in health'** and can be demonstrated for a variety of health outcomes and by most measures of SES (Bartley, 2004, Marmot, 2004, Graham, 2007). Figure 1.1 below illustrates such a social gradient in premature mortality, in England and Wales. Mortality rates are plotted across different occupational classes, specified by the National Statistics Socioeconomic Classifications (NS-SEC). Occupations with the highest status, such as company chief executives, are categorised into class 1.1, whereas those with the lowest status are in class 7 (see Box A1.1 in the Appendix for more details).

Figure 1.1 Social gradients in mortality by age-group and NS-SEC, England and Wales, 2001-2003



NB: Source for male data: White et al. (2007). Source for female data: Langford & Johnson (2009). Women's data for the 60-64 age-group is omitted because of difficulties with attributing occupational class (Langford and Johnson, 2009). Authors took mortality data from death registration across the whole of England and Wales from 2001-2003.

Three main lines of research have come to the forefront of the health inequalities literature in order to explain the social gradient in health. In brief:

1) **'Behavioural/cultural explanations'** are based on socioeconomic differences in health-related behaviours, referred to here as 'health behaviours'. Under behavioural/cultural explanations, differences in health behaviours are ultimately caused by differences in health awareness, cultural values, and social influences - those impressed by peer groups and neighbourhood norms.

2) **'Material explanations'** are based on socioeconomic differences in the ability to purchase 'things' that directly relate to health or health behaviours. At the household level, these things include healthy groceries, healthy meals out and quality accommodation. However, material explanations also take into account differences in the ability to choose where to live, particularly with regards to a neighbourhood with low pollution, with access to good health services, and with exercise-friendly surroundings.

3) **‘Psychosocial explanations’** are based on socioeconomic differences in psychological distress and chronic levels of ‘stress’ that lead to differences in health and health behaviours. Under psychosocial explanations, the socially graded nature of psychological distress and stress are ultimately caused by the psychological effects of relative status and social exclusion.

1.1 Awareness, Culture, Capability and Behaviours

Smoking and obesity together account for the highest disease burden compared to all other independent causes of disease in high-income countries (Ezzati *et al.*, 2006). At the same time, smoking and the two health behaviours that lead to obesity - poorly balanced diets and physical inactivity - reflect the social gradient in health. The social gradient in smoking is so ubiquitous across high-income countries that it has been referred to as a *'general law of western industrialized society'* (Jarvis and Wardle, 2006). A review of the social gradients in diet and physical activity across Europe concluded that most studies found that people of lower socioeconomic groups eat fewer fruit and vegetables, eat more meat and high-fat dairy products, have diets with lower levels of vitamin C, folate, iron, zinc and magnesium, do less sport and fewer active past-times, and spend more time passively *'relaxing'* when not at work (Dowler, 2001).

Behavioural/cultural explanations of health inequalities have emphasised socioeconomic differences in health awareness, cultural values, and social influences (Bartley, 2004). In this section, I discuss how there is little evidence for differences in health awareness, and I suggest that although there is some socioeconomic division in cultural values that relate to behaviours, and social influences allow this to be maintained, the pressures that prevent behaviour change are unlikely to rest predominantly in the cultural domain.

Lack of Evidence for Inequalities in Health Awareness

Socioeconomic differences in what people know about how behaviours affect health may be thought to cause the social gradient in health behaviours. This perception would be consistent with the association often found between educational achievement and healthy behaviours if the higher educational qualifications of high socioeconomic groups led to greater health awareness. In the Health and Lifestyles Survey of England, Wales and Scotland in the 1980s, there was little evidence to support this (Blaxter, 1990).

One question in the survey was directly related to the smoking behaviour of respondents. When smokers were asked whether they were willing to give up, manual and non-manual smokers were equally as likely to want to quit (Blaxter, 1990: 167). Another question asked respondents to attribute causes for poor or good health separately to 'society at large', to 'one's own life', and to 'a range of specific diseases'. Respondents of both manual and non-manual occupations chose individual behaviour most over six other causes (Blaxter, 1990: 159). Patterns of choosing other causes were also similar between the two groups. Taken together, the answers to these questions imply that the British population represented in the survey were as willing to change unhealthy behaviours, and were as likely to understand their own responsibility for the behaviours needed to stay in good health, regardless of their socioeconomic status.

I am not aware of a systematic review of studies of socioeconomic differences in health awareness of the current UK population. However, in light of the findings from the Health and Lifestyles Survey from the 1980s, and in light of the continuing persistence of inequalities in health behaviours despite the ubiquity of health education interventions targeted to increase public awareness, it is likely that the social gradient in health behaviours is affected by other factors.

Socioeconomic Differences in Cultural Values

Instead of interpreting socioeconomic differences in behaviours as resulting from differences in knowledge and awareness, it may be more useful to consider the socioeconomic group as the cultural context within which health information is understood and acted upon. The reasons for taking up a healthy behaviour in the first place may not be health-related in any way. In a separate survey from the 1980s, it was found that almost half of changes in health behaviour were initially made for reasons unrelated to health (Anderson, 1983). Although these factors were not reported, they were more important for making health-related decisions than the actual health impacts.

The French sociologist, Bourdieu, theorised that cultural values and traits are acquired by people from their socioeconomic environment, such that they unconsciously conform to a standard repertoire which he calls **'the habitus'** (Bourdieu, 1984). In the case of those respondents above who adopted particular health behaviours for reasons unrelated to health, some of their decisions may be unconsciously related to the habitus that is ascribed by their socioeconomic status. Bourdieu expands on this concept, proposing that people may also consciously choose to participate in behaviours depending on their cultural value, whether it is 'the done thing', as a means of gaining what Bourdieu calls **'social distinction'**. In his words,

> It follows that the body is the most indisputable materialization of class taste, which it manifests in several ways. It does this first in the seemingly most natural features of the body dimensions (volume, height, weight) and shapes (round or square, stiff or supple, straight or curved) of its visible forms, which express in countless ways a whole relation to the body, i.e., a way of treating it, caring for it, feeding it, maintaining it, which reveals the deepest dispositions of the habitus.
>
> (Bourdieu, 1984: 190)

If Bourdieu is right, then the health value of any behaviour may be outweighed by its cultural value. Therefore, despite any level of health awareness or exposure to health information, decisions regarding health behaviours will not necessarily be rational, in terms of health.

If behaviours are influenced to a large extent by cultural values, one should find that health behaviours are most strongly associated with socioeconomic status when the measure of status is sensitive to divisions of culture and social class rather than income. This is perhaps best captured by The Cambridge Social Interaction and Stratification Scale (CAMSIS), or more simply the 'Cambridge Scale'. This scale was devised to take account of 'social distance', incorporating the likelihood of social and marital relationships between people of different occupations (Stewart *et al.*, 1980: Ch2). As such, shared social environments and social networks, an important dimension of class for the formation of the habitus, are captured by this scale.

In analyses of the Health Survey for England, it was found that, based on the Cambridge Scale, the social gradients for diet, smoking, hypertension and central obesity were steeper than gradients based on a more conventional scale of socioeconomic status, the Erikson-Goldthorpe scale (Bartley *et al.*, 1999). Further to this, in an analysis of the Health and Lifestyles Survey, it was found that the Cambridge Scale was a better predictor of a range of risk factors for coronary heart disease than either the Erikson-Goldthorpe scale or the Registrar General's Social Classification (Chandola, 1998). Of course, the closer associations found between the Cambridge Scale and health behaviours do not preclude a relationship between health behaviours and employment relations, working conditions, or other material and psychosocial correlates of socioeconomic status, which will be discussed below. However, these studies do provide evidence to support the theory that socioeconomically distinct cultural values or norms play an influential role in people's health behaviours.

Building on Bourdieu’s theories, there is recent evidence to suggest that apart from the different habitus of socioeconomic groups leading to different health behaviours, peer groups are another normative force that maintain such divisions through direct influence. In an analysis of a network of 3,604 pairs of peers from the US Framingham Heart Study, the risk of becoming obese was shown to increase by 57% if a peer had become obese (Christakis and Fowler, 2007). This study reached a wide audience for its novel methodology, but its conceptual design was criticised for the lack of adjustment for socioeconomic and contextual circumstances (Cohen-Cole and Fletcher, 2008, McNeeley and Crosnoe, 2008, Steptoe and Diez Roux, 2008). The researchers did not take account of the fact that the observed peer influence could have been alternatively explained as socioeconomic differences, as social relationships tend to form between people of similar socioeconomic status. In response, the authors demonstrated persistent peer influences after socioeconomic adjustments in another sample from the Add Health Study (Fowler and Christakis, 2008), and published a further analysis of the Framingham Heart Study looking at smoking cessation, this time with socioeconomic adjustment (Christakis and Fowler, 2008). In this second analysis, it was found that smoking cessation by a peer reduced an individual’s probability of smoking by 34%. Additionally, in the decline of smoking in the US over the study period, smokers disappeared by cluster, and those who continued to smoke did so in smoking clusters, thus suggesting a phenomenon of quitting (or not) 'together'.

Peer effects suggest potential ways in which the neighbourhood socioeconomic milieu may influence the health behaviours of residents. As people of low socioeconomic status are more likely to live in neighbourhoods composed of low socioeconomic households, local peer effects may be an additional normative source of maintaining distinct health behaviours. This may partly explain the associations found between neighbourhood socioeconomic status and health behaviours of residents (Curry *et al.*, 1993, Yen and Kaplan, 1998, Datta *et al.*, 2006, Lee *et al.*, 2007, Rundle *et al.*, 2008, Adams *et al.*, 2009). However, the important consideration to emphasise here is that these peer effects serve to *maintain* socioeconomic differences in health behaviours. Neither Bourdieu's theories nor the findings from network analyses of peer influences can explain how the social gradient in health behaviours was established to begin with, nor why it has been resilient to change.

Establishing Inequalities in Behaviours: Unequal Capabilities

In the late 1950s, about 60% of men and 40% of women were cigarette smokers in the UK (Graham, 2007: 91). The prevalence did not vary significantly between socioeconomic groups, although surveys at the time had limited socioeconomic measures. It was not until the late Sixties that smoking became less prevalent in higher socioeconomic groups. A similar pattern is evident with the prevalence of obesity, although instead of an unequal decline as observed with smoking, an unequal increase occurred for the social gradient in obesity to emerge (Graham, 2007: 93).

The concept of unequal '**capability**' of behavioural change offers an alternative explanation. The interpretation of the social stratification of behaviours over time, based on this concept, is that people in lower socioeconomic groups have been less able to stop smoking, resist unhealthy diets, or get involved in regular physical activity because of material or psychosocial barriers (Graham, 1987, Graham, 1994, Marmot, 2004, Jarvis and Wardle, 2006, Graham, 2009, Pickett *et al.*, 2009b). The inherent capacity and the will to change behaviour does not need to have diverged between classes. Instead, to generate an unequal pattern of health behaviours, an equal exposure to behavioural pressures through marketing, and an equally shared increase in health awareness through health education, may not have been coupled with an equally shared material and psychosocial capability to change behaviour. It is from this perspective of capability where the material and psychosocial explanations are likely to clarify the complexity behind the social gradient in health behaviours. However, before discussing these explanations, I first discuss how much of the social gradient in health behaviours is likely to be the result of divergent health behaviours.

Health-Related Behaviour: Sufficient but not Necessary for Health Inequalities

It may be the case that the current inequality in health behaviours would be sufficient to create observable social gradients in health, regardless of what the causes of behaviour differences were. However, this does not mean that all of the social gradient in health is necessarily due to a socioeconomic stratification of health behaviours. To quantify the contribution of health behaviours towards the social gradient in mortality, careful studies using the Whitehall cohort of civil servants were conducted, adjusting for health behaviours. In one such study, the sample of civil servants were first divided into a low-risk and a high-risk group; those in the low-risk group did not smoke, had low blood cholesterol and had low blood pressure, and were therefore more likely to have other healthy behaviours (van Rossum *et al.*, 2000). The 25-year mortality rates of both the high-risk and the low-risk groups were graded, with the highest mortality rate amongst the lowest occupational grade. This indicates that factors unrelated to health behaviours were likely to cause at least some of the social gradient in mortality in this sample. Secondly, all participants were analysed together, adjusting for smoking status, blood cholesterol, and blood pressure. After adjustment, approximately a third of the unadjusted ratio in mortality rates between the top and bottom occupational grades was explained. This indicates that two thirds of the social gradient in mortality amongst the participants were likely to be caused by factors unrelated to health behaviours.

This estimate, that approximately one third of health inequalities are caused by health behaviours, has been quoted elsewhere (Marmot, 2004). However, it is likely that this attributable proportion is underestimated as measurements of health behaviours are often taken at only one time-point. This does not capture the full impact of health detrimental behaviours; for example, it has been shown from autopsies that even health behaviours that were recorded in early life have associations with atherosclerotic progression (Berenson *et al.*, 1998). A further study of the Whitehall cohort took four time-points into account (Stringhini *et al.*, 2010). Adjusting for smoking, alcohol consumption, diet and physical activity at just baseline explained approximately 40% of the unadjusted mortality ratio. However, adjusting for these health behaviours at all four time-points explained approximately 70% of the unadjusted mortality ratio. This is a substantial difference in estimating the contribution of health behaviours to the social gradient in health.

It is clear that health behaviours are important causes of the health inequality that is observed in the UK. It is no coincidence that both health behaviours and mortality are socially graded. Estimates of the contribution of health behaviours to the social gradient in mortality range from 30% to 70%. Although material and psychosocial factors may explain the residual social gradient in health and mortality after health behaviours are taken into account, it is likely that the root causes of the social gradient in health behaviours themselves are predominantly due to socioeconomic differences in material and psychosocial factors. These factors are likely to act by impeding people’s capability to change their behaviours.

1.2 Material Causes of Inequalities in Health and Behaviours

As stated above, in this opening chapter, I aim to present the current debate about the relative importance of material and psychosocial explanations for health inequalities. In this section, I discuss the theories and evidence for the material pathway. In discussing material factors, I include their **indirect effects on health via health behaviours** as well as their **direct effects on health**, but I do not include such effects that are mediated by the cultural or peer effects that I discussed in the previous section, nor do I include those effects that are mediated by the psychosocial pathways that I discuss in the following section. For the sake of clarity, my definition for 'material causes of inequalities in health and behaviours' is as follows:

- The causes of health and behavioural inequalities that originate from socioeconomic divisions in exposure or access to physically detrimental substances and environments, and physically beneficial treatments. These divisions may result from an inequality in financial capability, or the disproportionate allocation of public resources.

Definitions in the literature surrounding material causes for health inequalities are not always clear. Researchers have used the term 'neomaterial' loosely to account for health effects that appear to be material in origin, but may have added layers of complexity. In one study, neomaterial effects on health were defined as those health and behavioural effects with material origins, but that do not have direct physical effects; they may be mediated by psychosocial factors for example (Kroenke, 2008). In another study neomaterial effects on health were defined as health effects that originate specifically from the disproportionate allocation of public resources, as a way of differentiating from health effects that originate from an inequality in financial capability (Lynch *et al.*, 2000). To avoid confusion, I do not refer to neomaterial causes or effects, and instead I use my own definition of material causes, stated above.

Before exploring the material causes of inequalities in health and behaviours, I will first briefly discuss how **health care** is unlikely to be a contributory factor to the social gradient in health. Health care may be considered an obvious material factor that explains differences in people's health, as it is a physically tangible resource which delivers life-prolonging detection and physical treatment of disease, therefore differential access to it creates health inequalities. Indeed, it has been highlighted in the past that the geographic provision of services has been governed by an 'inverse care law', where market demands not population needs are more important, thus leaving poorer neighbourhoods with poorer access (Tudor Hart, 1971). However, recent studies that investigate the present equity in access to quality health care based on population needs have shown otherwise. For example, a study of coronary revascularisation across different census wards in one region in Britain showed that the most deprived wards had revascularisation rates that were proportional to needs based on coronary heart disease mortality rates (Ben-Shlomo and Chaturvedi, 1995). In a similar study that compared wards across the UK, there was no evidence for inequity in revascularisation by ward deprivation (Morris *et al.*, 2005). Without further exploring the literature behind health care inequalities, for the rest of this section, I focus on the material factors that lie upstream, which may cause disease in the first place.

Material Causes of Unhealthy Behaviours

At the end of the last section, I suggested that unequal capabilities for behaviour change are likely to produce inequalities in health behaviours. Here I discuss the extent to which these unequal capabilities are directly caused by material factors.

In the case of **smoking**, a literal interpretation of its association with material factors would be paradoxical. Regular smoking is an expensive activity, yet people with the lowest financial capability are the most likely to smoke. However, looking beyond the affordability of a packet of cigarettes, and instead at the affordability of living in a neighbourhood of higher socioeconomic status, where there are proportionally fewer smokers, there may be an indirect material explanation via neighbourhood peer effects as I have discussed above. Nevertheless there is no evidence of physical barriers to give up smoking in neighbourhoods of low socioeconomic status. On the contrary, such neighbourhoods should promote smoking cessation as they are disproportionately targeted by smoking cessation services, a publicly provided resource (Bauld *et al.*, 2007). As such, the social gradient in smoking is unlikely to be explained by material causes, unless mediated by psychosocial pathways or the influence of neighbours.

Physical activity has a clearer relationship with material factors that may contribute to explaining health inequalities. Firstly, regularly attending a gym or other sports facility can be an expensive activity. Nevertheless, the cost of a gym membership is not the only way in which material disadvantage acts as a barrier to physical activity. As with smoking, the affordability of living in a neighbourhood with higher socioeconomic status must be taken into account. This is because neighbourhood socioeconomic status is associated with the availability of parks and other free 'green spaces' - material aspects of the environment that can be used for a range of physical activities, especially in dense surroundings such as urban contexts. In a study of neighbourhood health inequalities and green space, it was found that just under a third of the variation in access to green space was explained by neighbourhood socioeconomic status, thus demonstrating inequality in access (Mitchell and Popham, 2008). Further to this, the authors found that inequalities in mortality were reduced after taking into account access to green space. In a separate study based in Bristol, it was found that the regularity of using green space decreased with distance (Coombes *et al.*, 2010). Importantly, those living closest to 'formal' parks were most likely to exercise to recommended healthy levels, even after adjustment for socioeconomic status and area deprivation. As such, the reduction in inequalities in mortality found by the first study may be partly attributed to the effect that green space has on exercise that was demonstrated in the second study.

Diet has a complicated and contested relationship with material factors. At the individual level, one must take into account the affordability of eating healthy meals both in and outside of the home. At the neighbourhood level, one must take into account the accessibility of both healthy grocery stores and healthy food outlets, such as cafes, take-aways and restaurants. Finally, the notion of healthy food is difficult to measure as both over-consumption of macronutrients, such as fat and carbohydrates, and under-consumption of micronutrients, such as vitamins and iron, lead to disease.

- **Eating healthy meals at home**
  I suggest that from the perspective of eating healthy meals at home, material factors in the UK at both the individual and neighbourhood level do not contribute to the

social gradient in unhealthy diets. At the individual level, I demonstrate this here by comparing data on housing expenditure from the Expenditure and Food Survey (Craggs, 2004) with estimations for the minimum expenditure on food required for healthy purchases. The latter estimations were made in a study conducted to find the minimum income required by a single adult male to live a healthy life - the'minimum income for health living' (MIHL) (Morris *et al.*, 2000). Healthy food requirements were based on dietary guidelines that took into account both micronutrients and macronutrients. The prices for these required food items were based first on average prices in local stores, and then separately on average prices in the cheapest supermarkets. Both sets of prices were surveyed from a deprived area of London. Two figures for minimum healthy food expenditure were thus created: the cheaper for supermarkets, and the more expensive for local stores. Prices are comparable between the Expenditure and Food Survey and the MIHL study as they were conducted within four years of each other.

In 2002-03, households headed by routine workers spent an average of £15.59 on food and non-alcoholic drinks each week per person. Morris and colleagues recommended £11.53 to £18.24 to be spent on food for consumption at home per person. These figures suggest that, provided they had access to a supermarket, the average person in low occupational classes had spent beyond the minimum required for a healthy diet. It must be noted that Morris and colleagues' study was designed to approximate the needs of adult men, whereas the composition of households in the expenditure survey included women, children, and elderly persons. As a result, the expenditure requirements above are overestimated for typical households. Taking this into account potentially pulls almost all households that were headed by a routine worker above the minimum healthy food expenditure whether they had access to supermarkets or were limited to local shops.

Despite spending an amount that would be adequate for healthy food purchases, the poorest households fall considerably short of the recommended spending on fruit and vegetables. Morris and colleagues recommended £2.53 to £3.42 of total food spending to go on fruit and vegetables. The tenth poorest households in the expenditure survey only spent £2 on these items out of a total of

£16.30 food expenditure per person each week. One explanation for this is that poorer people may prioritise food spending on energy-dense items, so that money committed to food is used more efficiently (Robertson *et al.*, 2006), hence fruit and vegetables may be overlooked. However, £16.50 places the poorest tenth above the financial threshold for healthy food expenditure if they can access supermarkets, and taking account of the overestimation of this threshold their budget should allow for healthier food spending even for those with access only to small local stores.

There is also limited evidence at the neighbourhood level. Areas with poor access to healthy food stores have been termed 'food deserts', and the hypothesis whereby residents of deprived areas are thought to have their already poor health compounded by poor access to affordable healthy food stores has been termed 'deprivation amplification'. In the UK, the evidence for deprivation amplification is mixed. Case studies do not consistently find deprived neighbourhoods to be food deserts (Whelan *et al.*, 2002, Macintyre, 2007). This is likely to be due to local idiosyncrasies of the spatial arrangement of food stores. For example, a spatial study of travel time to stores in Scotland from neighbourhoods of different socioeconomic status and different urban/rural contexts found context-dependent associations (Smith *et al.*, 2010). The study found that within cities, the most deprived neighbourhoods had the shortest travel time by road to food stores with fresh produce, in opposition to the deprivation amplification hypothesis. However, deprived rural neighbourhoods were found to have longer travel times than the least deprived rural neighbourhoods.

- **Eating healthy meals out of the home**

Although there is little evidence that eating healthy meals *at* home has much to do with material factors, there may be more scope behind the material mediation of eating healthy meals *out of* home, especially in terms of affordability. Ascending the socioeconomic strata, the range of frequented food take-aways and restaurants diversifies (Warde *et al.*, 1999). Although there have been cultural reasons put forward for this phenomenon, it is likely that some of the constraint in diversity amongst the lower socioeconomic groups is to do with cost. A recent report on a survey of independent food outlets in the UK concluded that the high cost to the provider for serving healthy food has resulted in an abundance of homogenous calorie-dense, micronutrient-poor food establishments amongst the cheaper end of the market, necessitating healthier meals to be sold in more expensive, yet more diverse food outlets (NEF, 2010). As such, in order to be included in the basic social activity of eating out, people of low socioeconomic status are likely to be financially constrained to choose less healthy establishments.

To date, research on the choices made by people of low socioeconomic status regarding eating out has focused more on the geographic accessibility of healthy and unhealthy food outlets and restaurants (Block *et al.*, 2004, Macintyre *et al.*, 2005), instead of the affordability of such places as I have just discussed above. However, in the UK the evidence behind the relationship between the locations of these places to eat out and the socioeconomic status of people in close proximity leads to equivocal conclusions. For example, in a study of food outlets in Glasgow, it was found that almost 50% of the thirty fast food chain restaurants were located in the neighbourhoods of the second least deprived quintile (Macintyre *et al.*, 2005). These neighbourhoods were also the most likely to have any other type of restaurant. After plotting the locations of these food outlets spatially, it was found that the clustering of all types of restaurants was predominantly driven by the centrality of the locations. The authors of this study concluded that the locations of food outlets in UK cities are most likely to be caused by the typical use of these establishments in concert with other entertainment activities that have little to do with where one lives, and more to do with where one goes for entertainment, such as the cinema and the high street. It would appear that the market forces created by consumers, irrespective of where they live, dictate the geography of food outlets, at least in the UK urban context.

Taken together, material factors may influence some but not all health behaviours. In the way that I have defined them, material factors do not contribute to the social gradient in smoking. On the other hand, there is evidence to show that they may contribute to the social gradient in obesity, primarily through people's financial capability to eat out without compromising the healthiness of the food served, and potentially through people's capability to afford living in places with free facilities for physical activity. Regarding whether the social gradient in obesity can be explained by the affordability of household food or the locations of shops and restaurants, the evidence is weak.

Direct Health Impacts of Material Factors

Beyond health behaviours, researchers have studied the direct effects of material factors on health. These effects may explain some of the residual social gradient in mortality and ill health after taking into account death and disease caused by poor health behaviours. Research in this area has focused on three environments that are socioeconomically stratified: the housing environment, which is predominantly divided by people's ability to pay; the residential neighbourhood context, which is divided by the housing market and therefore people's ability to pay; and the workplace, which is not divided by people's ability to pay nor by a disproportionate allocation of resources, but by the means of production.

In the past, **the workplace**, has been a major source of morbidity through physical exposure. For example, miners, a large proportion of the working class when mining was a major industry in the UK, were at a greatly heightened risk of acquiring pneumoconiosis or 'black lung' (Shaw *et al.*, 2002: 140). However, as mining and other severely hazardous occupations have become replaced by the service industry, the present inequalities in health in the UK cannot be attributed to physical risks at the workplace. The Office of National Statistics (ONS) in the UK produces estimations of occupational hazards by comparing the causes of death of people in different occupations recorded in death registers. In analyses of these deaths, some occupations have particularly high risks of dying from specific diseases, and indeed these occupations are almost exclusively from the low NS-SEC categories (Coggon *et al.*, 2009). However, the actual number of deaths for these specific diseases are too small to account for significant contributions to the higher mortality rates in lower occupational classes. For example, in one analysis, ceramics casters were over twenty times more likely to die from silicosis than people with other occupations, but this was due to only three deaths. For the major causes of death that contribute to the social gradient in mortality there are no clear associations with particular occupations.

The **residential neighbourhood context** has also been a major source of diseases through physical exposure in the past. However, since the establishment of efficient sewerage and slum clearing, present inequalities in physical neighbourhood characteristics are not as distinct, and instead of leading to diseases caused by biological agents such as cholera, non-biological ambient properties, specifically pollution, is presently more important. Although pollution may cause disease (Chow *et al.*, 2009), the potential for it to explain the social gradient in health is limited as it typically disperses over areas that are large enough to include neighbourhoods of all socioeconomic types. Briggs and colleagues conducted a geographic analysis of multiple air quality measures across the UK to find whether ambient air pollution is associated with local socioeconomic characteristics (Briggs *et al.*, 2008). Neighbourhood-levels of income, employment and education together explained less than 15% of the variation in air pollution measures. Also, they found that differences in pollution levels were most pronounced between large areas, such as local authorities, and not between small neighbourhoods where the socioeconomic milieux would be more homogenous. What is more, the direction of associations varied: for example, areas of higher socioeconomic status had higher exposure to ozone and radon.

The physical **housing environment** may be the material environment with the strongest supporting evidence for contributing to health inequalities. Firstly, this is because different problematic physical aspects of houses have been shown to lead to specific diseases of the heart, the lungs and the gastrointestinal tract. Regarding the heart, cold indoor temperatures, those experienced by residents of poorly insulated and under-heated accommodation, have been associated with raised blood pressure and blood viscosity; this may explain the excess heart-related deaths in the winter amongst elderly people (Collins, 1986). Regarding the lungs, houses with damp may lead to influenza-like symptoms, allergies and asthma because of exposure to house mites and fungal spores that reproduce under such conditions (Gill and de Wildt, 2002). Regarding the gastrointestinal tract, childhood exposure to overcrowded housing may lead to subsequent risk to stomach cancer later in life, due to increased likelihood of *Helicobacter pylori* infection in early life (Shaw *et al.*, 1999: 16-17, Dedman *et al.*, 2001). Secondly, housing quality has been shown to be socioeconomically divided. Using a measure of physical housing quality based on disrepair, structural stability, dampness, lighting, heating, ventilation, water supply, drainage, food preparation facilities, toilet facilities, and bathing facilities, the proportion of houses considered unfit is highest amongst households in the poorest quintile, based on household income (Sharp, 2005: 109).

Accumulation of Material Disadvantages and the Social Gradient in Health

Investigated cross-sectionally, the material causes of health and behaviours would explain health inequalities if there was a threshold above which health was no longer improved by further material advantage. For example, beyond a certain threshold of housing quality there is no material reason for further health improvement. However health inequalities are characterised by a social gradient in health, not a threshold.

To resolve this, researchers interested in the material causes of health inequalities have analysed entire life courses. I described how, in the Whitehall cohort, taking account of health behaviours at four points in life explained 70% of mortality differences between the top and bottom occupational grades, compared to only 40% when health behaviours were only measured at the baseline (Stringhini *et al.*, 2010). Eating unhealthily and exercising less at different points in life were shown to have independent effects - even if one improves one's diet or exercises more later in life, some physiological damage has already occurred. As I have discussed in this chapter, these behaviours, especially diet and physical activity, can be driven by material factors. As such, from a life course perspective, a period lived in material disadvantage may have led to an unhealthy out-of-home diet at that time, for example. With this logic, the incremental increase of mortality for each lower socioeconomic group may partly reflect the increasing chance of living below a certain threshold of material advantage at some point in life. In other words, the lower the socioeconomic strata, the higher the probability of accumulating multiple exposures to material disadvantage which lead to both transient unhealthy health behaviours, and transient direct exposure to physical risks.

This understanding of the social gradient in health has been further developed by life course epidemiologists. In one study, it was found that mortality rates were significantly affected by physical household conditions in childhood, irrespective of childhood and adult socioeconomic position (Dedman *et al.*, 2001). In particular, poor ventilation and the lack of private tapped water during childhood in the UK during the 1930s were significant predictors of increased mortality between the late 1940s and the late 1990s. More detailed life course analyses have found cumulative effects of material disadvantage. For example, in an analysis of the Swedish Survey of Living Conditions, it was found that financial stress at an early point in life, as well as a more recent point in life, over a 16-year period, cumulatively increase the risk for indicators of poor health, after adjustment for educational and occupational status (Ahnquist *et al.*, 2007). These studies support the theory that the accumulation of material disadvantage may contribute to the social gradient in health.

Framing material and cultural explanations in the context of this thesis

Having discussed both the material explanations for health inequalities, and the cultural explanations, those of peer effects and 'habitus', here I recapitulate the aims of this chapter and this thesis for context. The aim of this chapter is to present the debate about the relative importance of material and psychosocial causes of health inequalities. This is to provide a background to the primary aim of this thesis, which is to assess the balance between the health effects of neighbourhood material factors and neighbourhood psychosocial factors. This relates to the thesis question, *Are poor people healthier in rich or poor areas?*, because from the perspective of material causes of ill health and unhealthy behaviours, one would predict that poor people would be healthier in rich areas. This is based especially on the evidence relating to the accessibility to green space in urban environments and, to an extent, the levels of pollution that I discussed above; it is further supported by taking into account the potential for neighbours to exert behavioural influences as discussed in the previous section. The other material factors that I discussed above are either not *directly* related to the neighbourhood context, such as housing quality and the cost of eating out, or do not have a definitive evidence-base, such as the accessibility of food shops and restaurants. In the following section, I discuss the psychosocial explanations of health inequalities. I suggest that from the psychosocial perspective, one may predict the opposite - that poor people might be healthier in poor areas instead of rich areas.

1.3 Psychosocial Causes of Inequalities in Health and Behaviours

'Psychosocial factors' are psychological stimuli that arise from the social environment (Stansfeld and Marmot, 2002: 1). They may promote or impair health. 'Stress' is a non-specific term that originally referred exclusively to physical forces or pressure on inanimate objects. Today, it is commonly used by people to refer to unpleasant psychological feelings, specific to pressures in work or life. Here, I use the term **'psychosocial stress'** to refer to the psychological and physiological state one experiences when exposed to detrimental psychosocial factors. In this section, I focus on psychosocial factors that are related to socioeconomic status, in order to discuss the significance of psychosocial stress for the social gradient in health.

Psychosocial Causes of Unhealthy Behaviours

In the last section, I discussed how material factors can physically affect people's capability to partake in healthy behaviours. Here I discuss the extent to which the psychosocial stress from psychosocial factors independently hinder this capability. Although there is little research on the direct effects of psychosocial stress on physical activity, researchers have identified the use of smoking to 'cope' with such stress (Graham, 1987, Graham, 1994), the biological rationale for this phenomenon (Siegrist, 2000), as well as the possible biological mechanisms for smoking and unhealthy eating under psychosocial stress (Siegrist, 2000, Sapolsky, 2002, Cohen, 2008).

The theory of the use of **smoking** to cope under stress has been understood through in-depth investigations into the daily lives of people in burdensome situations, mostly due to their low socioeconomic status. For example, in a qualitative study of 57 mothers of low socioeconomic status living in the UK in the late 1980s, Graham collected information from 24-hour diaries and personal interviews (Graham, 1987). From this sample, half had no day care help, 70% were constantly in the company of one of their children, and 40% of daily tasks were reportedly interrupted by their children. Graham then queried the qualitative data to find whether smoking featured in a prominent role related to the high caring burden endured by these mothers of low socioeconomic status. She found that, amongst the smokers, about two-thirds mentioned that having a cigarette was the most helpful coping strategy when the demands of their children became overwhelming. This dependency on smoking for coping was exemplified by one of the mothers, quoted below:

> I think smoking stops me getting so irritable. I can cope with things better. If I was economising, I'd cut down on cigarettes but I wouldn't give up. I'd stop eating. That sounds terrible doesn't it? Food just isn't that important to me but having a cigarette is the only thing I do just for myself.
>
> Anonymous mother, cited in Graham (1987)

The biological rationale for smoking as a coping behaviour has been suggested by Siegrist (2000). He posited that people may consume substances, not just cigarettes, that offer short-term gratification in order to 'self-regulate' their lowered self-esteem that has been brought on by psychosocial stress. This psychological process is thought to be controlled by the part of the brain called the 'mesolimbic dopamine system'. This system regulates motivations and reward, whereby a deficit in reward caused by low self-esteem causes the initiation of a desire for short-term rewarding substances. To some extent, this theory has been supported by experimental evidence. Morgan and colleagues ranked a group of macaques by their natural dominance hierarchies, then implanted them with devices for self-administering solutions intravenously (Morgan *et al.*, 2002). The dominant macaques self-administered solutions indiscriminately whether their devices were connected to saline or cocaine solutions. On the other hand, subordinate macaques not only preferred to self-administer when connected to cocaine over saline solution, they also had physiological differences in their mesolimbic system. The findings from this experiment indicate that low status may indeed increase the motivation to self-regulate. Importantly, there were no material differences between macaque ranks, therefore suggesting a psychological difference that might be stress-related.

As well as smoking, **unhealthy eating** may be another coping behaviour that is physiologically triggered under psychosocial stress. Unhealthy eating may operate through the same system of self-regulation as suggested by Siegrist, especially in the case of the desire for food items that offer immediate short-term satisfaction. In an experiment which artificially induced either a feeling of social exclusion or social inclusion in people, it was found that when offered cookies, people who had been made to feel socially excluded consumed, on average, roughly twice as many than those who had been made to feel socially included (Baumeister *et al.*, 2005, cited in Cacioppo and Patrick, 2008). As social exclusion is a psychosocial factor that is more commonly experienced amongst the lower socioeconomic groups, as will be discussed below, this experiment supports Siegrist's theory of self-regulation in relation to appetite for immediately gratifying food. However, psychosocial stress may also cause indiscriminate overeating of all types of food as a result of the chronic release of stress-related hormones in the body. Cortisol, a hormone released into the bloodstream when under psychological stress, has been shown to generally increase appetite (Sapolsky, 1999a: 77). Although the mechanism of its effect on appetite is currently unclear, one theory is that the consistent overproduction of cortisol in people who are chronically stressed may desensitise specific receptors in the brain from the appetite-suppressing hormone, leptin (Sapolsky, 1999b: 77-79, Dagogo-Jack *et al.*, 2005).

Direct Health Impacts of Psychosocial Stress

As I have discussed, the social gradient in health is not fully explained by differences in health behaviours. As with the material explanations for health inequalities, there are psychosocial explanations for health inequalities beyond health behaviours. These explanations are based on studies that have investigated direct physiological damage that is caused by psychosocial stress. However, I first discuss the natural responses to psychological stress that are only detrimental when they become altered by chronic exposure. Some of these responses are not specific to particular stimuli, so long as the stimulus is threatening to the individual, such as an open flame touching skin, or a sudden onslaught of barking from an aggressive dog. These threats, or 'stressors', activate the non-specific **'stress response'** that is internal to the body.

The two most well-understood physiological systems involved in the stress response are the **'sympathetic-adrenomedullary' (SA) axis** and the **'hypothalamic-pituitary-adrenocortical' (HPA) axis** (Sapolsky, 2002). As can be inferred from the names of the axes, the adrenal glands, located just above the kidneys, are key to these two systems. During stress, they are stimulated to release specific hormones into the bloodstream that then orchestrate a cascade of short-term physiological changes. At the instance of encountering a stressor, the SA axis is activated which can physically be felt as an 'adrenaline rush'. This feeling is due to the effects of the hormone **adrenaline**. Adrenaline increases both blood pressure and heart rate. The HPA axis is activated in minutes, releasing the hormone **cortisol**, that I discussed above. Amongst other functions, cortisol inhibits the storage of energy substrates away from the blood, thus keeping blood fat and sugar levels high.

In the short-term, the stress response is beneficial to an individual, provided there is a real threat or stressor. The adaptive logic follows that in most threatening situations, either perceived or physical, a rapid physical response by an individual is required, making it useful to have mobilised energy substrates available to muscles. Hence the inhibition of substrate storage acting in concert with increasing cardiovascular tone. However, if stressors are to be present consistently over the long-term, the adaptive effects of the stress response may cause physiological damage. The SA and HPA axes may reset to more active baseline levels, leading to increased resting levels of substrates in the blood and increased resting cardiovascular tone. The stress response itself may become less sensitive. This impaired physiological balance is sometimes referred to as **'allostatic load'** (Brunner, 2002, Mattei *et al.*, 2010).

Whether chronic stressors can reliably lead to allostatic load has been tested in the Whitehall II cohort (Chandola *et al.*, 2006). Civil servants were categorised as experiencing chronic work-related stress if, in three out of four survey points over 14 years, they reported high demands and low control at work. Those chronically stressed civil servants were more than twice as likely to have a combination of measured biological indicators of allostatic load severe enough to be given the clinical label **'metabolic syndrome'**. In this study, metabolic syndrome is defined as having any three of the following indicators: obesity, high blood fat concentration, high fasting glucose concentration, low high-density lipoprotein (HDL) cholesterol concentration, and high blood pressure. These indicators could also be indicative of unhealthy behaviours, but when analyses were adjusted for health behaviours and SES, or restricted to non-obese civil servants, the significant association between chronic stress and metabolic syndrome remained.

The study above did not include any measures of the stress response itself, therefore it does not give direct evidence for the pathway between chronic stressors, the stress response, and allostatic load. However, in a separate study of the Whitehall II cohort, metabolic syndrome was associated with increased baseline activity of both the SA and HPA axes (Brunner *et al.*, 2002). In this case-control study, levels of noradrenaline metabolites and cortisol metabolites (proxy measures of the activity of the SA and HPA axes respectively) were compared between 30 cases with metabolic syndrome and 153 healthy controls. Cases had significantly higher metabolite levels, and in the case of cortisol metabolites, the increased level was partly explained by adjustment for job strain, thus suggesting the role of work-related stress in altering the stress response and consequently physiological balance.

Metabolic syndrome is an important risk factor for cardiovascular disease and insulin-resistant diabetes, therefore its association with the stress response suggests that it plays a central role in the pathway to disease from chronic psychosocial stress (Brunner, 2002). However, other mechanisms influenced by the SA and HPA axes may also play roles in disease progression. These other mechanisms include the control of inflammatory cytokines, clotting factors and growth hormones [see Sapolsky (2002), Brunner (2002) and Holmes et al. (2006)]. Table 1.1 summarises the adaptive effects of the stress response along with its pathological consequences when stressors are chronically present.

Table 1.1 Components of the Stress Response and Common Pathologic Consequences of Prolonged Exposure

THE STRESS RESPONSE	ITS PATHOLOGIC CONSEQUENCES, WHEN PROLONGED
Mobilisation of energy at the cost of energy storage	Fatigue, myopathy, steroid diabetes
Increased cardiovascular and cardiopulmonary tone	Hypertension
Suppression of digestion	Ulceration
Suppression of growth	Psychogenic dwarfism, bone decalcification
Suppression of reproduction	Anovulation, impotency, loss of libido
Suppression of immunity and the inflammatory response	Impaired disease resistance
Neural responses, including altered cognition and sensory thresholds	Accelerated neural degeneration during ageing

NB: Table adapted from Sapolsky (2002: 435)

With respect to the social gradient in health, the link between cardiovascular disease and psychosocial stress is most important, since cardiovascular disease is the major contributor to the social gradient in mortality. A study of Puerto Ricans living in the US found that an increasing number of indicators of allostatic load, such as high cortisol, high adrenaline, low HDL cholesterol and markers of altered sugar and fat metabolism, led to a progressively increasing likelihood of hypertension, self-reported cardiovascular disease, and diabetes (Mattei *et al.*, 2010). Associations persisted after controlling for health behaviours. This study reinforces the link between stress-induced allostatic load and cardiovascular diseases. Nevertheless, cross-sectional studies such as this one cannot safely conclude that long-term allostatic load leads to disease, instead of the reverse. Studies that analyse disease incidence or mortality with previously measured biological markers provide stronger causative evidence. Such a study measured the ratio of cortisol and testosterone of men in Wales between the ages of 45 and 59 and followed the cohort over an average of 16.5 years to analyse their subsequent disease-specific mortality (Davey Smith *et al.*, 2005). Controlling for health behaviours, they found that the mortality rate specific to coronary heart disease was significantly associated with cortisol-testosterone ratio, whilst the all-cause mortality rate was not significantly associated. The specificity of the association with coronary heart disease mortality, and the longitudinal nature of the analysis in this study, add strong evidence over that from cross-sectional studies that alterations of stress-related physiology can cause deaths from cardiovascular disease. Taken together, the studies above piece together the pathway from chronic exposure to stress, to allostatic load, followed by disease progression, and over the long-term, premature mortality.

Psychosocial Stress and the Social Gradient in Health

To confirm that the pathway of psychosocial stress to health may be at the root of the social gradient in health it must be shown that stress response physiology is associated with socioeconomic status. Indeed, for many of the studies I discussed above, this was the case. In the study of the cortisol-testosterone ratio amongst men in Wales, it was found that socioeconomic status was associated with this ratio, and this was therefore adjusted in analyses (Davey Smith *et al.*, 2005). In their study, Chandola and colleagues (2006) found that socioeconomic status mediated part of the association between allostatic load and metabolic syndrome. Other studies have examined these associations directly. In a study of different socioeconomic groups by occupation, education and income in Lithuania and Sweden, lower socioeconomic status was a significant risk factor for increased baseline cortisol and blunter cortisol responses (Kristenson *et al.*, 2001). In another study of the Whitehall II cohort, lower employment grade was associated with lower heart rate variability (Hemingway *et al.*, 2005). As a result of the consistent finding of an association between the stress response and socioeconomic status, several theories have arisen concerning which socioeconomically stratified psychosocial factors are responsible for mediating this relationship. Here I explore two theories in particular: 'status comparisons'; and 'poor social support'. I elaborate on these as they explain the social gradient that is observed in health inequalities well, especially in the case of status comparisons, and they are both relevant to the neighbourhood focus of this thesis.

Status comparisons

It has been hypothesised that when people encounter each other, especially for the first time, an allocation of status takes place. This may occur through a competition for dominance, which has been called a **'dominance contest'** (Mazur, 2005: 81). Physical acts of dominance may be employed, including keeping one's gaze at another's eyes, adopting a firm voice, and holding an upright posture. Passive symbols may also convey dominance, such as those that relate to status: e.g. clothing, accent, and hairstyle. A dominance contest is a stressful event (Mazur, 2005: 85). Initial encounters and eye to eye contact can lead to a reduction of peripheral blood flow - an indication of the stress response. It is possible that individuals who are not dominant in a socioeconomic sense perceive stress from dominance contests more acutely than those in a position of dominance through higher socioeconomic status. This is because they may attribute a low value to themselves, based on how they believe others value them. Dickerson and colleagues (2004a) conduct a program of research based around this phenomenon of self-attributing value, what they call **'self-evaluation'**. They suggest that a person feels **'shame'** when they transform a perception of negative social evaluation into negative self-evaluation, and as a consequence, the stress response is triggered (Dickerson *et al.*, 2004a).

The subjective feeling of negative self-evaluation is perhaps best illustrated by the words of people who experience social encounters from the perspective of having low status, as those of an unemployed man below. In his words, he describes a feeling of shame when coming across somebody who he describes as "slim, attractive" and "middle class".

> What it is, it's a form of violence… right, it's like a barrier saying "listen low life don't even come near me! …We pay to get away from scum like you" …stresses you, you get exhausted… they've got the right, the body, the clothes, and everything, the confidence, the attitude, know what I mean… We [sadly, voice drops] haven't got it, we can't have it. We walk in like we've been beaten, …dragging our feet when we're walking in, …you like feel like you want to hide…
>
> Unemployed man in 30s quoted (phonetic spellings removed)
> in Charlesworth et al. (2004: 51-52)

In the context of a society which has several socioeconomic grades, such as in the UK, the lower one's socioeconomic position, the more negative their self-evaluation, and therefore their social encounters are likely to be more stressful. Under this theory of status comparisons, even people who have high socioeconomic positions still have others who are dominant to them, and so they also have stressful encounters, albeit less stressful than if they were in a lower socioeconomic group. This reasoning has been used to explain why health inequalities in the UK are patterned along a social gradient (Marmot, 2004, Wilkinson, 2005, Wilkinson and Pickett, 2009).

Social support

It has been hypothesised that the social support that one gains from belonging to a social network can exert both direct health effects, and indirect health effects by insulating people against psychosocial stress (Cohen and Pressman, 2004). This hypothesis has been tested in several studies and has been reviewed as I discuss below.

A review by Uchino and colleagues (1996) included three types of studies that took physiological measurements to compare against levels of social support: correlation studies, intervention studies and lab studies. In their literature search, they found 87 studies matching their criteria: 57 measured cardiovascular tone, 10 measured endocrine (SA and HPA axes) markers, and 19 measured immunological function. Studies that measured cardiovascular tone most consistently found a beneficial effect of social support. Of those studies, where the stress-buffering hypothesis was tested, the majority (5 of 8) found that social support attenuated the association between measures of 'life stress' and cardiovascular tone. A minority of the cardiovascular studies that tested cardiovascular responsiveness to a stressor measured social support not through assessment of social or family networks, but through accompaniment of a friend or family member during the test. These studies did not find consistent results, although it is likely that these studies more reliably measured the effects of self-evaluation rather than social support.

In light of the findings from these reviews, and those from a range of other studies: such as those that associate the incidence of mortality or health functioning with the size of social networks (Stansfeld *et al.*, 1998a, Berkman *et al.*, 2004, Stansfeld, 2006: 153, Cacioppo and Patrick, 2008); those that associate social support with lowered heart rate, systolic blood pressure, serum cholesterol levels and adrenaline metabolite levels (Seeman and McEwen, 1996); and that which associates social support with changes in DNA transcription related to stress-sensitivity (Cole *et al.*, 2007); it is likely that social support is an important psychosocial mediator of chronic health outcomes. Linking these findings with health inequalities, it has been found that, in the UK, the lower a person's socioeconomic position, the more likely they are to receive inadequate social support (Stansfeld *et al.*, 1998b, Marmot, 2004: 167).

Framing Psychosocial Explanations in the Context of this Thesis

In the last section, I discussed that from the perspective of material causes of ill health and unhealthy behaviours, one would predict that poor people would be healthier in rich areas. However, based on the two particular psychosocial explanations of the social gradient in health and behaviours I discuss above, one may predict that poor people might be healthier in poor areas. I will explain the theoretical reasoning for this more fully in Chapter 4, where I test these theories with data analyses that indirectly explore status comparisons and social support in the context of poor people living in rich and poor areas. In brief however, these theories are summarised below:

- **Status comparisons**
  In high status neighbourhoods low status people judge themselves more negatively than in low status neighbourhoods. This is because of constant and contrasting

status comparisons made directly through contact with high status people and indirectly through exposure to other high status indicators in the neighbourhood, therefore low status neighbours are more beneficial to the health of low status individuals.

- **Social support**
  In low status neighbourhoods low status people are more likely to have supportive neighbourhood-based social networks than in high status neighbourhoods, therefore low status people in these contexts are more likely to mitigate the negative health impacts of detrimental psychosocial factors that are experienced by low status people in general.

As such, the balance between the two sides of the material-psychosocial argument, at least at the neighbourhood level, can be investigated by the thesis question, *Are poor people healthier in rich or poor areas?*

Chapter Conclusions

In this chapter, I have set out the debate about the relative importance of material and psychosocial causes of health inequalities. In doing so, I have made clear how investigating the question in this thesis is one way in which to engage with this debate. This is because from a material perspective, one would argue that poor people would have better health in rich areas, whereas from a psychosocial perspective, one may argue the opposite, that poor people might have better health in poor areas. Of course, neighbourhood contexts are likely to have both material and psychosocial effects on the health and behaviours of residents. As such, their conflicting effects, along with the additional peer effects that are neither material nor psychosocial, are best conceptualised as creating a balance. In the next chapter, I will explain how I will investigate the thesis question taking into account this concept of a balance.

The secondary aim of this thesis is to explore the health consequences of living as a poor person in a segregated deprived enclave that is located within a relatively affluent neighbourhood, and I will investigate this specifically in Chapter 5. The majority of this thesis, however is concerned with the primary aim: to contribute towards the material-psychosocial debate. The reason for choosing this as the primary aim is because of broad implications for public health. The material causes of health inequalities have been acknowledged by policy makers and have led to a focus on alleviating poverty for the benefit of public health in the UK. These policies aim to keep people, regardless of socioeconomic group, above the poverty threshold throughout their lives so that no unequal accumulation of material disadvantage can take place, thus eliminating the social gradient in health. Indeed, the conclusions of the Black Report on health inequalities in the 1980s included a recommendation to abolish child poverty. This is still the aim of much public health policy today.

> Above all, we consider that the abolition of child-poverty should be adopted as a national goal for the 1980s.
>
> (Black *et al.*, 1988)

> Policy Objective A: Give every child the best start in life.
>
> Policy Objective D: Ensure healthy standard of living for all.
>
> (Marmot, 2010)

The psychosocial causes of health inequalities have also been acknowledged by policy makers. However, this has been generally focused on how they relate to people of the lowest socioeconomic groups, and not how they relate to the social gradient in health. Above I discussed the theory of status comparisons, and how these remain significant to health amongst people in high socioeconomic groups. Critical proponents for the psychosocial explanations of health inequalities argue for policies that address socioeconomic inequality directly through interventions beyond the alleviation of poverty, such as the establishment of pay ratios, the encouragement of cooperative business models, and more progressive taxation (Wilkinson and Pickett, 2009).

Although the investigation into whether poor people are healthier in rich or poor areas will not be able to quantify the balance of the different causes of health inequalities reliably, it serves as a novel perspective to address the debate, albeit confined to the neighbourhood level. In the next chapter, I will review the scientific literature that has specifically addressed the question of this thesis.

2

A Review of the Balance between Beneficial and Detrimental Health Effects of Poor Neighbourhoods on Poor People

- **Aim of this chapter**

  The aim of this chapter is to review the literature that has specifically addressed the thesis question, *Are poor people healthier in rich or poor areas?,* in such a way that takes into account the balance between beneficial and detrimental health effects in poor neighbourhoods.

As I discussed in the last chapter, poor neighbourhoods, or more generally neighbourhoods of low socioeconomic status, are associated with contextual material disadvantage that may lead to ill health or unhealthy behaviours. At the same time, these neighbourhoods may offer psychosocial benefits, particularly for poor people who may make less stressful status comparisons in such contexts, and may be better socially supported, given their congruity with the socioeconomic milieu. In this chapter, I do not fully explore these psychosocial theories in detail, as I will do this in Chapter 4. Instead, in this chapter I focus on how the detrimental and beneficial health effects for poor people in poor neighbourhoods might balance each other, whether one may outweigh the other, and to what extent the studies reviewed here support the material-psychosocial divide of such contextual effects. Finally, I will discuss the limitations of current studies, and how I may develop them in the analyses in later chapters of this thesis.

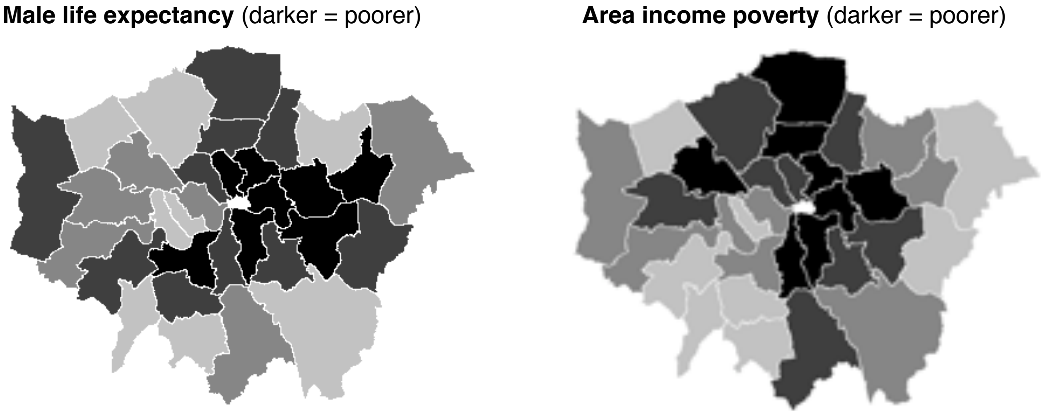
2.1 Background

As I discussed in the introduction to this thesis, to some, the answer to the thesis question may seem obvious - living in deprived surroundings must be detrimental to health. Indeed, ecological and multilevel analyses of neighbourhood socioeconomic characteristics and health indicators consistently show that health is worse in neighbourhoods of lower socioeconomic status, even after controlling for individuals' socioeconomic characteristics (Pickett and Pearl, 2001, Riva *et al.*, 2007). Based on this, one might conclude that the contextual material disadvantage in poor neighbourhoods that I discussed in the last chapter compounds the general disadvantage experienced by poor people when they live in such neighbourhoods, therefore they would be healthier living in richer neighbourhoods. In this section, I discuss the multilevel evidence that would suggest this, and argue that to estimate differential neighbourhood health effects by socioeconomic group, more specific types of analyses are required.

Evidence for Detrimental Health Effects of Poor Neighbourhoods

A study of health in areas where both the exposure and the outcome are measured at the area-level is called an '**ecological study'**; an example would be a study that looked at the effect of the proportion of unemployed residents on the mortality rate of an area. In England, the Department of Health has measured health inequalities spatially by ecological analyses that compare 'spearhead areas' to the rest of the country. Spearhead areas are the most deprived fifth of England's local authorities (DH, 2008). Between 2003 and 2005, 13,700 fewer 30-59 year olds would have died in these areas if their mortality rates were equal to the rest of the country. Several similar ecological studies in the UK have found close associations between area deprivation and poor health outcomes, consistently showing spatial correspondence between deprivation and health measures (Gordon, 2003, Stafford and McCarthy, 2006). I have illustrated such spatial correspondence using maps of London boroughs below (Figure 2.1).

Figure 2.1 Correspondence between quartiles of male life expectancy* and area income poverty†



NB: Choropleths generated using MapWindow software with borders from Edina. Data from the City of London are not included (left white).

* Male life expectancy data from Office of National Statistics (2008)

† Income domain of index of multiple deprivation 2007. Data from Department of Communities & Local Government

Ecological studies illustrate associations, but in order to determine whether these associations between area deprivation and health are contextual, and not just compositional, unaggregated status and health measures are needed. With such measures, the independent effect of area deprivation on the health of residents can be identified after taking into account the association between the status of individual residents and their health. An example of such a study was conducted using the Whitehall II cohort (Stafford *et al.*, 2001). In this study, sociodemographic characteristics of civil servants, including their employment grade and level of financial difficulties, explained about a third of the variation between electoral wards in the self-rated health of men, and about a sixth of the variation between wards in the self-rated health of women. The remaining variation between electoral wards in self-rated health indicates either unaccounted compositional (individual) or unaccounted contextual (area) predictors of self-rated health within wards. Taking the above sociodemographic characteristics into account, area deprivation at electoral ward level was significantly associated with self-rated health, such that living in the most deprived wards increased the likelihood of low self-rated health by about 30% compared to living in the least deprived wards. This association suggests a contextual effect of area deprivation, although this explained little between-ward variation in self-rated health beyond that explained by compositional differences between wards.

In a review of similar studies of neighbourhood socioeconomic status and health, Pickett and Pearl (2001) found that 23 of 25 studies reported significant independent associations between area deprivation and poor health. They included studies that investigated mortality, chronic disease, infant birthweight, mental health and health behaviours. However, only 10 of the 25 studies reviewed used statistical techniques that could partition and quantify the level of variation in health outcomes between areas over that within areas, such as the study above by Stafford and colleagues (2001). Such statistical techniques require models that take account of the two-tiered structure of data; called **'multilevel models'**. Multilevel models allow quantification of how much additional between-area variation is explained by area-level variables, which is important in the evaluation of the predictive importance of variables (Merlo *et al.*, 2005). They also take into account the clustering of residents when estimating standard errors and allow associations between variables to vary by area (Subramanian *et al.*, 2003, Gleave *et al.*, 2004, Merlo *et al.*, 2005).

A later review of studies included only those that used multilevel models (Riva *et al.*, 2007). In total 86 studies were reviewed including 37 from the US and 14 from the UK. Only 6 did not provide significant evidence for a contextual effect on health. Studies included those that measured self-rated health, coronary heart disease and risk factors, and mortality. All but 2 of 35 studies of area deprivation and low self-rated health showed significant associations. All 23 studies of area deprivation and coronary heart disease and risk factors showed significant associations. All but 2 studies of area deprivation and mortality showed significant associations.

It is from studies such as those reviewed in the two reviews above that has lead to the generalisation of 'area effects' - specifically that neighbourhoods of low socioeconomic status are detrimental to the health of their residents, regardless of what a resident's own socioeconomic status is. However, such generalisation is not valid as I discuss below.

Limitations of Multilevel Studies for Identifying Differential Health Effects

The first limitation of most of the multilevel studies for the purposes of finding health effects for poor people in particular, is that associations between the neighbourhood socioeconomic status and the health of residents are not usually tested separately for different socioeconomic groups. Differences in such associations by socioeconomic group are called **'cross-level interaction effects'**, referring to the modification of effects at one level, the neighbourhood, by factors at another level, the individual. To find such effects studies must use appropriate statistical interaction tests, or conduct analyses that are stratified by socioeconomic group. Without doing so, average adjusted health effects are generalised to residents of all socioeconomic groups.

The second limitation is that the neighbourhood measures of socioeconomic status used in such studies often rely on indicators of socioeconomic disadvantage alone, and often these indicators are restricted to material disadvantage, without taking into account social conditions or socioeconomic milieux. As such, analyses are biased towards measuring the health effects of material factors, in particular those that are related to the bottom of the socioeconomic scale. In order to identify psychosocial causes of ill health and unhealthy behaviour, it would be preferable to measure characteristics of the social environment.

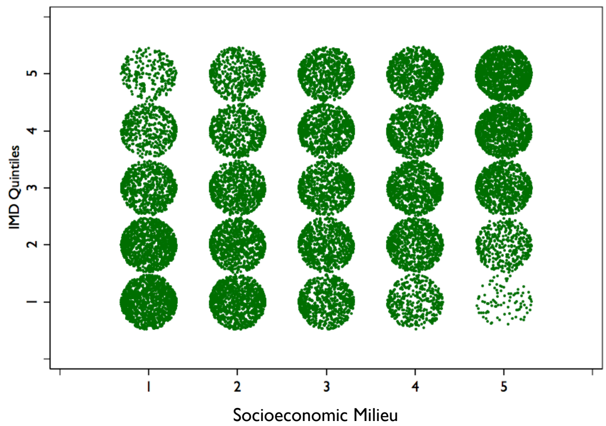
Three often-used area deprivation measures for health research in the UK are:

- Townsend Deprivation Index
- Carstairs Deprivation Index
- Index of Multiple Deprivation (IMD)

The Townsend Deprivation Index is a composite measure of unemployment, household overcrowding, car ownership, and household ownership. This is the measure used in the study of area deprivation and self-rated health of the Whitehall II cohort discussed above (Stafford *et al.*, 2001). The Carstairs Deprivation Index is a similar measure, but household ownership is replaced by low social class. The IMD is a composite measure made up of 7 domains: income; employment; health and disability; education, skills and training; barriers to housing and services; living environment; and crime. This area deprivation measure is unlike the other two in that its domains contribute to the overall score to different extents, and it includes area characteristics that are not aggregated from residents' characteristics. This is the measure used in part to define the spearhead areas used by the Department of Health in the UK.

Importantly, although these measures are closely associated with conditions of neighbourhood material disadvantage, they are not as closely associated with neighbourhood socioeconomic milieu. For example, three of the four proxy variables measured to derive the Townsend Deprivation Index are asset-based. In Figure 2.2 below, I demonstrate that areas with high densities of low status residents are not necessarily characterised by low material standards of living. In this figure, areas in London are plotted by their quintile based on the Index of Multiple Deprivation against their quintile based on an index of socioeconomic milieu made up of the combined ratios of highly educated to poorly educated people and professionals/managers to routine/manual workers (for details, see methods in Chapter 5). Although there is considerable overlap in how the two different scales categorise areas, there is discordance. Areas allocated to any quintile based on IMD may be allocated to any quintile based on social milieu. Consequently, many areas that are rated high status on the basis of IMD, are conversely rated low status on the basis of the social milieu. In other words, some areas that have few physical characteristics of deprivation and low crime rates may be inhabited by predominantly working class people, whilst some areas that are physically deprived and have high crime rates may be predominantly inhabited by highly educated professionals and managers.

Figure 2.2 Weak correspondence between IMD and Socioeconomic Milieu



NB: Lowest area status on both scales = 1. Each point represents an output area in London. Its location on the grid is based on which quintile it belongs to based on IMD and based on socioeconomic milieu (composite score of the ratios of highly educated to poorly educated people and professionals/managers to routine/manual workers).

In this review, I include only studies that have an analytical element which investigates the differential effects of neighbourhood socioeconomic status by individual socioeconomic status - i.e., **'cross-level interaction studies'**. It would be ideal to further restrict inclusion to studies that use measures of neighbourhood socioeconomic status that take into account socioeconomic milieu and not just material disadvantage. However, because this would severely limit the number of studies included, I will instead consider how neighbourhood socioeconomic status is measured in different studies in the discussion towards the end of this chapter.

2.2 Methods for Literature Search for Cross-level Interaction Studies

The two most important criteria for studies to be included in this review is that they:

1) measure neighbourhoods socioeconomic status at the area-level and the health of residents and status at the individual level, and
2) analyse associations between neighbourhood status and the health of residents separately for different socioeconomic groups.

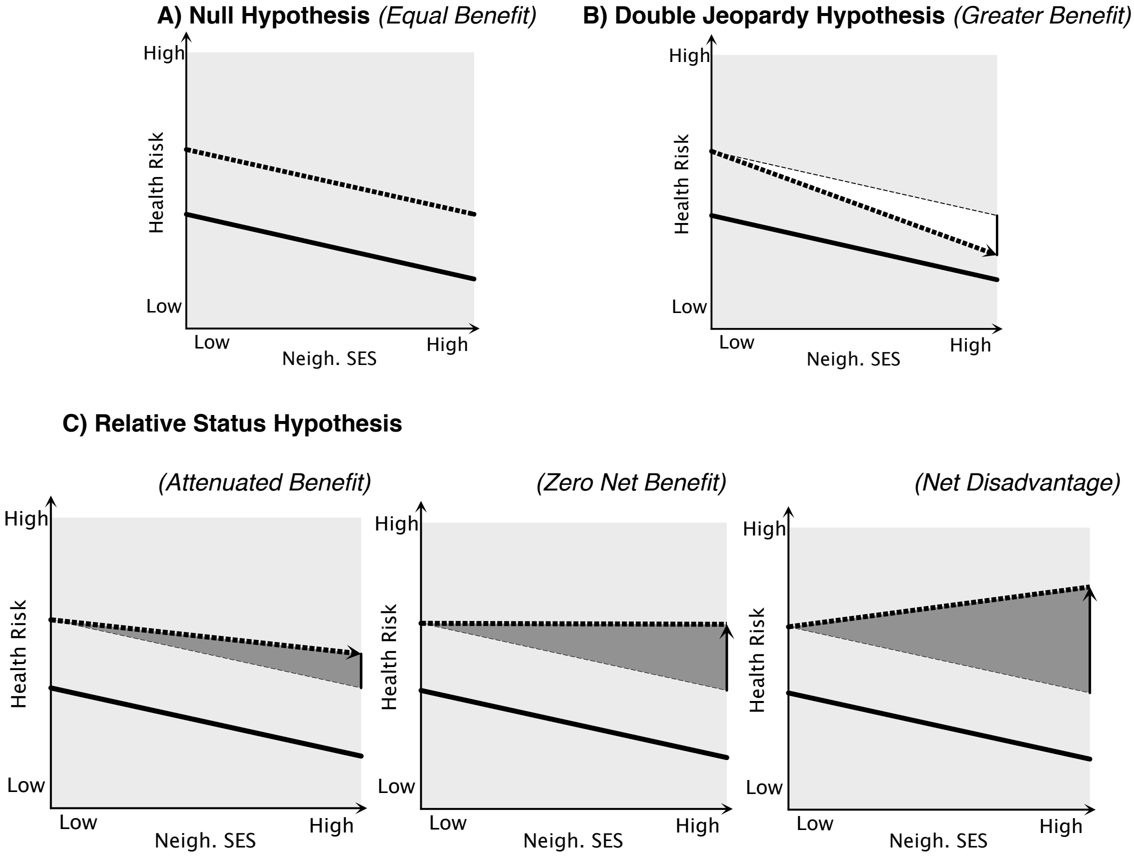
In this section I explain the search methods used, including inclusion and exclusion criteria. Before this, I discuss the complexity of findings that may be reported in cross-level interaction studies. In doing so, I set out the different hypothetical models that may be demonstrated by the findings of such studies, which provides the framework within which I discuss the results of studies in this review, as well as the results of my own analytical analyses in the later chapters of this thesis.

Hypothetical Cross-level Interaction Effects

Different hypothetical models of cross-level interaction effects are illustrated in Figure 2.3. These models anticipate different levels of balance between beneficial and detrimental neighbourhood health effects for poor people living in poor areas. As discussed above, in most multilevel studies of area effects on health it is found that low neighbourhood socioeconomic status is associated with poor health, controlling for individual socioeconomic status (Pickett and Pearl, 2001, Riva *et al.*, 2007). One model of cross-level interaction effects is that there is in fact no interaction, i.e. the association between neighbourhood status and poor health is consistent across all socioeconomic groups. This is referred to here as the **'null hypothesis'**. It is illustrated in Figure 2.3A. In this figure, the broken line representing the health risk to low status residents is parallel to and above the solid line that represents the health risk to high status residents. This reflects an additive effect of neighbourhood status on health over that of general socioeconomic health inequalities. Both high and low status residents receive *equal benefits* from living in high status neighbourhoods.

Figure 2.3 Hypothetical Cross-level Interactions (*Hypothesised Effects of High Neighbourhood Status on Low Status individuals' Health*)

---------- = Health Risk to Low Status Individuals
_______ = Health Risk to High Status Individuals



Note: Broken line = Low status individuals; Solid line = High status individuals. In all graphs area SES increases on the horizontal x axis and risk to health increases on the vertical y axis.

Figure 2.3B illustrates a multiplicative hypothesis of the area effects on health. In this hypothesis, referred to here as the **'double jeopardy hypothesis'** (Stafford and Marmot, 2003), the negative effects of low neighbourhood status and individual status compound to make the health risks of poorer residents particularly high in deprived neighbourhoods. In other words, low status individuals receive *greater benefit* from living in neighbourhoods of high status than high status individuals. Health inequalities between residents in neighbourhoods of low status would be greater than areas of high status, according to this hypothesis.

The third hypothesis is referred to here as the **'relative status hypothesis'**. Illustrated in Figure 2.1C, it has three variant models. All three of them contrast with the double jeopardy hypothesis. Health inequalities in any of these three scenarios would be more pronounced in high status compared to low status neighbourhoods. In the most extreme of the scenarios, illustrated by the graph on the lower right, the health of low status and high status residents are affected by area status in opposite directions. Instead of the negative health effects of low status being amplified in low status neighbourhoods, in this scenario, low status residents experience higher health risks in high status areas - they incur a *net disadvantage* as their relative status decreases. The two less extreme variations hypothesise more subtle effects. In these cases the beneficial health effects of neighbourhood status are attenuated for low status individuals, but not to the extent that the benefit is outweighed by the disadvantage. Instead, low status individuals receive *zero net benefit* to health in high status areas, or continue to benefit but to a lesser extent (*attenuated* benefit*)* compared to high status individuals.

Defining the Study Question

This review aims to find which cross-level interaction model for physical health currently receives the most consistent and valid support, and to identify current gaps in knowledge. The primary stage of searching the literature for such evidence is to identify the research question that relevant studies must address, taking into account the study population, the exposure and the outcomes.

Study population

As I set out in Chapter 1, my thesis tests whether psychosocial health effects may be exacerbated for low status individuals who live amongst people of high status. As it is in high-income countries where material effects on health are more likely to be weak and potentially counteracted by psychosocial effects, the relevant populations to investigate must be in high-income countries like the UK or the US (Wilkinson, 2005, Wilkinson and Pickett, 2006, Wilkinson and Pickett, 2007).

Exposure

Studies must include two levels of exposure to socioeconomic circumstances: the individual or household[1], and the area or neighbourhood. It is the interaction between the two levels, the cross-level interaction, that is important to this review. Studies may take two distinct approaches to analysing cross-level interaction effects. The first approach is to look at how the health effects of individual status vary by neighbourhood status. The second is to determine how the health effects mediated by neighbourhood status vary by individual status. A cross-level interaction study may not fully report results for both approaches, but for this review a descriptive report of either forms the minimum requirement for inclusion.

Another varying factor is the type of status that is measured for each level as an exposure. Since preliminary searches of the literature returned a limited number of relevant studies, I have kept the variety of status measures allowed for inclusion very broad. Individual status is typically measured by income, education or occupation, but may also include factors such as household assets, housing tenure, employment status, financial security and benefit status. Neighbourhood status is more varied and more usually combined into an index that may include population aggregates of the same measures as well as physical components such as commercial stores, air quality and green spaces. The diversity of possible interactions between these two levels of status is an example of how heterogenous these cross-level interaction studies are and warns against conducting any pooled analysis.

Outcome

Whether self-rated or objectively measured, for the purpose of this review, a measure of physical health is sufficient for studies to be included. Nevertheless, in this review I focus on the 'end' physical outcome, that is the eventual states of health that may result from chronic exposure. Measures that do not indicate physical health directly but are related, such as health behaviours, well-being and mental health, are relevant in understanding mechanisms that translate social exposures to physical health outcomes, therefore these are referred to here, but not reviewed in detail.

1 Although status at the lower level may be measured for individuals or households, I collectively refer to both measurements as individual status.

Specifying these three terms, the study population, the exposure, and the outcome, I formulate the research question below:

"Within the context of high-income countries, for different socioeconomic groups, is there a difference in the way in which area socioeconomic circumstances affect physical health?"

Search Strategy and Study Selection

To search for relevant studies a combination of recommendations from existing networks, reference lists, and electronic databases were used. Recommended papers formed a starting point and directed the rest of the search. Key terms from those papers (Yen and Kaplan, 1999, Veugelers *et al.*, 2001, Stafford and Marmot, 2003, Borrell *et al.*, 2004, Roos *et al.*, 2004, Winkleby *et al.*, 2006) and other papers cited in these papers were used to formalise a three-stage electronic search strategy, summarised below.

Stage 1: Restricting search to human physical health	**Stage 2: Filtering search to studies of status**	**Stage 3: Further filtering search to neighbourhood studies**
Search results were limited to studies on humans and papers which had any of the following in their *title* were indexed: *health* *mortality* *death* *morbidity* *illness* *sick** *disab** *weight* *overweight* *obes** *BMI* *waist* Note: If a word is starred(*), the search engine returned papers whose titles had the word or any variation following from the star. For example, when searching for papers with obes*, titles with obesity or obese would be indexed.	The list of indexed papers from *stage 1* were filtered so that each had to contain any of the following words in their *abstract*: *depriv** *income* *education* *socio** *poor* *poverty* *status*	The filtered results from *stage 2* were then filtered further by removing papers without the following words in their *titles*: *neighb** *area* *environment* *context** *place* *geograph** The results were again further filtered by picking only those papers which had also mentioned the following in their *abstracts*: *neighb** *area* *place* *geograph**

An online web browser-based research package, OvidSP, was used to perform the search strategy above. OvidSP was chosen for its filtering tools, saving capabilities, and wide database access. MEDLINE, a literature database of biomedical research including studies from allied health fields, biological sciences, physical sciences, humanities, and information sciences, was available through OvidSP with studies from approximately 3,900 journals. The search strategy above was used to search through the OvidSP MEDLINE database from 1950, the earliest records on the service, up to the first week of March 2010, the current week at the time of the search.

The search terms above are relatively broad. This is to maximise the number of studies found that could potentially match the specified research question. In total, the search strategy returned 1,542 studies. Most of these studies were not relevant, therefore *post-hoc* selection criteria were used for exclusion of non-relevant studies. In a systematic review it would not be usual to devise selection criteria *post-hoc* and this is avoided by conducting pilot searches. However, the review here is based on scoping review guidelines that are designed to be flexible, whereby selection criteria are *'based on increasing familiarity with the literature'* (Arksey and O'Malley, 2005).

The most common reason to exclude a study was a lack of cross-level interaction description or analysis. This could have been avoided by including a further filter in the search strategy, however initial searches that had such a filter missed studies that were found with the broader search strategy. Some of those studies that were initially missed did not include any terms relating to cross-level interaction effects, interaction analyses, or stratified analyses in their titles or abstracts. Some studies only made reference to the significance value of a test for cross-level interaction effects briefly in the text of the paper, or simply included the test and significance value in a table with other results. Other studies did not analyse cross-level interaction effects formally, but had sufficient information in their tables or charts for a description of these effects. Since most of the studies found in the searches were not designed to look at cross-level interaction effects specifically, finding relevant cross-level descriptions and analyses was difficult to achieve.

After ascertaining whether studies had some form of descriptive or analytical content regarding cross-level interaction effects, the next most common reason for exclusion of a study was related to the size of the areas that were analysed. In this review, both theoretical and practical considerations were taken into account when deciding what was an acceptable scale. The type of area that is particularly relevant to this thesis is one that could be considered a 'reference group' for status comparisons (Merton, 1968: 287, 362) and a 'neighbourhood' at the same time, where relationships may form. However, because of the variation in the level of social interaction that people experience living in different types of places (Curtis, 2008), conceptualising the correct area size is indefinite. For example, in population-dense urban areas there is, statistically, a higher chance of social interaction, but at the same time the city-wide public transport and negative perceptions of high population density may distort social interaction behaviours (Evans and Lepore, 2008), and potentially diminish the identification of an urban neighbourhood as a reference group by its residents.

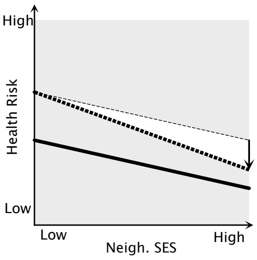
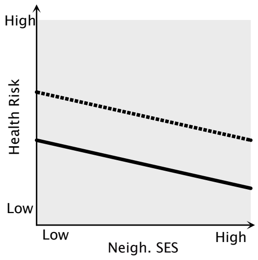
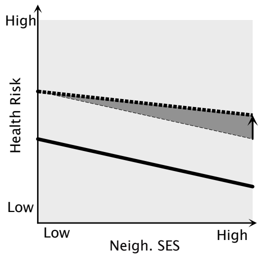
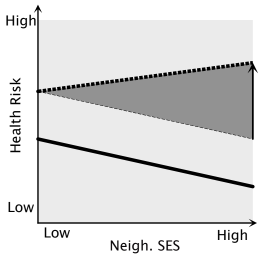
Practical considerations relating to the limited number of relevant studies found restricts the maximum size of an area to subdivisions of cities. The study with the largest scale of areas *included* in this review used administrative neighbourhoods in the Italian city of Turin, averaging approximately 40,000 residents (Marinacci *et al.*, 2004). The study with the smallest scale of areas *excluded* in this review used metropolitan commuter regions in Finland, averaging about 90,000 residents (Blomgren and Valkonen, 2007).

After the exclusion of studies based on cross-level interaction analysis and neighbourhood scale, more studies were excluded for having health outcomes that were too specific to be generalised to physical health. One example was a cross-level interaction study of tooth-loss (Sanders *et al.*, 2008).

2.3 Results of Literature Search and Overview of Findings

In total, 25 studies were included in this review of cross-level interaction effects on physical health. A summary of which cross-level interaction models each study supports is illustrated by Table 2.1 below. The full details for each study are presented in tables in the Appendix (Table A2.1 for mortality studies and Table A2.2 for physical morbidity studies). In interpreting the findings of studies, such as the categorisation of studies in Table 2.1, it is important to bear in mind the differences between the models discussed in the last section, summarised by Figure 2.3. Especially important is the distinction between the **double jeopardy** hypothesis and the **relative status** hypothesis. The former states that, compared to high status individuals, low status individuals receive a **greater health benefit** when they live in high status neighbourhoods as opposed to low status neighbourhoods. The latter states that, compared to high status individuals, low status individuals receive an **attenuated benefit**, **no benefit**, or are actually at a **disadvantage** when they live in high status neighbourhoods compared to low status neighbourhoods. Diagrams of the hypotheses and models are provided in Table 2.1.

Table 2.1 Findings of included papers by outcome and supported model

Hypothesis	**DOUBLE JEOPARDY**	**NULL**	**RELATIVE STATUS**	
dotted line: **low status people** solid line: **higher status people**				
Model (Effect of high status neigh. on low status people)	**Greater Benefit**	**Equal Benefit**	**Attenuated/Zero Net Benefit**	**Net Disadvantage**
Mortality	Borrel 2004 Davey Smith 1998	Bosma 2001 Marinacci 2004 Turrell 2007	Ecob 1998*	Roos 2004* Veugelers 2001* Wen 2005* Winkleby 2003 Winkleby 2006* Yen 1999*
Physical morbidity	Hou 2005 Kobetz 2003* Stafford 2003 Stafford 2001	Adams 2009 Dibben 2006 Diez Roux 2001 Diez Roux 1997 Lindstrom 2004 Wight 2008	Collins 2009 Malmstrom 1999 Rundle 2008*	

* Significant cross-level interaction tests.

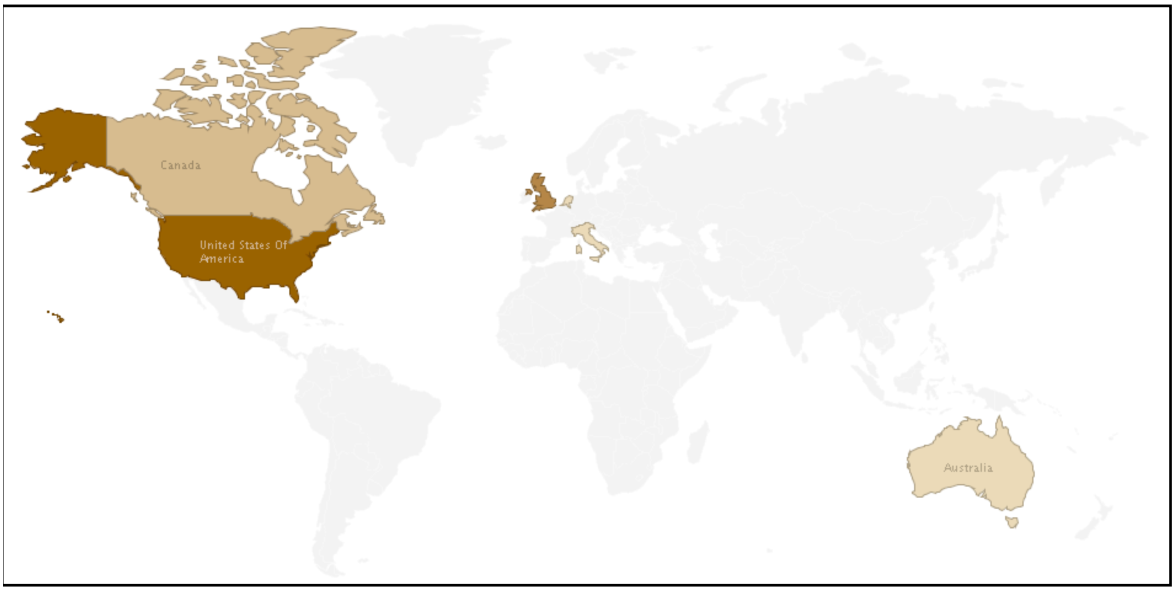
Overview of studies

Before discussing the differences between individual studies, I provide an overview. The overview presented here does not include studies that did not formally test for cross-level interactions between neighbourhood status and individual status in predicting health. The reason for this is because the evidence from such studies for cross-level interaction effects may not be significant. Of the 25 studies, 19 are included in this overview.

International distribution

As shown in Figure 2.4 below, the majority of studies are of populations from either the US (8) or the UK (5). Three studies are from Canada. Australia, Italy and the Netherlands are represented by one study each.

Figure 2.4 International distribution of included studies

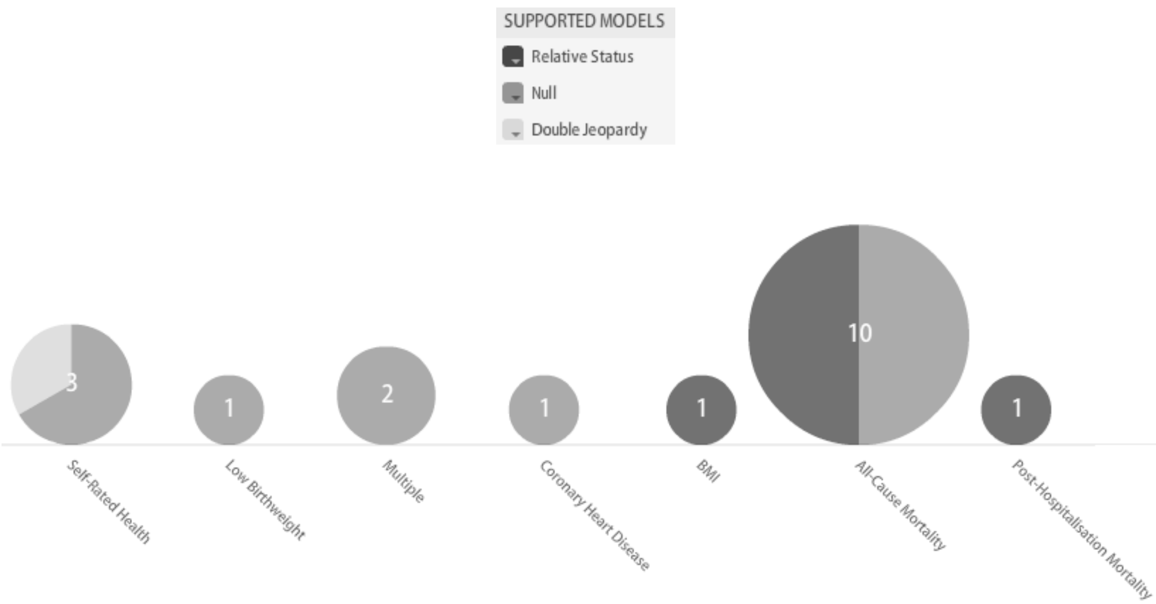


NB: The intensity of the shading of countries denotes the number of studies that sample from each country. Studies that did not test for the significance of cross-level interactions are not included.

Range of physical health outcomes

Ten studies analysed all-cause mortality, and one analysed post-hospitalisation mortality specifically. The remaining 9 studies analysed a variety of physical morbidity outcomes. All physical health outcomes, and the models supported by studies of these outcomes are summarised in Figure 2.5 below. Half of the studies that analyse all-cause mortality report significant findings that support the relative status hypothesis, whereas the findings of the other half support the null hypothesis. Most other physical health outcomes are only analysed by one study. As such, there is no reliable consensus on the supported model for any particular health outcome.

Figure 2.5 A lack of consensus support for any specific model by any physical health outcome

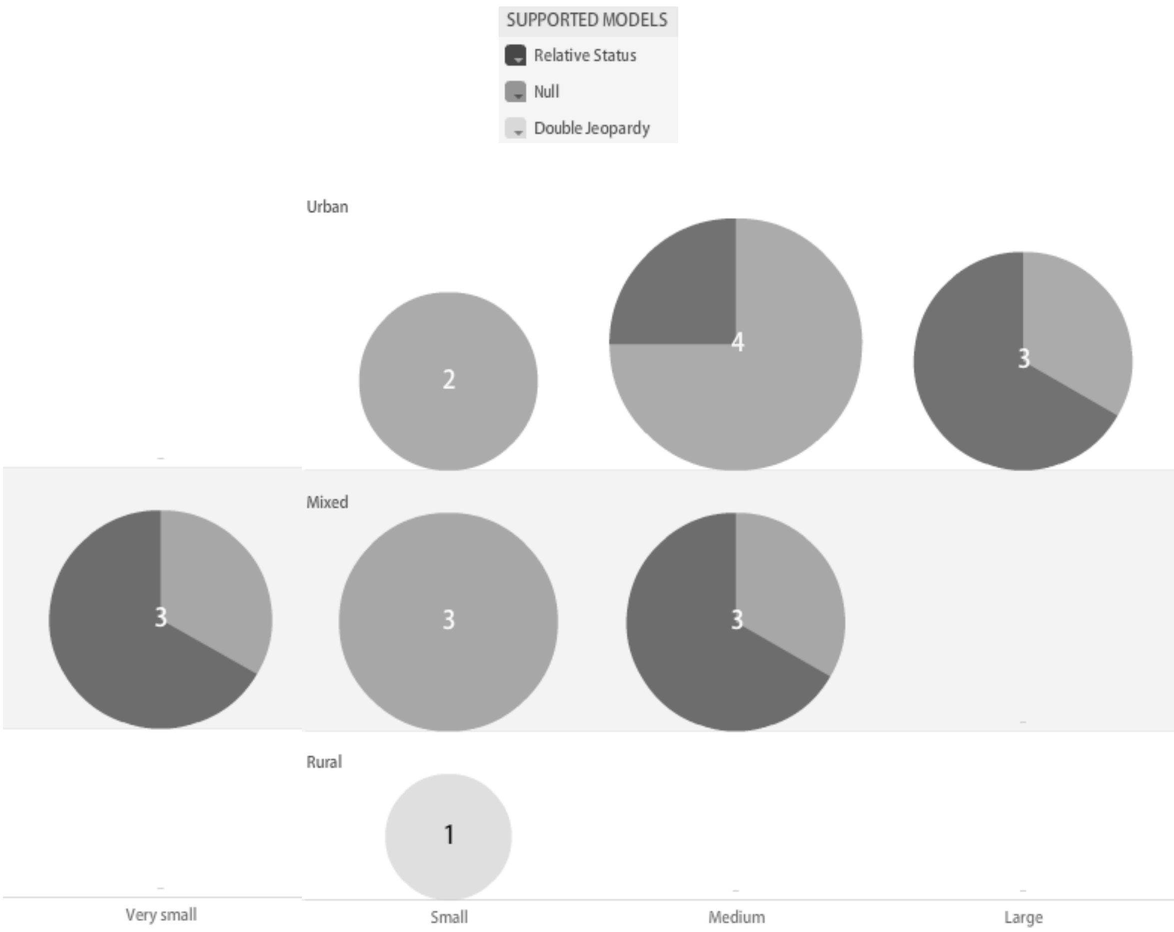


NB: The numbers within each pie, and size of each pie, represent the number of studies that analyse a particular health outcome. Studies that did not test for the significance of cross-level interactions are not included.

Geographic size and urban/rural context of neighbourhoods

Almost all studies used samples from populations living in urban contexts (9) or from mixed populations that live in both urban and rural contexts (9). There was only one study that sampled from a solely rural population, and this was the only study to report statistically significant findings that support the double jeopardy hypothesis (Kobetz *et al.*, 2003). The geographical scale defined as a neighbourhood varied considerably. Seven studies defined neighbourhoods as medium-sized areas, approximately the size of an electoral ward in England, with about 5,000 residents - this was the most commonly analysed area size. Six defined neighbourhoods as small-sized areas, approximately the size of a lower-layer super output area in England, with about 1,500 residents. The other six studies defined neighbourhood size in opposite extremes. Three used large areas with tens of thousands of residents. Three used very small areas, roughly equivalent to US census block-groups or England output areas, with about 500 residents. There was no consistency in the model supported by studies by the size of area that was used to define a neighbourhood. Although all studies that used small areas had findings to support the null hypothesis or the double jeopardy hypothesis, the relative status hypothesis was supported by some studies that used very small, medium and large areas. This information is summarised in Figure 2.6 below.

Figure 2.6 A lack of pattern for supporting any specific model by defined size of neighbourhood



NB: The numbers within each pie, and size of each pie, represent the number of studies in each particular category. Studies that did not test for the significance of cross-level interactions are not included.

Interpretations of statistical adjustment in analyses

Methods for testing whether cross-level interaction effects on health between neighbourhood status and individual status vary across studies, as discussed earlier in the last section. The most common two methods are 1) testing whether the association between neighbourhood status and health is significantly different for different socioeconomic groups; 2) testing whether the socioeconomic inequality in individuals' health outcomes is significantly different across neighbourhood status. Generally, formal methods test whether the data are best fit by statistical models that include interaction terms between neighbourhood status and individual status, or models that do not include such interaction terms. Other factors included in such statistical models also vary across studies. This may affect the interpretation of findings.

In discussions of study findings, a key feature that I will examine is whether additional indicators of individuals' socioeconomic status are included when testing for cross-level interaction effects. Note that all studies have primary indicators of individual status - those indicators that are used to form interaction terms with neighbourhood status. The interest here is whether adjustment for *additional* socioeconomic characteristics take place. Without such adjustment two interpretation errors may occur: 1) spurious cross-level interaction effects may be found, and 2) true cross-level interaction effects may be masked.

To illustrate the first error, consider a study whereby professionals are compared to manual workers. If such a study found that professionals significantly benefited from living in high status neighbourhoods, whereas manual workers did not, one may conclude that the findings support the relative status hypothesis (specifically *zero net benefit* model), since manual workers receive zero net benefit from high status neighbourhoods compared to professionals. However, further investigation may find that the income of professionals in high status neighbourhoods were higher than when they lived in low status neighbourhoods, but the income of manual workers did not vary by neighbourhood status. If that were the case then the observed benefit received by professionals living in high status neighbourhoods may in fact be due to the fact that they are richer in those neighbourhoods. The cross-level interaction analyses, if further adjusted for income, may have findings that support the null hypothesis, not the relative status hypothesis.

To illustrate the second error, consider a similar study to above. If instead, such a study found that professionals and manual workers alike benefited from high status neighbourhoods, one may conclude that the findings support the null hypothesis. Let us say that in this study, further investigation revealed that the income of professionals did not vary by neighbourhood status, whereas the income of manual workers was higher in high status neighbourhoods. If that were the case then the observed benefit received by manual workers in high status neighbourhoods may be attributed to the fact that manual workers are richer in those neighbourhoods. In this case, cross-level interaction analyses that adjust for income may have findings that support the relative status hypothesis, not the null hypothesis, as the health benefit to manual workers from high status neighbourhoods attributed to income would be diminished, whereas the health benefit to professionals from such neighbourhoods would remain.

2.4 Discussion of Findings and Gaps in the Literature

What follows is a discussion of the findings of the studies, separate for those that analysed mortality and those that analysed physical morbidity. As an aid to account for whether sufficient adjustments were made by studies, graphical representations of studies that statistically tested for cross-level interaction effects are represented, with studies grouped by the type of adjustments made, and colour-coded by the specific model supported. Note that in these diagrams, studies are only shown to support models if they have tested for the significance of cross-level interaction effects. If a study had findings to support a particular model, but such findings were not significant, then that study is not considered to support such a model, unlike Table 2.1 above.

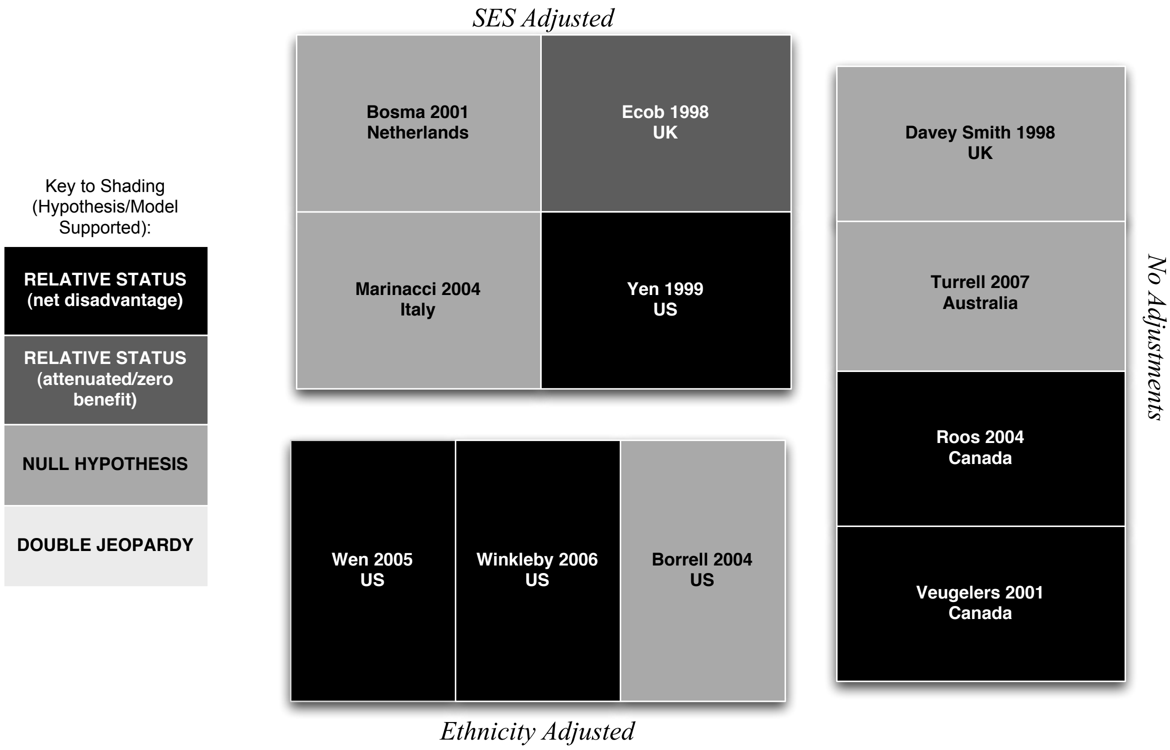
Discussion of Studies on Mortality

Twelve studies that analysed mortality are included in this review. Only one study did not statistically test for cross-level interaction effects (Winkleby and Cubbin, 2003). In this study the mortality rates were separately considered for samples made up from the Black, White and Mexican populations of the US. Although cross-level interaction tests were not carried out, data on mortality rates for each of the three samples were diagrammatically represented in three-dimensional bar charts, with mortality rates on the *y* axis, individual income on the *x* axis, and neighbourhood status on the *z* axis. From these diagrams, no cross-level interactions were evident among the White and Black samples - low neighbourhood status was equally detrimental to all income groups. However, for the Mexican sample, this effect was reversed for the lowest income group - low earners had the highest mortality rate in high status neighbourhoods. Although not formally tested, this cross-level interaction effect supports the relative status hypothesis; in particular, the net disadvantage model in Mexican-American populations is supported by this study.

Findings of mortality studies testing for cross-level interaction effects

Figure 2.7 below is a **'tree map'** diagram that represents all of the mortality studies that statistically tested for cross-level interaction effects. As explained above, studies are grouped by the type of statistical adjustments carried out, and colour-coded by the specific models that findings support.

Figure 2.7 Tree map organisational chart of mortality studies grouped by adjustment and shaded by supported model



NB: One study that did not test for the significance of cross-level interaction is not included (Winkleby and Cubbin, 2003).

Five of the 11 studies represented in Figure 2.7 have similar findings to that of Winkleby and Cubbin (2003). They find that low status individuals have higher mortality rates when living in high status areas compared to living in low status areas; therefore their findings support the net disadvantage model of the relative status hypothesis (Yen and Kaplan, 1999, Veugelers *et al.*, 2001, Roos *et al.*, 2004, Wen and Christakis, 2005, Winkleby *et al.*, 2006). Two of these studies did not adjust for any additional socioeconomic indicators or ethnicity (Veugelers *et al.*, 2001, Roos *et al.*, 2004). As discussed above, there are implications as to how under-adjusted findings are interpreted. However, in the case of findings that support the net disadvantage model, where the health of low status individuals is actually worse in high status neighbourhoods than in low status neighbourhoods, the issue of under-adjustment has unintuitive implications. In the case of these two studies, if one were to attribute the higher mortality rates of low status individuals in high status neighbourhoods to unadjusted socioeconomic characteristics, that would imply that those low status individuals have *lower* unmeasured status characteristics in high status neighbourhoods, compared to their counterparts in low status neighbourhoods. Although unintuitive, such explanations must be considered when analyses are under-adjusted (see Results and Discussion sections of Chapter 5 where this is found to be the case in London when housing tenure is additionally investigated).

Further support for the relative status hypothesis comes from a study in England and Wales (Ecob and Jones, 1998). This study found an attenuated reduction in the mortality rates of men of low social class who live in wards with high proportions of professionals, compared to the reduction in the mortality rates of high social class men; therefore the attenuated benefit model is supported by this study. Overall, 7 of the 12 mortality studies had findings to support relative status, either following the net disadvantage model or the attenuated benefit model. Before discussing whether any potential health mechanisms were investigated to explain such cross-level interaction effects in these studies, and whether there was support for either of the two explanatory hypotheses for positive health effects of low status neighbourhoods discussed earlier in this chapter, the five studies that found no cross-level interaction effects must be discussed.

Firstly, as can be deduced from Figure 2.7, 3 of the 5 of the studies that have findings that support the null hypothesis are likely to have been under-adjusted (Davey Smith *et al.*, 1998, Borrell *et al.*, 2004, Turrell *et al.*, 2007). One study in the US did stratify analyses by ethnicity so that the mortality effect of neighbourhood status could be investigated separately for White and Black samples, but within samples there were no adjustments for any other socioeconomic characteristics, therefore any cross-level interaction effects may be masked (Borrell *et al.*, 2004). Another study in Scotland found that, despite no significant cross-level interaction effect, when analyses were stratified by occupational class, the manual group was more strongly negatively affected by area deprivation than the non-manual group. However, as discussed above, this differential effect may attributed to unmeasured socioeconomic indicators, such as income, that may be higher for the manual group in less deprived areas than more deprived areas. The third study in Australia did not show any indication for a cross-level interaction effect (Turrell *et al.*, 2007). Nevertheless, as with the other two under-adjusted studies, any interactions may be masked by unmeasured socioeconomic characteristics that are ‘picked up’ by area status. It is also important to note that this study was the only one set in the context of Australia, which may have significant societal differences. What is more, of the mortality studies this particular study had the shortest interval for measuring mortality rates at three years, therefore the inevitably lower rates may reduce the power needed to detect cross-level interaction effects of either direction.

The two mortality studies that produced findings that support the null hypothesis and sufficiently adjusted for additional socioeconomic characteristics were conducted in Italy and the Netherlands (Bosma *et al.*, 2001, Marinacci *et al.*, 2004). As with the study conducted in Australia, it is possible that these studies have different findings because of different societal contexts to North America and the UK. However, with only one study from each of these different contexts, such an explanation is in no way conclusive. In the case of the study conducted in Italy, its findings may support a different model because of the size of area that it defined as a neighbourhood. Of all the mortality studies in this review, this study used the largest areas in their analyses - administrative neighbourhoods in the city of Turin, each with about 40,000 residents. It could be argued that a neighbourhood where social interactions may feasibly take place on a regular basis is smaller than an administrative neighbourhood in Turin, therefore health mechanisms that involve the interaction between area status and individual status may in this context may be unrelated to those in the context of smaller areas. It must be noted however, that one of the studies above that had findings to support a relative status hypothesis also used very large areas of about 30,000 residents (Wen and Christakis, 2005).

Investigations into causes of cross-level interaction effects

Of the 6 studies supporting a relative status hypothesis after testing for cross-level interaction effects, 4 offer some insight into potential health mechanisms (Yen and Kaplan, 1999, Veugelers *et al.*, 2001, Roos *et al.*, 2004, Winkleby *et al.*, 2006). Arguably the best analytical method among the mortality analyses, in terms of applying statistical techniques that take account of the full progression of mortality over the study interval, was used by a study in the US by Winkleby and colleagues (2006). Their study compared different mortality rates and the survival curves of 9 different sub-samples of each sex. For each sex, sub-samples were created by dividing people into 3 individual socioeconomic groups, then for each socioeconomic group they were sub-divided into 3 US census-tract socioeconomic groups, thus making the 9 sub-samples for each sex. Seventeen-year all-cause mortality for all groups were analysed using a Cox-regression, which takes survival curves into account, thus increasing the power to detect differences between sub-samples. As was discussed above, this study found that the lowest status individuals had the worst survival rates in the highest status census-tracts. Although this study did not adjust for additional socioeconomic characteristics when testing for cross-level interaction effects, when further investigations were conducted low status individuals in high status census tracts were found to be more highly educated, and to have higher median income (men only), therefore cross-level interaction effects are not likely to be due to a lack of adjustment.

This study also investigated other factors that may potentially explain the poorer survival or higher mortality of low status individuals in high status census tracts. One finding was that low status men had higher rates of hypertension in high status census tracts whilst having higher levels of cardiovascular knowledge. At the same time, high status census tracts exposed low status households to more primary care physicians and health care clinics, and fewer alcohol outlets. Although it was not statistically tested whether hypertension rates could explain the approximate mortality rate increase of 25% for low status men in high status tracts compared to low status tracts, and given that the increase is unlikely to be due to material factors such as income or geographic access to health care, or to level of health knowledge, the findings of a difference in hypertension rates raises the possibility of a psychosocial cause. Psychosocial factors, such as social support and self-esteem that are discussed earlier in this chapter, were not investigated in this study.

Yen and Kaplan (1999) found similar results to Winkleby and colleagues (2006) above. They found that low-income people in the US had more than two and a half times (approx. 280%) the mortality rate in high status census tracts compared to low status census tracts. However, this finding was specific to an analysis that categorised census tracts into high and low status using social class-related factors that included per capita income and the proportion of residents that are 'white-collar employees'. Another analysis in the same study categorised census tracts using housing and environment-related factors, such as the proportion of renting households, proportion of single-unit housing structures and population density. In this analysis it was found that low-income people have a 60% reduction in mortality rate in high status census tracts (as defined by housing and environment) compared to low status census tracts. This finding, where the effect of neighbourhood status is reversed depending on the way in which it is measured, supports the postulation discussed earlier in this chapter that low neighbourhood status based on socioeconomic density or social milieu may have positive effects for low status individuals, whereas when measured by material markers of deprivation, negative effects may be more prominent. As such, the findings of the study by Yen and Kaplan (1999) suggest that there may be a psychosocial pathway related to the social milieu of the neighbourhood that explains the cross-level interaction effect.

Similar to the study by Yen and Kaplan (1999), two studies of Canadian samples had differential findings depending on how neighbourhoods were categorised (Veugelers *et al.*, 2001, Roos *et al.*, 2004). In both studies it was found that, unlike the high income group, the low income group had a higher mortality rate in high status census enumeration areas compared to low status census enumeration areas. However, for both studies, this finding was specific to analyses that categorised the status of census enumeration area by social class-related factors such as average household income and average educational achievement. Analyses that categorised areas by typical deprivation-related factors, such as level of unemployment and average dwelling value, found that the low-income group had similar mortality rates in different types of areas. As with the findings in the study by Yen and Kaplan (1999), these two studies from Canada support the hypothesis that the positive health effects of low status neighbourhoods is more likely to be found in analyses that attribute neighbourhood status to the social milieu of residents, rather than to the level of material deprivation experienced by residents.

With 7 of the total 12 mortality studies revealing findings that support the relative status hypothesis, there is considerable evidence to call for more investigation for the generalise-ability of these unintuitive findings. Particularly considering that 6 of these 7 studies find that low status individuals are actually further disadvantaged, in terms of their health, by living in high status neighbourhoods, the consideration of what these health mechanisms might be is of interest to public health.

Discussion of Studies on Physical Morbidity

The studies discussed above of the cross-level interaction effects on mortality may be informed from studies of physical morbidity, particularly to find which morbidity outcomes best complement the findings from mortality studies so that potential health mechanisms may be made clearer. Of particular interest for the mortality studies, which found considerable support for the relative status hypothesis, would be the morbidity outcomes that also follow patterns in keeping with the relative status hypothesis.

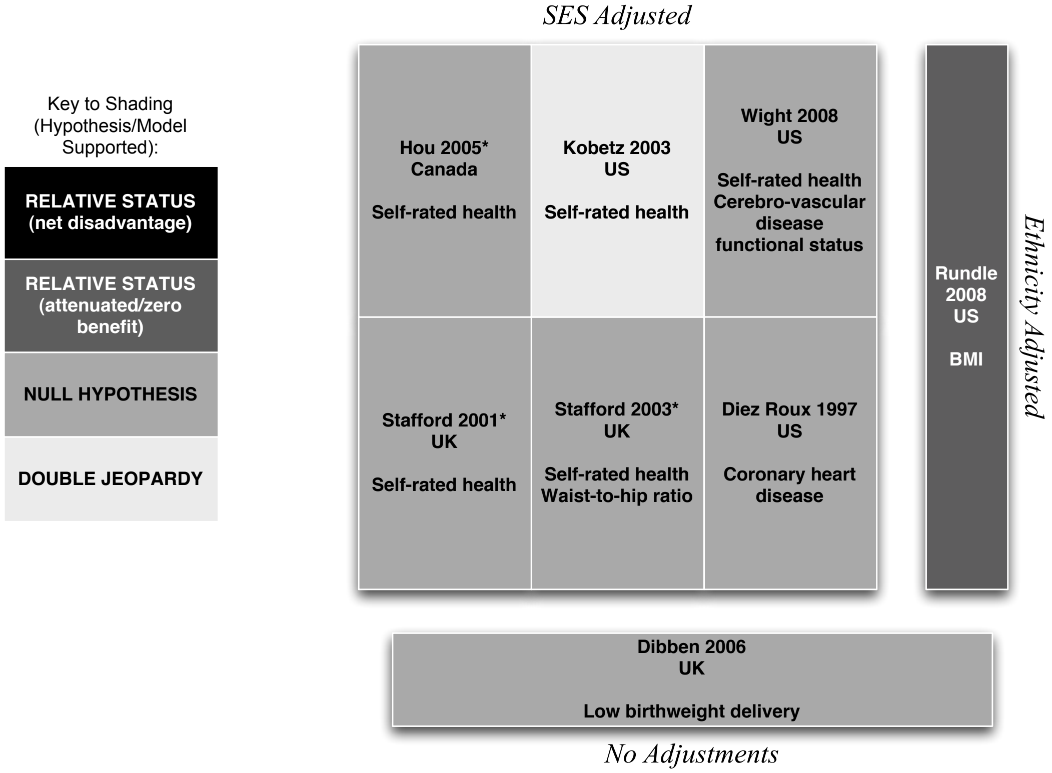
Many of the studies on physical morbidity did not statistically test for cross-level interaction effects, unlike the mortality studies where only one did not include such a test. Five of the 13 physical morbidity studies included in this review did not test for the significance of cross-level interaction effects (Diez-Roux *et al.*, 1997, Malmstrom *et al.*, 1999, Lindstrom *et al.*, 2004, Adams *et al.*, 2009, Collins *et al.*, 2009). Before discussing those that did, these five studies are briefly described below.

Two of these studies reported findings that indicate some support for the relative deprivation hypothesis. These studies analysed different physical morbidity outcomes: self-rated health (Malmstrom *et al.*, 1999) and low birthweight deliveries (Collins *et al.*, 2009). The study of self-rated health used a sample from the town of Malmo in Sweden. In this study, compared to poorly educated people, highly educated people were found to receive a greater benefit regarding their self-rated health when living in less deprived neighbourhoods. These findings support the attenuated benefit model of the relative status hypothesis. The study of low birthweight deliveries used a sample of mothers from Illinois in the US. For both White and Black samples investigated by this study, the risk of low birthweight deliveries was more strongly negatively associated with census tract average income for the most educated mothers than the least educated mothers. For both of these studies, no other adjustments were made for other socioeconomic characteristics. Both of these studies may therefore be under-adjusted. As discussed above, this could mean that the observed cross-level interaction effect is a spurious one. What is more, regarding the analysis of self-rated health, when a separate study was conducted of another sample from the same Swedish town, Malmo, all variability in reported self-rated health across neighbourhoods was diminished after adjustment of several individual-level socioeconomic characteristics (Lindstrom *et al.*, 2004). This suggests that the findings from Malmstrom and colleagues (1999) study were indeed due to under-adjustment.

The other three studies that did not test the significance of cross-level interaction effects (including Lindstrom *et al.,* 2004) had findings that support the null hypothesis (Diez-Roux *et al.*, 1997, Adams *et al.*, 2009) or no neighbourhood effect at all (Lindstrom *et al.*, 2004). These three studies all looked at different physical morbidity outcomes: self-rated health in Sweden (Lindstrom *et al.*, 2004), coronary heart disease in the US (Diez-Roux *et al.*, 1997) and a combination of obesity, metabolic syndrome and quality of life in Australia (Adams *et al.*, 2009). None of these studies showed indications of any cross-level interaction effects. However, two of these studies were under-adjusted (Diez-Roux *et al.*, 1997, Adams *et al.*, 2009). It is difficult to ascertain conclusions from these studies that are relevant to which hypotheses they support due to their heterogeneity in outcome and methods, as well as the fact that most of them were under-adjusted, and none of them conducted statistical tests for cross-level interaction effects. In order to gain further insight, discussion of the physical morbidity studies that did statistically test for cross-level interaction effects are divided between analyses of self-rated health, and analyses of other physical morbidity outcomes.

As with the discussion of the mortality studies above, a tree map diagram is included below (Figure 2.8) that represents all the physical morbidity studies that statistically tested for cross-level interaction effects. In this figure, studies are grouped by the type of statistical adjustments carried out, and colour-coded by the specific models that findings support.

Figure 2.8 Tree map organisational chart of morbidity studies grouped by adjustment and shaded by supported model



* Starred studies had findings that support the double jeopardy hypothesis, but tests for cross-level interaction effects are not significant.

NB: Five studies that did not test for the significance of cross-level interaction are not included (Diez-Roux *et al.*, 1997, Malmstrom *et al.*, 1999, Lindstrom *et al.*, 2004, Adams *et al.*, 2009, Collins *et al.*, 2009).

Findings of studies on self-rated health testing for cross-level interaction effects

Five of the 8 physical morbidity studies that tested for the significance of cross-level interaction effects analysed self-rated health (Stafford *et al.*, 2001, Kobetz *et al.*, 2003, Stafford and Marmot, 2003, Hou and Myles, 2005, Wight *et al.*, 2008). None of these studies have findings that support the relative status hypothesis, differing from the findings from Malmstrom and colleagues (1999). Four of these studies have findings that support the null hypothesis, and of these four, three have non-significant findings that support the double jeopardy hypothesis. Indeed one of the five studies has significant findings that support the double jeopardy hypothesis (Kobetz *et al.*, 2003).

As they differ substantially to the findings from the mortality studies, it is important to explore why four of the studies on self-rated health indicate or significantly corroborate the double jeopardy hypothesis (Stafford *et al.*, 2001, Kobetz *et al.*, 2003, Stafford and Marmot, 2003, Hou and Myles, 2005). Summarising these studies:

- Kobetz and colleagues (2003) found that in a sample of women from North Carolina, those in poverty were most likely to report poor self-rated health, particularly when living in impoverished neighbourhoods - neighbourhoods where over 20% of the residents earn below the poverty threshold. This study was the only study in this review to exclusively sample from a rural population, therefore the fact that it is the only study to find a significant cross-level interaction effect that supports the double jeopardy hypothesis may be to do with its particular rural context. However, with only one study conducted in such a context, there is no means of comparing other methodological differences.
- Two studies analysed the Whitehall II cohort, which is a sample of civil servants from the UK (Stafford *et al.*, 2001, Stafford and Marmot, 2003). Both analyses found that compared to high grade civil servants, the self-rated health reported by low grade civil servants was more strongly negatively associated with ward deprivation. However, cross-level interaction tests were not significant for either study. As with the study by Kobetz and colleagues (2003), these studies adjusted for additional individual-level socioeconomic characteristics. However, it must be noted that in these studies, wards were grouped into deprivation categories based on the Townsend Deprivation Index, which as discussed earlier in this chapter is primarily composed of indicators of material deprivation, and not the social milieu of areas. Also, in analyses of civil servants, the lowest status individuals are not as poor or unqualified as in analyses of the general population.
- Hou and Myles (2005) found a modest indication that the self-rated health of the lowest income group from a sample living in Canada was more strongly associated with the census tract median income than the self-rated health of the highest income group. As with the analyses of the Whitehall II cohort, tests for the cross-level interaction effect were not significant.

From five studies of self-rated health above, apart from one study by Wight and colleagues (2008), there is some support for the double jeopardy hypothesis, although only one of the cross-level interaction tests proved significant. These findings do not closely reflect the findings from the mortality studies. As such, one may conclude that the health mechanisms that result in low status individuals having higher mortality rates in high status neighbourhoods compared to low status neighbourhoods, may be different to those that affect the way in which low status individuals self-rate their health. However, such a conclusion cannot be made due to the heterogeneity of the studies of self-rated health, and also because of the lack of clarity as to the actual components of neighbourhood status that interact with individual socioeconomic status in these studies. As described in the discussion of mortality studies, three of the investigations considered different categorisations of neighbourhood status (Yen and Kaplan, 1999, Veugelers *et al.*, 2001, Roos *et al.*, 2004). Analyses which most closely captured the social milieu of neighbourhoods had findings that supported the relative status hypothesis, whereas analyses which more closely described the material deprivation of neighbourhoods did not, and in one study the opposite neighbourhood effect was found (Yen and Kaplan, 1999).

Of the studies on self-rated health, two categorised neighbourhoods based closely on material deprivation, therefore the findings which indicate some support for the double jeopardy hypothesis may delineate a material health mechanism (Stafford *et al.*, 2001, Stafford and Marmot, 2003). Indeed, in one of these studies, further investigation revealed that low grade civil servants living in the most deprived wards were more likely to have financial difficulties, were more likely to report neighbourhood problems, were most dissatisfied with their neighbourhoods and subjectively felt that they were lower in the social hierarchy than any other group (Stafford and Marmot, 2003). What is more, further geographical analysis found that the high grade civil servants living in deprived wards lived in the parts within those wards that were more affluent. As such, the indication of a double jeopardy effect in these analyses may be indicative of compounded material deprivation at the level of the household and the immediate surroundings.

Findings of studies on other physical morbidity outcomes testing for cross-level interaction effects

Fewer studies of other physical morbidity outcomes were included in this review. All but two of these studies had findings that support the null hypothesis. The physical morbidity outcomes analysed by such studies were coronary heart disease (Diez-Roux *et al.*, 1997), low birthweight (Dibben *et al.*, 2006) and waist-to-hip ratio (Stafford and Marmot, 2003). Wight and colleagues (2008) investigated coronary heart disease and cerebro-vascular disease, as well as self-rated health, but after adjustment of individual-level characteristics, they found that apart from self-rated health, all the variation in physical morbidity outcomes across areas were explained by individual-level outcomes.

The one study that did find a significant cross-level interaction effect was of body-mass index (BMI) (Rundle *et al.*, 2008). This study investigated a sample from New York City. In this study, the disparity in BMI by education (men and women) and income (women only) was greater in zip codes with the lowest rates of poverty compared to zip codes with the highest rates of poverty. This finding supports the relative status hypothesis, particularly, the attenuated benefit model. It must be noted however that although the test for cross-level interaction effects adjusted for ethnicity in this study, no other socioeconomic characteristics were adjusted. Nevertheless, a study not included in this review, as it measured only physical activity and no direct health measure, had findings that complement those of this study on BMI (Yen and Kaplan, 1998). On the other hand, no cross-level interaction effects were found in analyses of waist-to-hip ratio by Stafford and Marmot (2003). It remains unclear whether weight-related behaviours may be part of a health mechanism that explains the findings of mortality studies support the relative status hypothesis. However, some of those mortality studies had adjusted for such behaviours and health risks in their analyses and still found significant support for the relative status hypothesis.

The only other study of physical morbidity that was found through the literature search analysed levels of limiting longterm illness across the UK (Shouls *et al.*, 1996). However, this study did not meet the inclusion criteria of this review as the size of areas that it analysed, local authorities, were very large, with hundreds of thousands of residents. As discussed above, studies that find cross-level interaction effects that use such large areas in analyses may be capturing an entirely different effect that is not related to the interaction between residents in neighbourhoods, or the experience of residents of their immediate surroundings.

Overall, the findings from the physical morbidity studies do not paint a clear picture. The most evidence derived from this review of physical morbidity outcomes relates to self-rated health, as more studies of this health outcome were found in the literature search than all the other physical morbidity outcomes. These studies had findings that mainly supported the null hypothesis, with some suggestive support for the double jeopardy hypothesis. However, as discussed above, the findings from these studies may differ from the mortality studies partly because of the contextual characteristics that were captured and used to allocate high and low status to neighbourhoods. Alternatively, the reporting of self-rated health may predict both mental and physical health, and so any differences in the way that mental health results from an interaction between contextual and individual indicators of status may be captured by cross-level analyses of self-rated health. To an extent, the findings that support the null or double jeopardy hypotheses from studies of self-rated health are supported by studies of mental health outcomes that were not sought for in this review (McLeod and Edwards, 1995, Ross, 2000, Stafford and Marmot, 2003, Aneshensel *et al.*, 2007). Nevertheless, self-rated health has been shown to be a significant predictor of mortality, therefore it would be expected that some of the health mechanism underpinning the findings from mortality studies would be captured by analyses of this health outcome (Idler and Angel, 1990, Burstrom and Fredlund, 2001). What is more, as discussed earlier in this chapter, mental distress in the form of psychosocial stress is hypothesised to be involved in the pathway to poor health in high status neighbourhoods, under the relative status hypothesis.

Gaps in Current Research

As discussed above, conclusions cannot be reached about the most likely model, nor the most likely mechanisms that link health to status incongruity in the neighbourhood. The heterogeneity of study methodologies, findings, and health outcomes limit the synthesis of the observations from mortality studies and physical morbidity studies. Analyses in the following three chapters of this thesis are conducted with a view to clarifying some of the uncertainties uncovered in this review, in the context of England. Uncertainties from the review are perhaps due to the fact that most studies were not conducted with the primary aim of conducting cross-level interaction effects. As such issues arise from methodological limitations as well as a lack of investigation into the potential health mechanisms.

Limitations of methods

1) There was a lack of adjustment for socioeconomic characteristics in many studies. As discussed above, under-adjustment has implications for the interpretation of findings.

2) There was a reliance on using contextual measures of material deprivation, predominantly derived from the lowest status groups within areas, in the creation of neighbourhood status categories. As discussed earlier in this chapter, such measures do not closely capture the social milieu of neighbourhoods. As such, the potential positive effects of socioeconomic density for low status individuals is unlikely to be captured by many of the studies.

3) Studies were focused on urban settings. Only one study exclusively sampled from rural settings. However, considering the heterogeneity of findings and methods despite the urban focus of studies, it would be helpful to conduct more urban-focused studies to increase the information that has already been acquired. To an extent, the hypotheses discussed above relating to the positive aspects of low status neighbourhoods, may be more relevant to settings where contact between neighbourhoods is most prevalent. This may be the case where population density is highest, such as in urban environments.

4) Most studies did not report the distribution of socioeconomic groups across neighbourhood types. Such distributions can affect the significance of findings. For example, low status individuals are likely to be concentrated in low status neighbourhoods and sparsely distributed across high status neighbourhoods. Small numbers in high status neighbourhoods may prevent the identification of significant neighbourhood effects.

5) Many studies that used multilevel methods did not report how the variation in outcomes differed between neighbourhoods and within neighbourhoods. As such, the importance of neighbourhood effects relative to individual-level effects were often not clear.

6) None of these studies took account of how long residents had lived in their specific neighbourhoods, nor whether the status of their neighbourhoods had remained stable throughout their exposure to such contexts. For studies that seek to test for cross-level

interaction effects, the selection of datasets may not allow for such longitudinal contextual exposure to be taken into account, not just because of a lack of measurement, but also because of the inevitable reduction in power with further specification of relevant samples.

Unclear health mechanisms to explain cross-level interaction effects

1) As well as being a methodological issue, the reliance on using contextual measures of material deprivation has implications for interpreting cross-level interaction effects. The most informative studies on this issue conducted analyses using different categorisations of neighbourhood types (Yen and Kaplan, 1999, Veugelers *et al.*, 2001, Roos *et al.*, 2004). Cross-level interaction effects detected by analyses based on material deprivation may be due to material health mechanisms, whereas those detected by analyses based on the social milieu of a neighbourhood, such as the socioeconomic density of different socioeconomic groups, may be due to psychosocial health mechanisms discussed earlier in this chapter.

2) Most of the studies in this review did not test for contextual or household characteristics that may mediate any significant cross-level interaction effects. However, some studies that found cross-level interaction effects and adjusted for characteristics such as health behaviours and associated health risks did not find that such characteristics fully explained their findings (Yen and Kaplan, 1999, Veugelers *et al.*, 2001, Roos *et al.*, 2004, Winkleby *et al.*, 2006). Nevertheless, most of these studies did not report unadjusted analyses, therefore whether mediation was taking place could not be ascertained (Diez-Roux *et al.*, 1997, Davey Smith *et al.*, 1998, Wight *et al.*, 2008).

3) None of the studies reviewed here considered the immediate social environments of low status people living in high status neighbourhoods. One general assumption may be that these individuals, who live in neighbourhoods that are composed predominantly of people belonging to socioeconomic groups that are of higher status than themselves, are isolated in a socioeconomic sense. Such an assumption would mean that the immediate neighbours living on the same street as these low status individuals are of higher status than themselves. However, as was partly alluded to by further investigations by Stafford and Marmot (2003), low status residents of high status neighbourhoods may in fact live

in the most deprived parts of such neighbourhoods. If this were the case, the immediate neighbours living on the same street as these low status individuals are likely to be of a similar status to themselves. In other words, instead of being socioeconomically isolated, low status residents of high status neighbourhoods may be segregated into poor enclaves within these neighbourhoods. The psychosocial, material and cultural health mechanisms are likely to have some differences depending on which of these two situations are experienced by low status residents of high status neighbourhoods.

This review in itself has limitations. Studies of mental health outcomes or health behaviours were not included to minimise heterogeneity of included studies. This, and the fact that only literature published in the English language was searched, may have limited the number of studies that met the inclusion criteria for this review.

Chapter Conclusions

In summary, 25 studies were included in this review. Twelve of these were studies of mortality, and 13 were studies of various physical morbidity outcomes. A tentative conclusion is that low status individuals who live in high status neighbourhoods do not necessarily benefit, as might be expected from the previous research on contextual effects discussed earlier in this chapter (Pickett and Pearl, 2001, Riva *et al.*, 2007).

The studies of mortality showed this most clearly, in that almost half of them found that low status individuals actually have higher mortality rates in high status neighbourhoods. In the terminology of this review, such findings were said to support the net disadvantage model of the relative status hypothesis. The studies of physical morbidity, where self-rated health was the most frequently analysed outcome, did not support the same hypothesis. Although not significant, the majority of these studies on self-rated health had findings supporting the opposing hypothesis - double jeopardy.

Nevertheless the methodological differences among studies and the limitations in analyses for delineating health mechanisms, necessitate that findings are interpreted cautiously. Having identified the major concerns and gaps in the literature, listed in the final discussion of this review, the empirical analyses that are presented in the next three chapters of this thesis will:

1) Analyse cross-level interaction effects on physical morbidity outcomes, as the review was less conclusive about such outcomes, because of heterogeneity in the choice of health outcomes studied (Chapter 3).
2) Investigate psychosocial factors as potential mediators that are related to the hypotheses set out at the end of Chapter 1 (Chapter 4).
3) Conduct analyses that specifically investigate the experience of low status residents in high status neighbourhoods who live in segregated low status enclaves within such neighbourhoods (Chapter 5).

3

Health and Behaviours across Neighbourhood Types by Individual Status

- **Aim of this chapter**
  The aim of this chapter is to find whether, in England, low status individuals experience better health and have healthier behaviours when they live in low status neighbourhoods, where they are amongst socioeconomically similar neighbours to themselves, compared to when they live in high status neighbourhoods, where they are socioeconomically incongruous.

In this chapter I analyse health and health behaviours directly. Data from the Millennium Cohort Study is used to determine whether the findings of the review in the last chapter are supported in the context of working age adults living within urban settings in England. Some, but not all, methodological limitations from previous studies are addressed in the analyses.

The findings of this chapter is relevant to answering the thesis question, '*Are poor people healthier in richer areas?*' directly and in a contemporary context in England. They are also important in providing a background for the investigation in the next chapter, where I use the same dataset to analyse psychosocial factors in order to addresses the primary aim of this thesis, which is to contribute to the understanding about the relative importance of psychosocial causes of health.

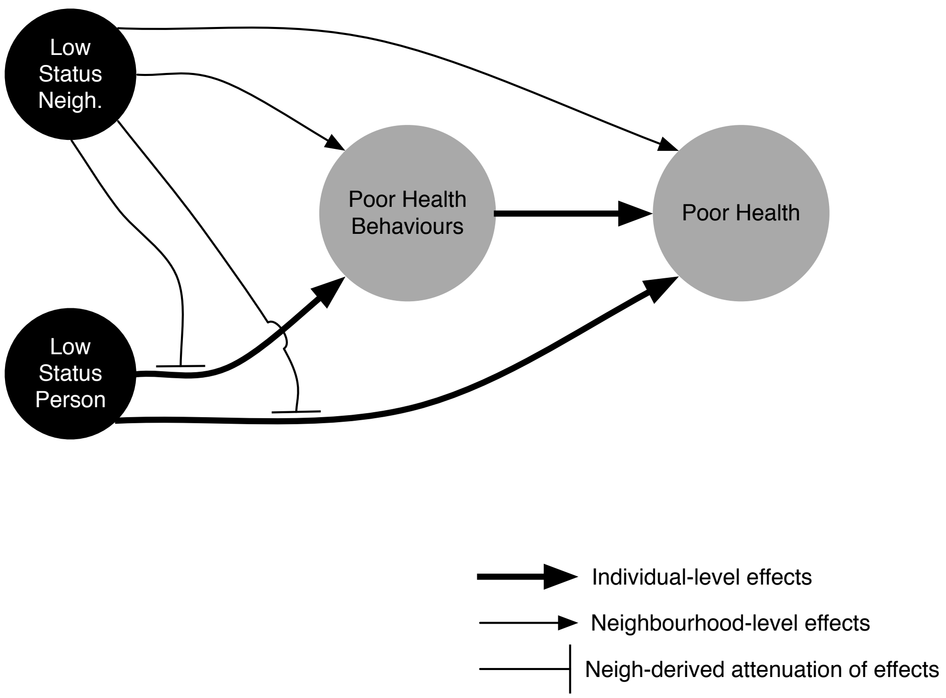
3.1 Background

The hypothesis tested by the analyses in this chapter is as follows:

- Living in high status neighbourhoods has a beneficial effect on the health and health behaviours of high status individuals, and conversely, it has a detrimental (or less beneficial) effect on low status individuals.

The model of health determinants that forms this hypothesis is illustrated in Figure 3.1 below.

Figure 3.1 Model of the detrimental influence on health of low status and how this is attenuated by socioeconomic congruity with the neighbourhood



NB: The detrimental effects of low status at the area-level are depicted by thin arrows. The detrimental effects of low status at the individual-level are depicted by thick arrows. The attenuating effect of living in socioeconomic congruity is depicted by the thin lines with blunt ends. These represent how socioeconomic congruity may dampen the detrimental effects of low status on poor health and poor health behaviours. The factors that may mediate such attenuation or dampening are not depicted in this diagram. These factors, specifically psychosocial (mental and social wellbeing factors), are investigated in Chapter 4.

There are two pathways shown here: one affecting health directly, and another affecting health via health behaviours. The detrimental health effects of having low status as an individual that were discussed in Chapter 1 are depicted here as thick arrows. Living in socioeconomic congruity with the neighbourhood, i.e. being a low status individual in a low status place, is shown in the diagram to attenuate such detrimental effects. On the other hand, low status places are also shown here as having direct detrimental health effects, depicted by the thin arrows. As I have discussed, these antagonistic contextual effects may simultaneously influence health. I have hypothesised the latter detrimental effects to be due to predominantly material causes, and the former beneficial effects to be due to predominantly psychosocial causes through: 1) fewer and less stressful status comparisons; and 2) stress-buffering from more social support (see end of Chapter 1). The overview that the model above provides is that, for low status people, the detrimental health effects of low status neighbourhoods are balanced by their positive effects. In this chapter I only analyse health and behavioural measures. I investigate the psychosocial pathway in the next chapter.

The Millennium Cohort Study

The Millennium Cohort Study (MCS) is the third nationally representative British cohort study. The first, the National Child Development Study, follows people born in England, Scotland and Wales in 1958. The second, the British Cohort Study, follows those born in 1970. The MCS was the first of cohort studies to cover the whole of the UK by including births in Northern Ireland.

The MCS follows people born over a 12-month period from 2000-2001. This is an academic-year cohort, therefore the recruited newborns were born between September 2000 and August 2001, although this was not exactly the case for all of the constituent countries of the UK. Every child that was registered for Child Benefit, which includes almost every child born in the UK, was eligible for inclusion in the study, provided they lived in households within the target electoral wards of the study. The initial sweep entered 18,818 newborns into the cohort. This was the result of a 72% overall response rate. Excluding those who were no longer living in the areas in which they were registered and those who were 'sensitive cases' according to the Department for Work and Pensions, the response rate was up to 82%, known as the 'in-scope' response rate (Dex *et al.*, 2005).

The targeted electoral wards in which recruitment took place were a stratified random selection. Three hundred and ninety-eight electoral wards were categorised into three strata:

- **'Minority ethnic'**: where the population based on the 1991 census were at least 30% 'Black' or 'Asian'.
- **'Other disadvantaged'**: the poorest 25% of electoral wards based on the Child Poverty Index that were not categorised as 'minority ethnic'
- **'Non-disadvantaged'**: all the rest

The minority ethnic and other-disadvantaged strata were over-represented in the random selection so that minority ethnic groups and families in poverty could be over-sampled. Sampling was also additionally boosted in Scotland, Northern Ireland and Wales to allow for statistical power in comparisons between countries within the UK.

There are multiple research intentions behind the creation of the MCS. They include an improvement of understanding of the life course influences on health and and quality of life, including household, family, community and neighbourhood factors. Areas of interest in the study range from the cognitive and behavioural development of children, to the social polarisation of the UK over time, incorporating both social and biological aspects of human development. As a result of such wide-ranging and multidisciplinary roles, survey methods are intensive and lengthy. Data collection is done partly face-to-face with the assistance of a computerised form, and some of it is self-completed by interviewees.

The first data collection sweep of the MCS, which is the focus of this chapter, was conducted when the cohort members were aged approximately 9 months. For the purposes of the analyses in this chapter, the important data from the first sweep were the exposures experienced by the **mother** and the health outcomes measured or reported by the mother. The **exposures of interest** are those due to the socioeconomic characteristics of the household, and the socioeconomic characteristics of the neighbourhood. The **outcomes of interest** are those that indicate subjective physical morbidity and objective physical morbidity. As discussed below, the MCS is an appropriate dataset for both types of data.

Exposure of interest

As the MCS aims to understand the social and economic influences on the development of a child, a wide range of socioeconomic characteristics are collected at the household and parental level. Both the mother and the father (or live-in partner) of the cohort member are asked for their occupation, educational achievement, and employment status, amongst other socioeconomic indicators. Housing tenure, household income and other household-level characteristics are also collected.

Particularly important, however, is that access to residential geographic indicators for cohort members from the very first survey sweep is available, as long as the requirements for a special license are met. This allows every cohort member in the dataset to be linked to their neighbourhood down to the level of an output area, which is an area with a population size that is usually fewer than 600 residents. As I discuss in the methods section which follows, this allows for any neighbourhood characteristics to be measured and analysed as exposures. As such, the neighbourhood social milieu can be tested for health effects without relying solely on routinely available neighbourhood material deprivation indicators.

Outcome of interest

As reported in the last chapter, the studies that investigated potential cross-level interaction effects on physical morbidity outcomes had findings that were neither consistent with the findings from the mortality studies, nor necessarily valid due to methodological limitations. The first sweep of the MCS has data on the physical morbidity of mothers through both subjective and objective measures, therefore an assessment of the consistency between outcome measures can be made.

Health and Behaviour Outcomes

The outcomes analysed in this chapter can be divided into three types: health behaviours, general health, and birth outcomes. How these data are collected in the MCS, and how they are analysed will be described in the methods section. Here, the relevance they have to health mechanisms in cross-level interaction effects are discussed.

Health behaviours

As illustrated in Figure 3.1 above, health behaviours are hypothesised as intermediate outcomes in one of the pathways to health investigated in the analyses here. Within the MCS, two outcomes of cohort mothers will be analysed: **smoking** and **obesity**. It must be noted that obesity is not a health behaviour in itself, but it is investigated as such here as it is so closely associated with dietary and physical activity-related behaviours.

As discussed in the last chapter, any positive health effects of low status neighbourhoods may have for low status residents are hypothesised to come from minimising psychosocial stress, either through avoiding constant status comparisons with high status individuals, or through increasing social support through higher socioeconomic density (See Section 2.2). In Chapter 1, I discussed how psychosocial stress may affect behaviour, resulting in the adoption and maintenance of poor health behaviours (See Section 1.3).

Currently there is no clear indication in the literature as to whether different health behaviours are affected in the same way by status incongruity. In the review of cross-level interaction effects in the last chapter, two studies that investigated obesity were included (Stafford and Marmot, 2003, Rundle *et al.*, 2008). The two studies had contradictory findings. The study based in New York City, which analysed body mass index (BMI), had findings supporting the relative status hypothesis - that is, the detrimental effect of low status neighbourhoods was attenuated for low status individuals (Rundle *et al.*, 2008). The study based on a sample of British civil servants, which analysed waist-to-hip ratio, had findings supporting the double jeopardy analysis - the detrimental effect of low status neighbourhoods was stronger for low status individuals (Stafford and Marmot, 2003).

General health

Two subjective health outcomes are analysed here, and considered as general health outcomes: **self-rated health** and **limiting longterm illness (LLI)** of mothers. Both health outcomes are commonly used in studies of physical morbidity, therefore the analyses can be compared to such studies. As discussed in the last chapter, self-rated health has been validated as a relatively good predictor of subsequent mortality, and is a reliable measure of general health (Idler and Angel, 1990, Burstrom and Fredlund, 2001). LLI is related to health in a specific way as it relates to the capability to participate in society. However, as the measure is self-reported in the MCS, participants may identify limits based on either the biomedical or social model of health. The former locates limitations within the body, whereas the latter may take the social environment into account. For example, based on the social model, a wheelchair-bound participant may consider themselves disabled or limited only if their neighbourhood or work place does not provide adequate access in the form of lifts or ramps. Nevertheless, the public perception of a LLI is considered to be predominantly based on the biomedical model of health, therefore the measure is likely to be a good measure of general health.

As with health behaviours, the intention of analysing general health is to ultimately test the psychosocial pathway whereby low status neighbourhoods are hypothesised to be beneficial for low status residents. Self-rated health was the most frequently analysed health outcome in the studies of physical morbidity that were included in the review in the last chapter. As discussed in the review, when tested for cross-level interaction effects, the findings of such studies, apart from one (Kobetz *et al.*, 2003), supported the null hypothesis - that is, the detrimental effect of low status neighbourhoods is equally strong for both high and low status residents. One study analysed LLI and found the opposite, that the detrimental effect of low status neighbourhoods is stronger for high status residents (Shouls *et al.*, 1996). However, this latter study analysed local authorities in the UK, which are not conventionally considered neighbourhoods.

Mortality studies in the review had findings contrasting to those of self-rated health. Close to half of the studies of mortality in the review found that the mortality rates of low status residents were actually higher in high status neighbourhoods than low status neighbourhoods (Yen and Kaplan, 1999, Veugelers *et al.*, 2001, Roos *et al.*, 2004, Wen and Christakis, 2005, Winkleby *et al.*, 2006). Considering the distinct difference in the findings from the mortality studies, it is one of the intentions of the analyses in this chapter to explore whether, using a different methodology, general health outcomes may be consistent with such findings.

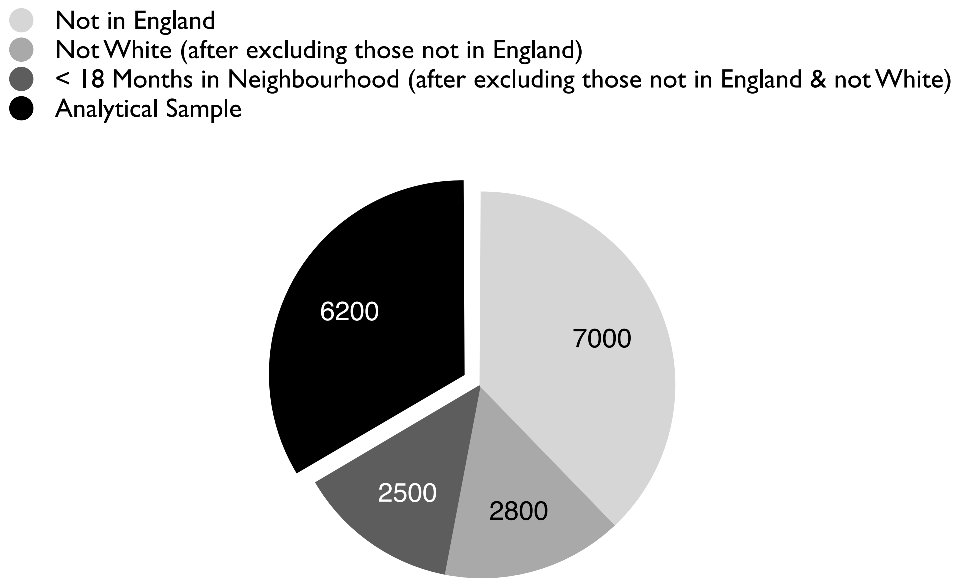
3.2 Methods

The simplest way to find whether low status neighbourhoods may have positive health impacts for low status residents is to estimate the association between neighbourhood status and health for high status individuals, and compare this association to that of low status individuals. As I have discussed, there may be evidence for such positive health impacts if the association between low neighbourhood status and poor health is attenuated or reversed (the attenuated or net disadvantage model of the relative status hypothesis). In this section I detail the methods which will be followed to some extent in the next two chapters.

Sample Selection

The mothers of the MCS cohort members were chosen for analysis. If they had partners, their health was also recorded during interviews by the MCS researchers, however because of the more restricted sample size of the partners, I chose to use only mothers in analyses. Of the approximate total of 18,000 mothers in the MCS, 6,205 were included in the analytical sample. The rationale for restrictions is discussed here and summarised in Figure 3.2 below.

Figure 3.2 Numbers of included and excluded mothers from the full MCS dataset to create the analytical sample



NB: Numbers within slices of the pie chart are rounded to the nearest hundred.

Sample restriction to mothers in England

The hypothesis of this thesis rests on the consequences of interactions between the social environments of neighbourhoods of different status and the residents of different status. The nature of this interaction is likely to be different depending on the wider context within which neighbourhoods are nested within. In order to keep such contexts consistent, I decided that only mothers living in England at the time of interview would be included in the analytical sample. Even within England, the distribution of mothers of different status across neighbourhoods of different status varies considerably by region. This suggests a heterogenous context for the analysis of cross-level interactions. An advantageous corollary of restricting analyses to England is that the categorisation and operationalisation of neighbourhoods is simpler and more comparable, due to standardised area-level data and more homogenous area size provided by the census.

Sample restriction to mothers who are White

The social experience of minority ethnic groups regarding the interaction between neighbourhood status and individual status is likely to differ from that of White people in England (Becares *et al.*, submitted). What is more, any differential effect of low status neighbourhoods that low status minority ethnic groups may experience may be confounded by an effect of ethnic density, instead of socioeconomic density. Ethnic density research has theoretical underpinnings that are parallel to the hypotheses in this thesis on socioeconomic incongruity, in that positive effects may come as a result of the stress-buffering effect of social support and the reduced risk from status comparisons (Pickett and Wilkinson, 2008, Shaw *et al.*, in review). Ethnic density has been investigated using MCS data and other surveys elsewhere (Becares *et al.*, 2009, Pickett *et al.*, 2009a, Stafford *et al.*, 2009). What is more, measures of socioeconomic status may be less appropriate for minority ethnic groups than they are for White people (Karlsen and Nazroo, 2006: 34).

Sample restriction to mothers who have lived in their neighbourhood for more than 18 months prior to the interview

As exposure to the neighbourhood is integral to the investigation into the interaction of residents within the social environment of their neighbourhoods, it is important that mothers in the analytical sample have lived in their neighbourhoods for a significant length of time for neighbourhood effects to be salient. In the MCS, the distribution of the length of time at current address is skewed towards short durations (Bartley *et al.*, 2005). In the first sweep 13% had moved to their address within the last 9 months, since the birth of the baby; and 16% in the previous 18 months, since conception. In order to meet a balance between statistical power for analyses and significant time of exposure to the neighbourhood, a compromise was necessary. As such, mothers that had lived at their address for less than 18 months were excluded. However, as health and behaviour outcomes may develop over periods longer than 18 months, there is an assumption even for these mothers that previous neighbourhoods were similar in social environment to current neighbourhoods. Nevertheless, 42% of the final analytical sample had lived in their current neighbourhood for more than 5 years, with a median of 4 years and 1 month, and a mean of 5 years and 4 months.

Neighbourhood Scale and Categorisation by Status

As discussed in the review in the last chapter, different scales have been used in studies that analyse area effects, from the size of a block to the size of a district and city borough.

Generally, studies that explicitly seek to investigate neighbourhoods in the UK have used wards (Ecob and Jones, 1998, Duncan *et al.*, 1999, Dorling *et al.*, 2000, Stafford and Marmot, 2003). Wards were not used in this study as they differ from each other greatly in population size from 100 to over 30,000. Instead middle-layer super output areas (MSOAs) were used to operationalise neighbourhoods, as they have less variable population sizes.

MSOAs are aggregations of lower-layer super output areas (LSOAs), which are themselves aggregations of output areas (OAs). OAs in turn are aggregations of post codes. OAs are constructed as homogeneously as possible, based on household tenure and dwelling type (detached, semi-detached, etc.). They were also designed to have broadly consistent population sizes, and to encompass wholly urban or rural contexts. Physical boundaries such as major roads were taken into account, and shapes were constrained to be normal so that long thin stretches and isthmuses were avoided. OAs contain a minimum of 40 households and 100 residents, with an aim for over 125 households. The aggregation of OAs to LSOAs was done ensuring homogeneity as with OAs, normalised in size, and restricted to containing above 1,000 residents and 400 households, with an aim of an average of 1,500 residents. The aggregation of LSOAs into MSOAs was a similar process. Again, MSOAs were homogenised in the same way, and were constrained by local authority boundaries, restricted to above 5,000 residents and 2,000 households. Finally, local authorities were consulted and allowed to change boundaries to suit local needs, but still restricted to population & household minimums. The final average size was 7,200 residents[1]. To illustrate how the different scales fit together, I overlaid their boundaries on a map of a part of central London in Figure 3.3 below.

1 http://neighbourhood.statistics.gov.uk/dissemination/Info.do?page=aboutneighbourhood/geography/superoutputareas/soafaq/soa-faq.htm

Figure 3.3 OAs (black boundaries) nested within LSOAs (thin red boundaries) nested within MSOAs (thickest red boundaries) in a residential part of central London

Note: For scale, the width of the map is about 0.8 miles, and the height is about half a mile.

Of particular importance to this thesis is how the status of neighbourhoods is defined. The rationale for this is discussed in detail in the previous chapter. To recapitulate, the status of a neighbourhood that is of interest is that which describes the social milieu of the neighbourhood. Particularly important is a way of capturing the type of person that one would most likely encounter in any given neighbourhood. This is because the the source of positive health impacts of low status neighbourhoods is hypothesised to come predominantly from the status of people one encounters and how that relates to status comparisons and to the formation of supportive social networks. I have discussed these hypotheses in the previous chapter, and elaborate more fully in the next chapter. The ratio of the likelihood of encountering a high status individual over a low status individual is one such measure that captures the relevant aspect of a neighbourhood.

The 2001 UK Census was used to create the neighbourhood status measure. To create the measure based on ratios, status indicators available in the census that have both high and low categories were chosen. These indicators are occupational and educational status, respectively based on the NS-SEC and equivalent-NVQ attainment. It would have been preferable to enrich the index by including income information. Casweb provides area income estimates generated by Experian, but they are point estimates for areas, therefore high and low status groups could not be created with this income indicator. The creation of the occupational and educational ratios was as follows:

- **Creation of the occupational ratio**

  In the case of occupational status, each resident was given the same status as the household representative person (HRP) under pensionable age in the census. The HRP was allocated by ordering household members first by economic activity, then age, then order on the census survey. Other methods for assigning status could be per individual independent of the HRP, or per household based on the HRP. The limitation with the former is that household members that do not work and live with partners in high status occupations would likely be assigned an unemployed status. However, they may be more accurately assigned a higher status based on their own status perception and consumption. The limitation with the latter is that it does not take into account the number of people within each household. This may inaccurately capture the true social composition of an area that is relevant to inter-personal encounter. For these reasons, for occupational status, all household members were categorised according to the HRP.

  To create the ratios, a balance had to be met between contrasting distinct high and low status groups, and including a large proportion of the population in generating the statistic. The more distinct high and low status groups are made the fewer and more extreme are the residents in the measure. The NS-SEC scale, used for creating the occupational ratio, can be divided into a clear hierarchy of three groups (see Box A1.1 in the Appendix for details of NS-SEC scale).

  - **Managerial and Professional**: NS-SEC 1 & 2
  - **Intermediate**: NS-SEC 3 & 4
  - **Routine and Manual**: NS-SEC 5, 6 & 7

  These three groups have been frequently used as distinct socioeconomic status categories (Shaw *et al.*, 2007). The occupational ratio in this study was created by dividing the number in the 'Managerial and Professional' group, by the number in the 'Routine and Manual' group based on the HRP in the neighbourhood.

- **Creation of the educational ratio**

  The educational ratio was created using the maximum qualification equivalent to NVQs attained by all residents aged between 16 and 74, inclusively. There are 5 levels, which categorise equivalent academic and vocational qualifications. Educational status does not have the same difficulties as occupational status regarding single-employed couples, and so categorisation is per individual, independent of the HRP. Categorisation is as follows:

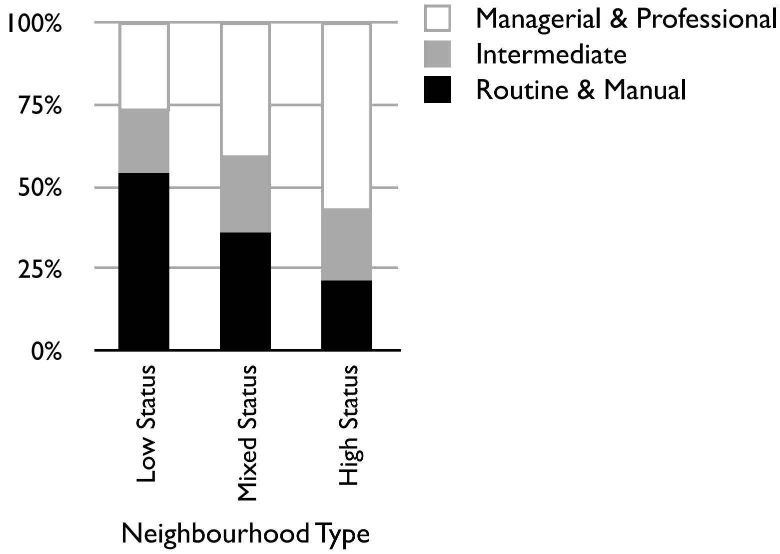
  - **Beyond Secondary Education**: Equivalent of 2 A-levels or more.
  - **Educated up to Secondary Education**: Educated up to an equivalent of 1 A-level.
  - **Not Qualified**: No educational qualifications.

  To create the educational ratio, the numbers of individuals in the 'Beyond Secondary Education' group were divided over the number in the 'Not Qualified' group in the neighbourhood.

The educational and occupational ratios were subsequently logged in order that the distribution of ratios across neighbourhoods in England could be inspected graphically. Based on either of the logged ratios, neighbourhoods across England were approximately normally distributed. The logged ratios were then standardised by z-scores, and the mean of the two z-scores for each neighbourhood is the statistic used here as the '**Neighbourhood Status Score**'. A high status neighbourhood has a high score, and vice-versa. The z-scores for occupational and educational ratios were highly significantly correlated with each other, and the resulting distribution of the neighbourhood status scores across neighbourhoods in England is normal.

Finally, neighbourhoods across England could be divided into three types by splitting them into tertiles based on the neighbourhood status score. The social milieu within each of these neighbourhood types are summarised in Figures 3.4 and 3.5 below.

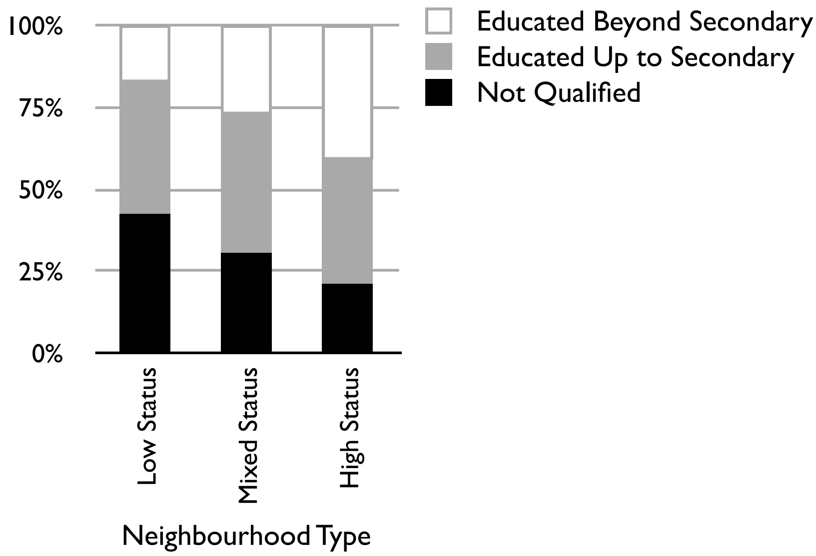
Figure 3.4 Social Milieu in Different Neighbourhood Types based on Median Percentage of Residents in Neighbourhood in Different Occupational Classes*



NB: Median proportions for each neighbourhood type are relative to each other, therefore cumulative sums are 100%. However, unemployed and unclassified residents are not included.

* Occupational Classes are based on the Household Representative Person.

Figure 3.5 Social Milieu in Different Neighbourhood Types based on Median Percentage of Residents in Neighbourhood with Different Educational Achievements



NB: Median proportions for each neighbourhood type are relative to each other, therefore cumulative sums are 100%. However, residents with overseas or unknown qualifications are not included.

Categorising Mothers

The categorisation of mothers into status groups is conducted using the same basis for creating neighbourhood types. In this way, using both measures, the interaction between neighbourhood type and individual status can capture the most conceptually appropriate status contrast or correspondence. To clarify this point, consider a low status mother living in a low status neighbourhood. Taking into account the average social milieu of a low status neighbourhood based on the measure created above, the low status mother should, on average, live amongst twice as many routine or manual workers than managers or professionals (based on HRP), and over twice as many unqualified people than those with education beyond secondary school. If the low status mother was identified as 'low status' based on her income, it would not be certain exactly how similar she is to the majority of the residents in the low status neighbourhood. However, if her low status was based on her occupation and education, her similarity to the neighbourhood population would be clearer. Any findings based on the latter method of allocating status to mothers would more clearly be applicable for testing the hypotheses of this thesis. This is because these hypotheses are based on status comparisons and social support through socioeconomic density. As such, the categorisation of mothers into status groups for the analyses here is based on the occupational class of their household and their educational achievement.

Categorisation of the analytical sample of mothers based on household occupational class and educational achievement followed a simple method of overlapping the two categories. Five distinct groups were created so that categorisation could be defined relatively narrowly. Creating narrowly defined status groups is important in analyses of cross-level interaction effects as it minimises residual confounding that may occur through unmeasured socioeconomic indicators (See Chapter 2 for a discussion of the implications of unmeasured socioeconomic indicators on interpreting the findings of cross-level interaction analyses). The status groups are summarised in Table 3.1 below.

Table 3.1 Status Groups of Mothers based on Overlap of Occupational Class and Educational Achievement

Occupational Class (The highest occupational class between mother and partner, if not a single mother, based on the NS-SEC)	**Educational Achievement** (The mother's own educational achievement based on qualifications equivalent to NVQ)	**Status Group of Mother**	**Number in MCS** (% from a total of 18,505)	**Number in analytical sample** (% from a total of 6,205)
Managerial or Professional (NS-SEC 1 & 2)	Degree Level and Above (NVQ 4 - 5)	Highest Status	4,096 (22%)	1,669 (27%)
	2 or more A-levels and Below, including Access to Higher Education Courses (None to NVQ 3 & Overseas)	High Status	3,018 (16%)	1,326 (21%)
Intermediate (NS-SEC 3 & 4)	Any Education	Mid Status	3,601 (19%)	1,243 (20%)
Routine and Manual or Not Applicable (NS-SEC 5, 6 & 7 and N/A)	5 GCSE passes and Above (NVQ 2 - 5)	Low Status	3,928 (21%)	1,079 (17%)
	4 GCSE passes and Below (None to NVQ 1 & Overseas)	Lowest Status	3,862 (21%)	888 (14%)

Importantly, for it to be possible for analyses to find any potential neighbourhood effects for any of the status groups of mothers, there must be sufficient numbers of each category in each neighbourhood type. This information is often omitted in published studies that have tested for cross-level interaction effects, such as those reviewed in the last chapter. A lack of power for some strata may account for the lack of significant cross-level interaction effects, should there be such effects. Table 3.2 below presents the distribution of each of the status groups of mothers in the analytical sample, across the three different neighbourhood types that were defined above. From this table, it can be seen that there are only 62 mothers who are in the lowest status group and live in high status categories. Weak neighbourhood effects may be masked by the small sample size if the variability by individual-level factors, and individual-level random effects, is large. This issue is discussed towards the end of this chapter.

Table 3.2 The distribution of each status group across neighbourhood types

Status of Mother	**Low Status Neighbourhoods** (% within status group in neighbourhood type)	**Mixed Status Neighbourhoods** (% within status group in neighbourhood type)	**High Status Neighbourhoods** (% within status group in neighbourhood type)
Highest Status	334 (20%)	509 (31%)	826 (49%)
High Status	487 (37%)	474 (36%)	365 (28%)
Mid Status	598 (48%)	415 (33%)	230 (19%)
Low Status	660 (61%)	290 (27%)	129 (12%)
Lowest Status	602 (68%)	224 (25%)	62 (7%)

Analytical Strategy

Statistical testing in this chapter uses multilevel methods. Applying these methods takes into account the potential for clustering of outcomes within neighbourhood to bias results of analyses. However, of particular value for interpretation of the findings is the ability to measure how much of the total variation in outcomes across mothers can be attributed specifically to differences between neighbourhoods. This way, the importance of any effects of neighbourhood status can be quantified relative to differences between mothers within neighbourhoods. This also allows for quantifying how much variation due to neighbourhoods is explained by the status of neighbourhoods by measuring how much residual variation between neighbourhoods remains after taking neighbourhood status into account.

All statistical tests here model health and behavioural outcomes as binary variables, therefore multilevel logistic regression is employed. As such, the results in tables are shown as odds ratios. This allows comparability across analyses of the different health outcomes. The coding of the health and behavioural outcomes is detailed in Box 3.1 at the end of this methods section. What follows is a description as to how the analyses are presented in the results section.

There are two major methods of analysis used in order to test for cross-level interaction effects for each health or behavioural outcome as systematically and clearly as possible. The first method is a stratified regression analysis. The second is a regression analysis with cross-level interaction terms. These are explained below.

Stratified Multilevel Logistic Regression Analyses

This first method analyses two sub-samples taken from the full analytical sample separately - the highest status group, and the lowest status group of mothers. This closely resembles the summary of this chapter's analyses in Figure 3.2 at the beginning of the methods section. For each health and behavioural variable, the odds of a poor outcome in both mixed status neighbourhoods and high status neighbourhoods are reported as odds ratios relative to a low status neighbourhood. As well as being stratified between the highest and lowest status mothers, these analyses are adjusted for the following sociodemographic controls:

- being younger than 30 years of age
- not being married
- being classified as living in relative poverty, based on having an equivalised household income less than 60% of the country's median
- living in social housing

The importance of sociodemographic control was discussed in Chapter 2. Binary sociodemographic variables are used in these analyses so that presentation of information is clear and straightforward.

Full Multilevel Logistic Regression Analyses of Whole Analytical Sample

This second method analyses the entire analytical sample, and includes cross-level interaction terms between neighbourhood status and mother's status. Instead of a categorical measure of neighbourhood status, the continuous neighbourhood status score is used in this analysis. Also, adjustments in these analyses use expanded sociodemographic controls:

- age as a continuous variable
- not being married
- quintiles of equivalised household income
- housing tenure (owner, private renter, social housing renter, or other)

The tables for these analyses are not shown as with four dependent variables to analyse the presentation of tables would be overly extensive. Findings are reported in text, and where there is an indication of cross-level interaction effects, figures are presented with predicted probabilities plotted against the neighbourhood status score.

Box 3.1 Coding of Binary Health Outcomes:

Health Behaviours

Smoking Status: Current smoking status (9 months after pregnancy) self-reported by mothers

Obesity: Self-reported weight 9 months after pregnancy and self-reported height were used to calculate body mass index (BMI, kg/m^2). BMI over or equal to 30 qualifies as obese.

General Health

Low Self-Rated Health: The following question was asked in interviews: *"How would you describe your health generally?"* Mothers who answered *'fair'* or *'poor'* as opposed to *'excellent'* or *'good'* were classified as having low self-rated health.

Limiting Longterm Illness: Mothers who answered *'Yes'* to the following two questions were classified as having a limiting longterm illness: 1) Do you have a *"longstanding illness, disability or infirmity... that has troubled you over a period of time or that is likely to affect you over a period of time?"* and 2) Does it *"limit your activities in any ways?"*

3.3 Results

There was a lot of information produced by the multiple analyses of the six different health outcomes. This information can be presented in a multitude of ways. Here, they are presented in as clear a way as possible by showing what is necessary for interpretation and using figures when possible. Further tables may be referred to in the Appendices.

After a description of the differences in sociodemographic characteristics across neighbourhood types by mothers' status groups, the statistical analyses of each type of health outcome at a time (i.e. health behaviours and general health) are presented in the following way:

1) Unadjusted differences in rates of the outcome across the three neighbourhood types presented as a figure. Rates are stratified by mothers status groups. The patterns across neighbourhood types, by status groups, are discussed in text.

2) The results of stratified multilevel regression analyses are presented in tables. For each outcome, three statistical models are presented for the highest status group, and then the lowest status group. The first is the ***empty*** model, which is presented to show the intra-class correlation coefficient (ICC) before taking any factors into account. The ICC is the proportion of the total residual variance in the outcome that is attributed to differences between areas. The second model is the ***controls*** model, which is presented to show which sociodemographic controls are significantly associated with the outcome within each of the two subsamples. The third model contains ***all*** of the explanatory factors, which includes the sociodemographic controls and the neighbourhood type. This is presented to show, firstly, whether the neighbourhood type is a significant predictor of the outcome, and secondly, how much neighbourhood-related residual variation is left after taking into account the neighbourhood type.

3) The results of the full multilevel logistic regression of the full analytical sample are not presented as tables in this section to minimise detail, although such tables are included in the appendices. Instead, figures are presented. These figures resemble those that depict the unadjusted differences in rates, but instead of rates, the probability of the

outcome is predicted from the model and plotted against the neighbourhood status with a linear fit each status group. Note that in these figures, two grey vertical lines are drawn to indicate divisions between low, mixed and high status neighbourhoods. These figures are for illustrative purposes to visualise differential effects of neighbourhood status by mothers' status group. Significant cross-level interaction terms are indicated by stars (* = $p < 0.05$, ** = $p < 0.01$), and those which are of borderline significance are indicated by a cross († = $p < 0.1$).

Overall, the four outcomes are: 1) described; 2) analysed for neighbourhood status associations amongst the highest and lowest status groups of mothers; then 3) formally tested for cross-level interaction effects. All figures are designed to be similar to Figure 2.3 so that the patterns may be compared visually with the hypothesised variations described in Chapter 2 (see Section 2.3). Clarity and consistency is maintained by depicting the lowest/ low status groups of mothers with dashed lines, the highest/high status groups of mothers with solid lines, and the mid status groups of mothers with dotted/short-dashed lines.

Sociodemographic Differences within Status Groups of Mothers

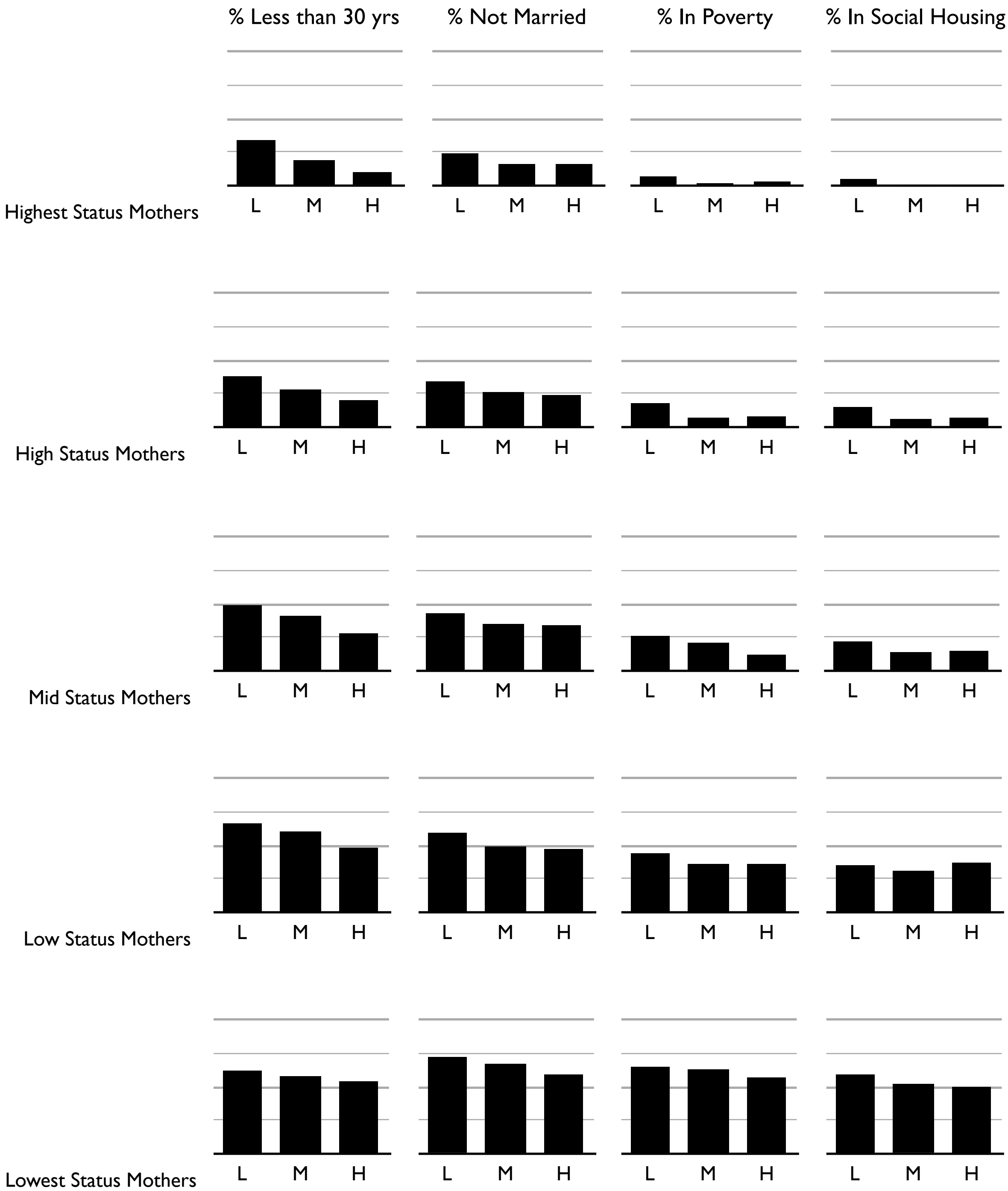
Figure 3.6 below is a descriptive summary of the sociodemographic differences by neighbourhood type within status groups of mothers. Because there are two dimensions to take into account - the neighbourhood type and the status of mothers - and because there are four different sociodemographic characteristics to take into account, a graphical approach is used so that general patterns can be observed.

From the figure, it can be seen that despite the categorisation of the mothers in the analytical sample into five narrowly defined status groups based on occupational class and educational achievement, there are considerable sociodemographic differences by neighbourhood type within status groups. For every mothers' status group, compared to mothers who live in high status neighbourhoods, a higher proportion of mothers living in low status groups are younger than 30, not married, in poverty[1], and accommodated in

1 equivalised household income less than 60% of the population median

social housing. Note that this is the case even within status groups, although the overall proportions with these characteristics are higher in lower status groups.

Figure 3.6 Sociodemographic Differences by Neighbourhood Type (Low Status, 'L'; Mixed Status, 'M'; and High Status, 'H'), Stratified by Status Groups of Mothers



NB: 'L' = Low Status Neighbourhood. 'M' = Mixed Status Neighbourhood. 'H' = High Status Neighbourhood. The y-axis of the charts range from 0% to 100%, with horizontal lines for every 25%.

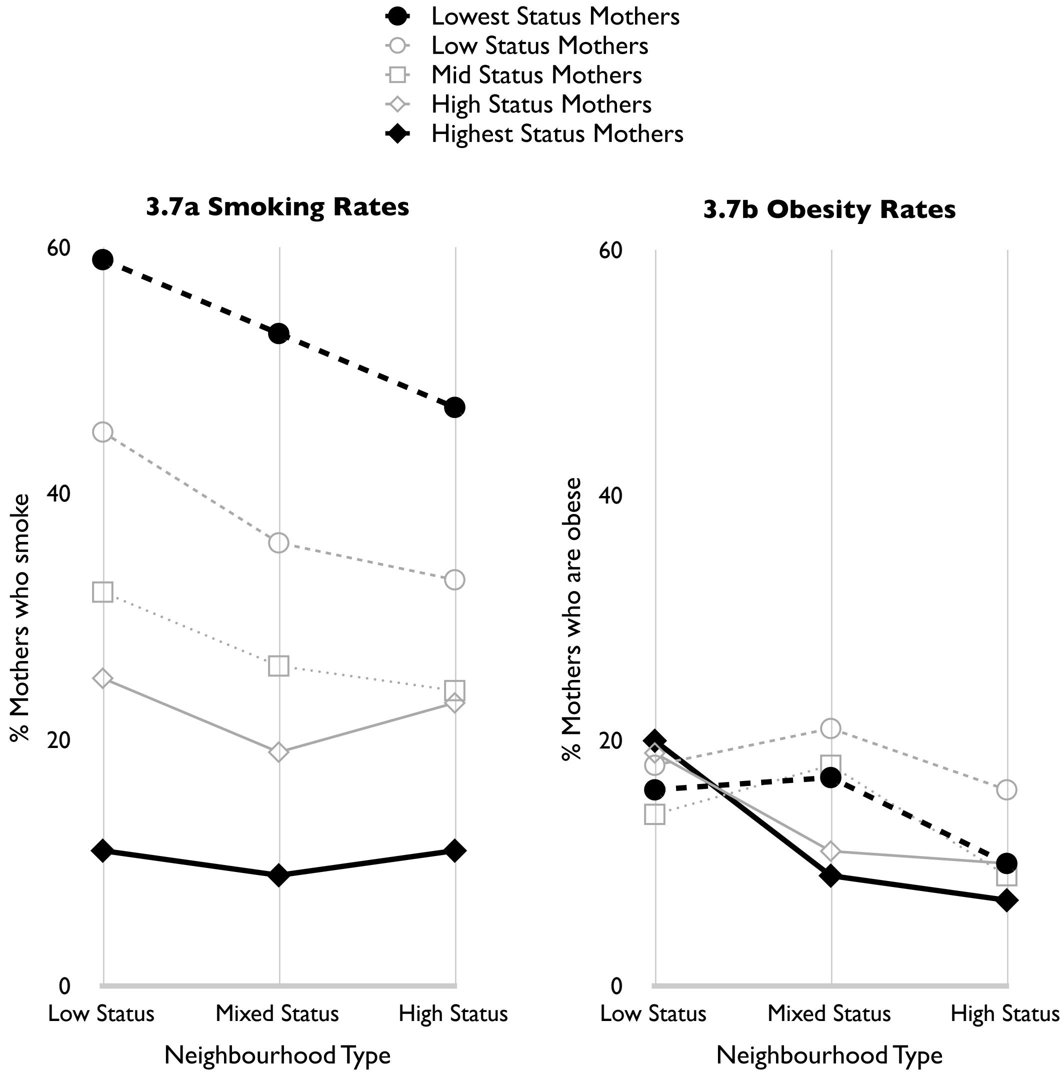
These observations confirm that statistical adjustment is necessary to ensure that any associations between neighbourhood status and health or behavioural outcomes are not due to these sociodemographic differences. Under-adjustment of analyses, especially in the case of testing for cross-level interaction effects between neighbourhood and individual status, have implications for the interpretations of findings, as discussed in previous chapters.

Health Behaviours

From Figure 3.7a, it can be clearly observed that the rates of **smoking** differ by mothers' status. The lowest status group has the highest rates of smoking, indicated by the thick black dashed line. The highest status group has the lowest rates of smoking, indicated by the thick black solid line. Within status groups, there appears to be very little difference in smoking rates across neighbourhood types. There is some suggestion that high status neighbourhoods are associated with lower smoking rates, which is more pronounced in lower status groups, compared to higher status groups. Such a pattern is an indication of support for the double jeopardy hypothesis, whereby low status individuals are more strongly negatively affected by low neighbourhood status.

The rates of **obesity** between status groups, shown in Figure 3.7b, are not as clearly differentiated between status groups. The highest overall rate is for the low status group (not the lowest status group), where 19% of mothers are obese. The lowest overall rate is for the highest status group. Within all status groups, a smaller proportion of mothers are obese in high status neighbourhoods compared to low status neighbourhoods. However, for the mid, low, and lowest status groups, obesity rates are highest in mixed status neighbourhoods. The comparison between the difference in obesity rates between the highest and lowest status mothers indicate support for the relative status hypothesis. As with the observations from smoking rates, these patterns in obesity may be confounded, therefore are analysed using regression analyses below.

Figure 3.7 Percentage of mothers who smoke and percentage of mothers who are obese, by neighbourhood type, stratified by status groups of mothers



NB: These percentages are not adjusted for any factors. Overall 28% of mothers smoke (of 6,205) and 14% of mothers are obese (of 5,801).

Smoking: Multilevel logistic regression analyses

Amongst the highest status mothers, 4.1% of the total variation in the odds of smoking was due to differences between neighbourhoods (see Table 3.3). Adjusting for sociodemographic controls, only 2.9% of that variation remained. In this status group, those in social housing, or not married, or who were less than 30 years old, had an increased odds of smoking. After these adjustments, the neighbourhood status was not a significant factor. These findings confirm the observation from Figure 3.7a that there is almost no observable difference in smoking rates across neighbourhood types for the highest status mothers.

As with the highest status mothers, the lowest status mothers who were living in social housing and who were not married had higher odds of smoking. Amongst this status group, none of the variation in the odds of smoking was due to differences between areas (see Table 3.3). As such, the lower smoking rates amongst the lowest status mothers in high status neighbourhoods observed in Figure 3.7a are masked by the high general variation in smoking.

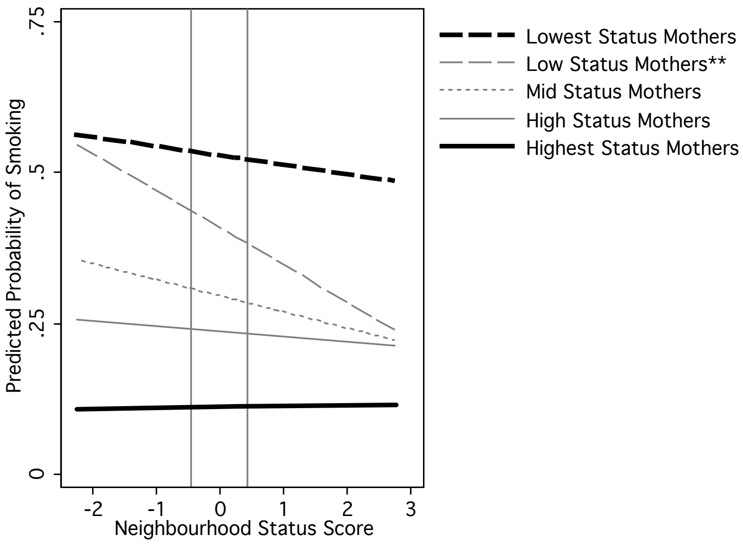
Following the stratified analyses, I conducted the full analysis which used a continuous measure of the neighbourhood status, included further categories of the sociodemographic controls for finer adjustment, and included the full analytical sample with cross-level interaction terms between the continuous neighbourhood status score and the mothers' status groups. The results of this analysis are illustrated in Figure 3.8. This figure illustrates a similar pattern to that in Figure 3.7a. However in Figure 3.8 the lines are based on the estimated probabilities of smoking as predicted by the fully adjusted model. The results of the regression include a significant cross-level interaction term, which specifically indicates that the association between the odds of smoking and the neighbourhood status score is significantly different for low status mothers compared to the highest status mothers. As such, the indication of support for the **double jeopardy hypothesis** from the unadjusted pattern of smoking rates in Figure 3.8a is strengthened by this significant cross-level interaction term.

Table 3.3 Results of Stratified Analyses of Smoking (Odds Ratios)

	Highest Status Mothers			Lowest Status Mothers		
Included Factors	Empty	Controls	All	Empty	Controls	All
Sociodemographic Controls (relative to contrary)						
< 30 years		1.54*	1.63*		1.22	1.21
Not Married		3.07**	3.10**		2.11**	2.09**
In Poverty		1.17	1.19		1.31	1.30
In Social Housing		3.82**	3.92**		1.53**	1.52**
Neighbourhood Type						
Low Status			1			1
Mixed Status			1.02			0.83
High Status			1.26			0.68
% of total residual variance in smoking due to differences between neighbourhood	4.1%	2.9%	1.2%	0%	0%	0%

NB: The results of three separate multilevel logistic regression analyses are presented here for two specific status groups: the highest status mothers and the lowest status mothers, making a total of six analyses shown as columns. For each analysis, the intra-class correlation coefficient, or the % of variance due to between-neighbourhood differences is presented .

Figure 3.8 Probabilities of smoking predicted from full model§ plotted with linear fit against neighbourhood status score stratified by status groups of mothers



§ Full multilevel logistic regression to predict odds of smoking by continuous neighbourhood status score. Adjusted for status group, age, marital status, household income category, housing tenure. Cross-level interaction terms included between neighbourhood status score and status group of mother.

** Association between neighbourhood status score and odds of smoking for low status mothers is significantly different to that for highest status mothers. Likelihood ratio test indicates that the model which includes cross-level interaction terms is a better fit of the data ($p < 0.05$).

NB: Of the 9.2% of variation in smoking due to differences between neighbourhoods in the empty model, only 0.8% remained after including all factors. More details are available in Table A3.1 in the Appendix.

Obesity: Multilevel Logistic Regression Analyses

Amongst the highest status mothers, about 14% of the total variation in the odds of being obese is due to differences between neighbourhood types. Adjusting for sociodemographic controls, nearly 11% of that variation remained. The only sociodemographic factor significantly associated with the odds of obesity for the highest status mothers was being less than 30 years of age. After these adjustments, including the neighbourhood type in the regression reduced the proportion of variation in obesity due to neighbourhood differences to only 2.7%. This indicates that neighbourhood type was an important factor in explaining the differences in the odds of obesity in the highest status mothers. For these mothers, in mixed and high status neighbourhoods the risk of obesity was significantly lower.

Amongst the lowest status mothers, none of the variation in obesity was due to differences between neighbourhoods. As with the highest status mothers, the only sociodemographic factor to significantly associate with the odds of obesity for the lowest status mothers was age. However, the opposite effect is found, in that being 30 or above increases the odds of obesity.

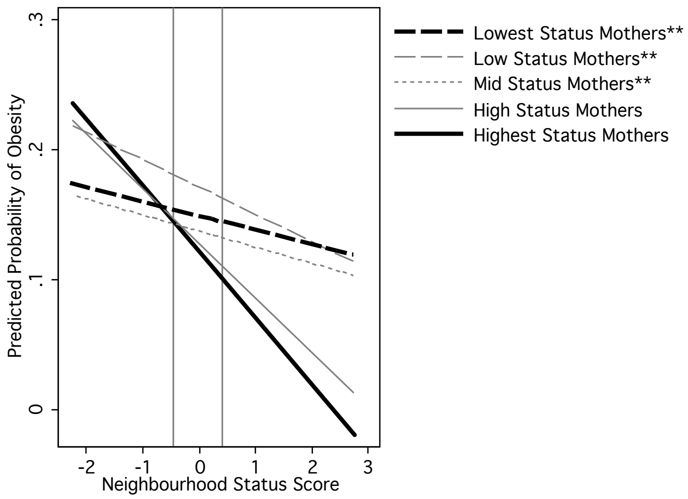
In the full regression analysis the non-significant negative association between the odds of obesity and neighbourhood status for the lowest status mothers is found to be significantly weaker compared to the significant association for the highest status mothers. This is illustrated in Figure 3.9 as a variation in the slopes of the thick dashed line and the thick solid line. Such associations are also found to be significantly different for low and mid status mothers compared to highest status mothers. These significant cross-level interaction terms indicate support for the **relative status hypothesis**, specifically the **zero/attenuated benefit model**. In other words, compared to the highest status mothers, the lowest, low and mid status mothers appear to benefit less from neighbourhood status, in terms of obesity.

Table 3.4 Results of Stratified Analyses of Obesity (Odds Ratios)

	Highest Status Mothers			Lowest Status Mothers		
Included Factors	Empty	Controls	All	Empty	Controls	All
Sociodemographic Controls (relative to contrary)						
< 30 years		1.68*	1.40		0.56**	0.55**
Not Married		1.06	1.01		0.68	0.66
In Poverty		0.70	0.61		0.76	0.75
In Social Housing		1.86	1.54		1.17	1.18
Neighbourhood Type						
Low Status			1			1
Mixed Status			0.40**			1.01
High Status			0.33**			0.50
% of total residual variance in obesity due to differences between neighbourhood	13.8%	10.6%	2.7%	0%	0%	0%

NB: The results of three separate multilevel logistic regression analyses are presented here for two specific status groups: the highest status mothers and the lowest status mothers, making a total of six analyses shown as columns. For each analysis, the intra-class correlation coefficient, or the % of variance due to between-neighbourhood differences is presented.

Figure 3.9 Probabilities of obesity predicted from full model§ plotted with linear fit against neighbourhood status score stratified by status groups of mothers



§ Full multilevel logistic regression to predict odds of obesity by continuous neighbourhood status score. Adjusted for status group, age, marital status, household income category, housing tenure. Cross-level interaction terms included between neighbourhood status score and status group of mother.

** Associations between neighbourhood status score and odds of obesity for the lowest status mothers, low status mothers and mid status mothers are significantly different to that for highest status mothers. Likelihood ratio test indicates that the model which includes cross-level interaction terms is a better fit of the data ($p < 0.01$).

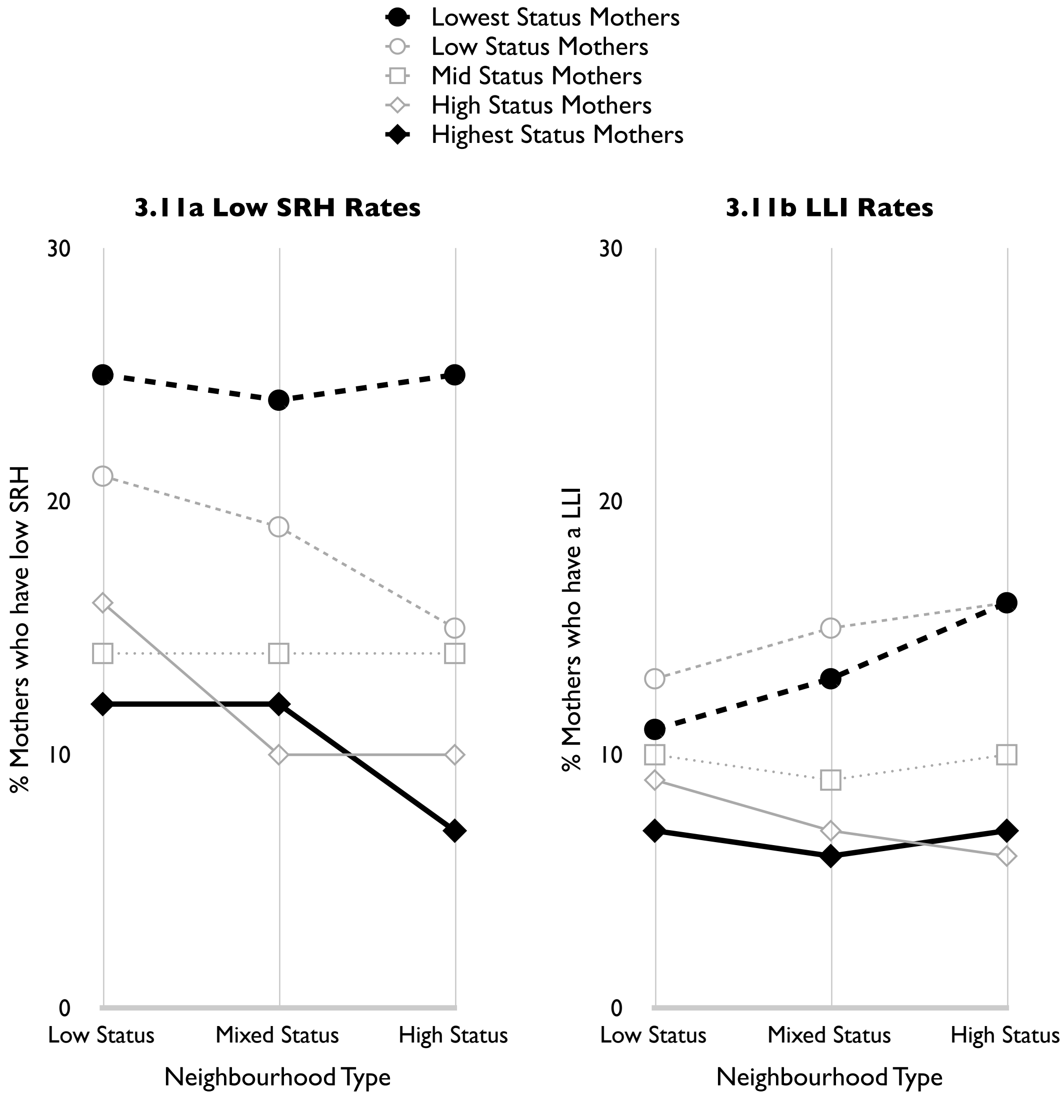
NB: Of the 3.1% of variation in obesity due to differences between neighbourhoods in the empty model, close to 0% remained after including all factors. More details are available in Table A3.2 in the Appendix.

General Health

The highest rates of low self-rated health are amongst the lowest status mothers, as shown in Figure 3.10a. The lowest overall rates of reporting low self-rated health are amongst the highest status mothers. Within status groups there is not a consistent difference across neighbourhood types. About 25% of the the lowest status groups living in any of the three neighbourhood types have low self-rated health. Amongst the highest status groups, 12% living in low or mixed status neighbourhoods have low self-rated health, but this rate is much lower at 7% in high status neighbourhoods. This difference in the pattern across neighbourhood types between the highest and lowest status groups is an indication of support for the relative status hypothesis, particularly the zero benefit model.

Figure 3.10b shows the distribution in **limiting longterm illness** (LLI). The overall rates of LLI in the analytical sample is lower than that of low self-rated health. The differences between status groups are also smaller, and less clear. The highest rates of LLI are amongst the low status mothers, not the lowest status mothers. The lowest overall rate of LLI is that of the highest status group. Comparing the rates of LLI for the highest and lowest status mothers across neighbourhoods types, it appears that there is almost no difference between neighbourhood types for the highest status mothers, whereas there is a higher rate of LLI for the lowest status mothers in higher status neighbourhoods. This contrast indicates support for the relative status hypothesis, as do the findings in rates of low self-rated health. In the case of LLI, there is support for the net disadvantage model.

Figure 3.10 Percentage of mothers who have low self-rated health and percentage of mothers who have a limiting longterm illness, by neighbourhood type, stratified by status groups of mothers



NB: These percentages are not adjusted for any factors. Overall 15% of mothers have low self-rated health (of 6,185) and 12% of mothers have a limiting longterm illness (of 6,204).

Low Self-Rated Health: Multilevel logistic regression analyses

Amongst the highest status group, none of the total variation in the odds of low self-rated health was due to differences between neighbourhoods, as shown in Table 3.5. In this status group none of the sociodemographic controls were associated with the odds of low self-rated health. Despite the fact that almost none of the variation was due to between-neighbourhood differences, the protective effect of high status neighbourhoods that can be observed in Figure 3.10a above is found to be significant. This suggests that the general variation in the odds of low self-rated health between the highest status mothers is so high that neighbourhood-related variation is masked.

Amongst the lowest status group, about 7% of the variation in the odds of low self-rated was due to differences between neighbourhoods. Adjusting for the sociodemographic controls, only being 30 years or older is found to be significantly associated with low self-rated health amongst low status mothers. Unlike for the highest status group, the neighbourhood type is not significantly associated with low self-rated health. None of the neighbourhood-related variation was explained by sociodemographic controls and neighbourhood type.

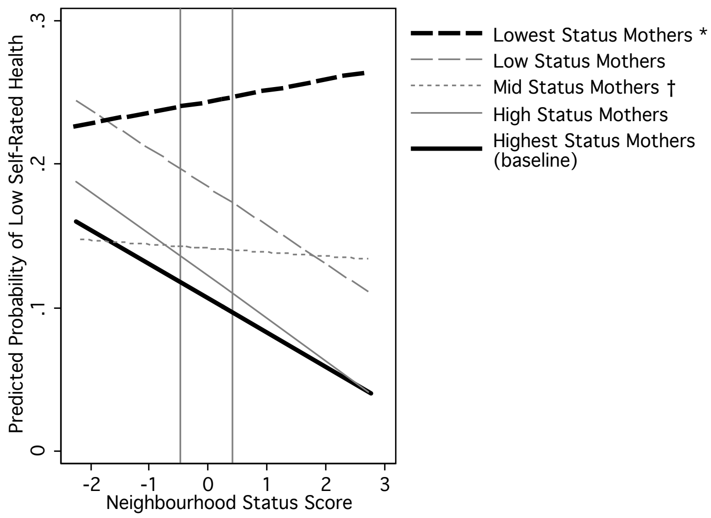
Upon inspection of the full regression model illustrated in Figure 3.11, it can be seen that compared to the highest status mothers, the association between the neighbourhood status score and the odds of low self-rated health is significantly different for the lowest status group. From this figure it appears that high neighbourhood status is associated with low self-rated health for the lowest status mothers. However, as was found in the stratified analysis, this association is not significant, despite it being significantly different to that amongst highest status mothers. Nevertheless, the distinct difference in pattern suggests support for the **zero-benefit model** of the **relative status hypothesis**.

Table 3.5 Results of Stratified Analyses of Low Self-Rated Health (Odds Ratios)

	Highest Status Mothers			Lowest Status Mothers		
Included Factors	Empty	Controls	All	Empty	Controls	All
Sociodemographic Controls (relative to contrary)						
< 30 years		0.89	0.78		0.67*	0.67*
Not Married		1.13	1.12		1.40	1.40
In Poverty		1.96	1.92		0.95	0.95
In Social Housing		1.66	1.55		0.97	0.97
Neighbourhood Type						
Low Status			1			1
Mixed Status			1.03			0.88
High Status			0.57*			0.96
% of total residual variance in low SRH due to differences between neighbourhood	0%	0%	0%	6.9%	7.2%	7.3%

NB: The results of three separate multilevel logistic regression analyses are presented here for two specific status groups: the highest status mothers and the lowest status mothers, making a total of six analyses shown as columns. For each analysis, the intra-class correlation coefficient, or the % of variance due to between-neighbourhood differences is presented.

Figure 3.11 Probabilities of low self-rated health predicted from full model§ plotted with linear fit against neighbourhood status score stratified by status groups of mothers



§ Full multilevel logistic regression to predict odds of low self-rated health by continuous neighbourhood status score. Adjusted for status group, age, marital status, household income category, housing tenure. Cross-level interaction terms included between neighbourhood status score and status group of mother.

* Association between neighbourhood status score and odds of low self-rated health for the lowest status mothers is significantly different to that for highest status mothers. Likelihood ratio test indicates that the model which includes cross-level interaction terms is not a better fit of the data.

NB: Of the 2.7% of variation in low self-rated health due to differences between neighbourhoods in the empty model, close to 0% remained after including all factors. More details are available in Table A3.3 in the Appendix.

Limiting Longterm Illness: Multilevel logistic regression analyses

Unlike low self-rated health, a higher proportion of the variation in the rates of limiting longterm illness (LLI) is due to differences between neighbourhoods. For the highest status group, this variation is 8%, as shown in Table 3.6. After adjustment for sociodemographic factors, this variation is reduced to 5.9%. This is due to the higher odds of LLI for the highest status mothers living in social housing. The explanation of neighbourhood-related variation by social housing suggests between-neighbourhood segregation of social housing that correlates with between-neighbourhood differences in the likelihood of LLI amongst the highest status group. As was indicated by the unadjusted rates of LLI shown in Figure 3.11b above, the neighbourhood type is not significantly associated with LLI for highest status mothers.

Amongst the lowest status mothers, also about 8% of the variation in LLI is due to differences between neighbourhoods. Adjusting for sociodemographic controls in this status group did not reveal any significant associations. There was no significant evidence for an association between neighbourhood type and the odds of LLI for the lowest status group, contrary to the indication of this by the unadjusted rates of LLI for the lowest status group between neighbourhood types in Figure 3.11b.

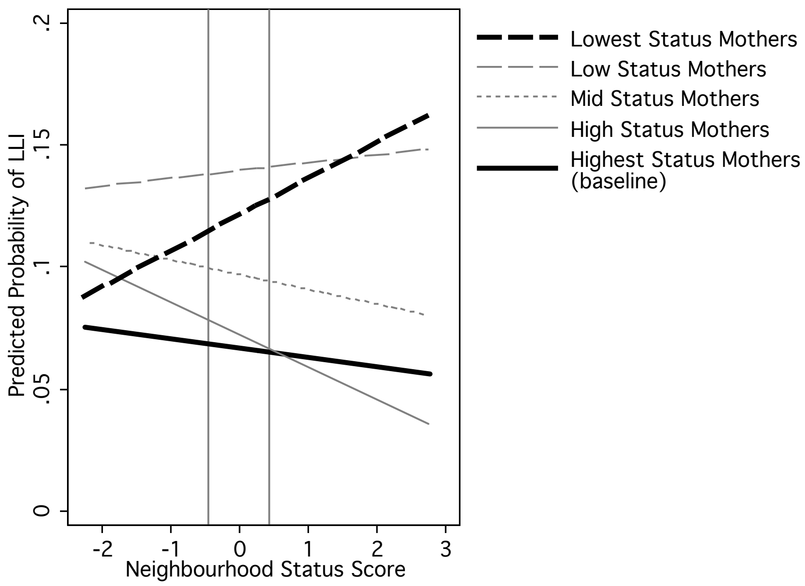
The results of the stratified analyses above show no support for a cross-level interaction effect. This was confirmed in the full regression analysis where none of the interaction terms were significant (Figure 3.12). As such, the differences in the association between the odds of limiting longterm illness and the neighbourhood status score, illustrated as slopes in Figure 3.13, are not statistically significant. There is no support for the null hypothesis whereby the health benefits of high status neighbourhoods are equally experienced, nor is there support for any of the other hypotheses.

Table 3.6 Results of Stratified Analyses of Limiting Longterm Illness (Odds Ratios)

	Highest Status Mothers			Lowest Status Mothers		
Included Factors	Empty	Controls	All	Empty	Controls	All
Sociodemographic Controls (relative to contrary)						
< 30 years		1.27	1.33		1.33	1.34
Not Married		0.92	0.93		0.92	0.93
In Poverty		1.98	2.01		1.15	1.15
In Social Housing		2.76*	2.85*		0.99	1.00
Neighbourhood Type						
Low Status			1			1
Mixed Status			1.08			1.14
High Status			1.23			1.40
% of total residual variance in LLI due to differences between neighbourhood	8.0%	5.9%	6.5%	8.3%	8.9%	8.7%

NB: The results of three separate multilevel logistic regression analyses are presented here for two specific status groups: the highest status mothers and the lowest status mothers, making a total of six analyses shown as columns. For each analysis, the intra-class correlation coefficient, or the % of variance due to between-neighbourhood differences is presented.

Figure 3.12 Probabilities of limiting longterm illness predicted from full model§ plotted with linear fit against neighbourhood status score stratified by status groups of mothers



§ Full multilevel logistic regression to predict odds of limiting longterm illness by continuous neighbourhood status score. Adjusted for status group, age, marital status, household income category, housing tenure. Cross-level interaction terms included between neighbourhood status score and status group of mother.

NB: Likelihood ratio test indicates that the model which includes cross-level interaction terms is not a better fit of the data. Of the 4.6% of variation in limiting longterm illness due to differences between neighbourhoods in the empty model, 4.1% remained after including all factors. More details are available in Table A3.4 in the Appendix.

3.4 Discussion

Despite defining status groups relatively narrowly, residual differences remain regarding age, marital status, household income, and housing tenure. Adjusting for these sociodemographic characteristics, the analyses of health behaviours have differing findings. For smoking, the odds are most affected by neighbourhood status in the case of low status mothers. Such mothers are most likely to smoke in low status neighbourhoods. For obesity, the odds are most affected by neighbourhood status in the case of the highest status mothers. These mothers are most likely to be obese in low status neighbourhoods. The findings for smoking support the double deprivation hypothesis, whereas the findings for obesity support the relative status hypothesis.

Adjusting for sociodemographic characteristics, analyses of general health outcomes have findings that are more similar to those of obesity than those of smoking. However, significant cross-level interaction terms are only found to be significant in the case of low self-rated health.

In the rest of this chapter, I discuss the interpretations of the findings that relate to the hypothesis set out at the beginning of the chapter, and to the questions asked by this thesis in general. The health outcomes analysed above are inspected more closely, and discrepancy in the findings here with previous findings using the same dataset are discussed (Albor *et al.*, 2009). Additionally, an assessment of the measure of contextual exposure is conducted by comparing findings when different neighbourhood measures are used.

Main interpretations

In the last chapter, I discussed how the majority of studies that analysed self-rated health found that this health outcome was equally associated with neighbourhood status amongst residents of all status, and in some of those studies there were indications that low status residents may benefit more than high status residents from high status neighbourhoods (Stafford *et al.*, 2001, Kobetz *et al.*, 2003, Stafford and Marmot, 2003, Hou and Myles, 2005). In the analyses here, there is some suggestion that mothers who were classified in the lowest status benefit the least from neighbourhood status. Although based on cross-level associations, this is contradictory to the findings of the studies I reviewed in the previous chapter. However, similar findings to these for self-rated health have been reported in a previous analysis of the Millennium Cohort Study (Albor *et al.*, 2009). In the previous analysis, it was found that for poor mothers, area-level income deprivation in particular was associated with *better* health, using measures of limiting longterm illness and low birthweight.

One reason to account for such discrepancy between the analyses of the MCS as reported here, and the other cross-level interaction studies of self-rated health, may be to do with the specification of status groups, and the level of sociodemographic adjustment undertaken. In the analyses presented here, status groups were defined by both household occupational status, and the educational achievement of the mother, and regressions were then adjusted for two further socioeconomic characteristics: household income and housing tenure. In the previous analysis of the MCS, status groups were defined solely by income poverty, and regressions were then adjusted for occupational and educational status. As such, for both of these investigations any associations between neighbourhood status and health outcomes are less likely to be confounded by unmeasured residual differences in socioeconomic characteristics.

Importantly, in the analyses in this chapter, the cross-level interaction effect predicting low self-rated health is found to operate in the opposite direction to that predicting smoking. This suggests that different neighbourhood-related mechanisms underly the pattern of low self-rated health than the pattern of smoking. On the other hand, because the cross-level interaction effect predicting obesity corresponds to that of low self-rated health, these two health outcomes may be influenced by the same neighbourhood-related health mechanisms.

Based on the health mechanisms discussed in the previous chapters, these findings invite an explanation that would attribute the findings for smoking to cultural mechanisms operating through neighbourhood-derived social values and peer influences, and attribute the converse findings for obesity and low self-rated health to psychosocial mechanisms through local status comparisons and neighbourhood-derived social support. However, without testing intermediate social factors, such explanations cannot be confirmed. As such, the next chapter takes forward analyses with mediating indicators of social and mental wellbeing. Nevertheless, the hypothesis specific to this chapter is supported by some of the findings reported here. Specifically, the hypothesis that '*living in high status neighbourhoods has a beneficial effect to the health and health behaviours of high status individuals, and conversely, it has a detrimental (or less beneficial) effect to low status individuals'*, is supported by the findings for obesity and low self-rated health, but not limiting longterm illness or smoking.

Inspection of Limiting Longterm Illness

The null findings from analyses of limiting longterm illness (LLI) are not necessarily uninformative to this thesis. LLI is a not a straightforward health measure, given that it may represent a multitude of illnesses that differ from person to person, and potentially may differ systematically by socioeconomic factors that may bias interpretations.

Before discussing the illnesses captured by the LLI measure, it is important to explain why the current findings include no significant cross-level interaction results, despite the finding, in my previous analysis of the MCS, of a significant *detrimental* effect of neighbourhood status for the LLI of poor mothers, in contrast to a significant beneficial effect of neighbourhood status on non-poor mothers (Albor *et al.*, 2009). The most important difference between the current and previous analyses are the sample sizes. The previous analysis included mothers from all countries within the UK, whereas in this current analysis, only mothers living in England were included. Also, as discussed in the methods section, mothers who had lived in their current address for less than 18 months were not included in the current analysis, whereas all mothers irrespective of length of residence were included in the previous analysis, thus making the sample (even for the subset within England) considerably larger. In the current analyses, when mothers who had lived in their current address for less than 18 months were added to the analytical sample, the cross-level interaction effect becomes significant - it is found that the lowest status mothers have an attenuated benefit from living in high status neighbourhoods compared to the lowest status mothers (see second column of ORs in Table A3.4 in the Appendix).

In further analyses of the sample that included all mothers despite time at residence, it was found that for the lowest status group, those living in the sixth decile of neighbourhoods (based on the neighbourhood status score) in particular had a significantly increased odds for LLI compared to the first, or lowest status, decile of neighbourhoods (see Table A3.5 in the Appendix). It is in the same, sixth, decile of neighbourhoods where significantly increased odds of low self-rated health are found for low status mothers. In these neighbourhoods, on average, there are about 40% more managers and professionals than routine/manual workers, and about the same proportion of residents with education beyond secondary school to no qualifications. Although it may seem that such a finding implies that the health risks are highest for the lowest status mothers where the social milieu is relatively mixed, some higher status deciles of neighbourhoods are found to have even higher odds of LLI, but because of the smaller sample sizes of the lowest status mothers in such neighbourhoods, the odds ratios are not significant. The detrimental effect of high status neighbourhoods on the lowest status group is therefore not significant.

Sample size clearly has implications for the likelihood of finding significant results. It is also the reason for difficulties involved when inspecting which specific illnesses constitute the LLIs that are more prevalent amongst the lowest status mothers who live in high status neighbourhoods. In the analytical sample, only 9 of the 61 mothers in the lowest status group who live in high status neighbourhoods have a limiting longterm illness. In the sample which included mothers irrespective of time at address, this was only 15 of 95. Neither samples have enough mothers for an informative assessment of specific illnesses by neighbourhood status. However, simply comparing across status groups, some indication of the most prevalent LLIs can be derived. For the highest status group, the two most prevalent were non-specific back problems (*'other dorsopathies'*) and asthma. For the lowest status group, they were recurrent depressive disorders and asthma.

These sensitivity analyses of LLI reveal a potentially complementary pattern for LLI risk with that of low self-rated health risk, seen by comparing Figures 3.11 and 3.12, and this is significant if the sample size is boosted with mothers who have not lived in the same neighbourhood for at least 18 months. Also revealed is that depression may have an important role in the pattern for LLI, especially in the case of the lowest status mothers, and may also potentially explain the pattern for low self-rated health. This particular finding has to be made cautiously considering the small sample sizes, but is investigated further in the next chapter.

Inspection of Neighbourhood Measures

The analyses here used a novel measure of the neighbourhood socioeconomic environment. The measure was designed to capture the social milieu, whilst aligning neighbourhoods on a status ranking without emphasis on characteristics of either affluence or deprivation alone. As the resulting neighbourhood status score has not been tested before, I compared the findings of the analyses above to findings of separate analyses that I conducted alongside, using the income domain of the index of multiple deprivation. Note that the IMD is calculated at the LSOA-level, which is roughly a quarter of the size of the MSOA-level - the level at which the neighbourhood status score was calculated.

For all analyses, apart from those on smoking, similar findings were found when using the IMD income domain instead of the neighbourhood status score. For smoking, no cross-level interaction effects were found when using the IMD income domain. Potentially, the association between neighbourhood status and smoking that is more pronounced for low status mothers, may be a reflection of the peer influences and cultural values that the social milieu of a neighbourhood may affect. These factors of the neighbourhood may be better captured by the neighbourhood status score than the IMD income domain. An alternative explanation would be that neighbourhood influences on smoking may be better captured at the MSOA-level than the LSOA-level. To investigate this, I recalculated the neighbourhood status score at the OA-level, roughly a quarter the size of the LSOA-level, thus much smaller than the MSOA-level. With this measure, the cross-level interaction effects on smoking were also found to be significant. As such, the differential influence of neighbourhood status by status group occurs both at MSOA and OA-level. This makes it unlikely that the reason why using the IMD income domain did not have the same finding is to do with scale.

After analysing all health outcomes with the OA-level status score, all findings were similar to those when using the MSOA-level score, apart from for self-rated health. After repeating analyses with different measures of the neighbourhood socioeconomic environment, it can be verified that the neighbourhood status score is a comparable measure that is at least as sensitive to the income domain of the IMD measured at LSOA-level. In terms of the scale used in the primary analyses, the MSOA may be the best suited for capturing the effects of the social milieu that influences the health of low status residents independent of the material factors of the neighbourhood. Neither the IMD income score nor the neighbourhood status score measured at OA-level were as consistent at identifying cross-level interaction effects.

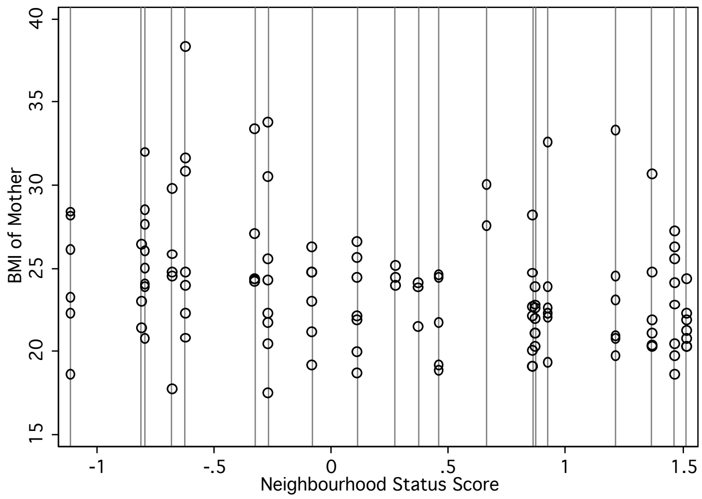
General Limitations

The neighbourhood-related differential effects that are investigated in these analyses are likely to be very weak when compared to the effects of individual socioeconomic status. As such, any deficiency in the sensitivity of the neighbourhood measure in capturing the factors that lead to such weak effects are likely to further minimise the explanatory power of the neighbourhood for the variation in health outcomes.

High variability within neighbourhoods

As reported in the results tables of the stratified analyses for all the health outcomes, the proportions of the total variation in the mothers' health outcomes that could be attributed to differences across neighbourhoods were often so small that they were reported in tables as 0%. The highest proportion of health variation due to neighbourhood differences was reported for obesity in the highest status group (Table 3.4). In this particular status group, this proportion was 13.8%. After taking into account sociodemographic factors it was reduced to 10.6%, and after additionally taking into account the types of neighbourhoods this was reduced further so that only 2.7% remained. To illustrate what these percentages mean, in Figure 3.13 below, the BMI of a particular selection of the highest status mothers are plotted against the neighbourhood status score. In this figure, the points that represent mothers living within the same neighbourhoods are aligned vertically, set on grey lines that represent the neighbourhood. As can be observed, the variation in BMI within each neighbourhood is very high. The variation in the average BMI within neighbourhoods, across all 20 of these neighbourhoods, is much lower in comparison.

Figure 3.13 The BMI of mothers of the highest status group living in a particular selection* of neighbourhoods



* These are neighbourhoods where about 8 mothers of the highest status group live - this selection was made for illustrative purposes.

NB: The vertical lines represent neighbourhoods. Mothers living in the same neighbourhood are aligned vertically by their BMI. The variation in BMI within neighbourhoods is much higher than the variation between neighbourhoods.

As a result of the high individual-level variability, the identification of significant neighbourhood-derived health effects is both less likely and less important in epidemiological terms. Regarding the latter point on epidemiological importance, as discussed in previous chapters, this thesis is not solely concerned with the significance of differential neighbourhood effects for the disease burden of the population. The issue regarding the balance between positive and negative health impacts that can be derived from low status neighbourhoods is considered in this thesis to be of relevance to the broader understanding of how psychosocial, material and cultural health pathways operate together, and particularly, how salient status comparisons and social support may be in affecting health.

Dependence between individual and area-level factors

Regarding the former point on the likelihood of identifying neighbourhood health effects, the methods available when using observational data are limited. Potentially, adjustment for many individual-level factors that have an association with the health outcome may increase the proportion of residual variation left that can be attributed to neighbourhood differences. This could make the identification of significant neighbourhood effects more likely. However, it would only be the case if such individual-level factors did not have any geographical bias. For example, in Table 3.6 it can be observed that the baseline 8% of neighbourhood-attributed variation in LLI is reduced to 5.9% after adjustment for sociodemographic controls. Note that these controls are individual characteristics, and should therefore increase, not decrease, the proportion of residual variation due to neighbourhood differences after adjustment. The reason why a decrease is observed is likely to be because the sociodemographic characteristics of mothers are geographically correlated - especially in the case of residence in social housing, which in this particular analysis was a significant predictor of LLI. As such, the dependence between neighbourhood-level and individual-level socioeconomic characteristics make any analyses of observational data to detect neighbourhood effects both conceptually and methodologically limited.

Limitations due to cross-sectional data

Finally, these analyses were all cross-sectional. Both the neighbourhood status measure, and the outcomes were taken at a single point in time: the former, from the 2001 UK census, and the latter from the point of interview (2001-2002). Using a neighbourhood status measure that is taken at one point in time does not take into account the dynamic nature of neighbourhoods. To an extent, the trajectory of the socioeconomic change over time within a neighbourhood can predict the health of its residents (Boyle *et al.*, 2004). Without accounting for this effect, the neighbourhood status score may be considered to be further limited at capturing more detailed aspects of the social milieu. A lack in this specificity may lead to greater error in neighbourhood status classification, and thus further reduce the likelihood of explaining outcomes by neighbourhood factors.

Using an outcome measure that is taken at one point in time, or simply measuring prevalence, limits the causative interpretation of findings. For example, the higher prevalence of LLI amongst the lowest status mothers in high status neighbourhoods may be interpreted as: 1) high status neighbourhoods cause illness in the lowest status mothers; or 2) the lowest status mothers who have a limiting longterm illness tend to move to high status neighbourhoods; amongst other explanations. Whether the first or the second interpretations are correct cannot be concluded without a longitudinal measure of LLI. All of the health outcomes that were analysed above were repeated using longitudinal measures of such outcomes, namely: smoking cessation, smoking take-up, weight gain, incidence of low self-rated health, and incidence of LLI. In all of these cases, the change or incidence was measured between the interviews of mothers at the first sweep, and the interviews of mothers at the third sweep of the MCS. Such analyses did not have any significant findings, although the directions of non-significant interactions were in the same direction to those of the cross-sectional analyses. The lack of significance is likely to be due to the following reasons:

1) The sample size of mothers available for analysis of incidence and change was smaller compared to that for the cross-sectional analysis. About 40% of the analytical sample that was used for the cross-sectional analyses were living in a new area by the time of the third sweep. On top of that, even fewer of the remaining sample could be analysed for each incidence outcome, as those who already had a poor outcome from the first sweep, such as low self-rated health, were not included in the longitudinal analytical sample. As a result, the statistical power for detecting significant neighbourhood effects, especially cross-level interaction effects, was much reduced. For example, from the 6,185 mothers who were included in the analysis of prevalence of low self-rated health, only 2,840 could be included for analysis of incidence of low self-rated health.

2) The amount of time that has elapsed between the first interview and the third interview was 5 years. This may not be enough time for change in the physical health outcomes to be analytically significant. For example, of the analytical sample for the prevalence of low self-rated health, 15% had low self-rated health, whereas of the analytical sample for the incidence of low self-rated health, less than half at 7% had changed from reporting high health to low health.

Chapter Conclusions

In the analyses of this chapter, significant cross-level interaction effects were found. Self-rated health and obesity were shown to support the hypothesis that low status neighbourhoods may have positive impacts on low status residents - the relative status hypothesis. It must be noted that such positive impacts are only observed to the extent that the association of low status neighbourhoods with poorer health found amongst higher status mothers is attenuated amongst lower status mothers. These lower status mothers did not necessarily experience an overall benefit that significantly improved their health in low status neighbourhoods compared to high status neighbourhoods. Further inspection of limiting longterm illness added more support for the relative status hypothesis, to the extent that there was some indication, albeit non-significant, for a net benefit for the lowest status group of mothers who were living in low status neighbourhoods compared to high status neighbourhoods. These findings were observed despite the opposite findings for smoking, whereby the low status group of mothers were the most likely to smoke more in low status neighbourhoods compared to high status neighbourhoods - the double jeopardy hypothesis.

Although the health mechanisms that explain such cross-level interaction effects cannot be inferred directly here, these analyses will be taken forward in the next chapter to test for the potential for social and mental wellbeing, or psychosocial, factors to mediate effects on health. As found in this chapter, there is some suggestion that depression may be partly driving the cross-level interaction effect for limiting longterm illness. It would be informative for the hypotheses of this thesis to directly analyse intermediate factors, such as depression, that relate specifically to psychosocial pathways.

4

Mental and Social Wellbeing across Neighbourhood Types by Individual Status

- **Aim of this chapter**
  The aim of this chapter is to find whether, in England, low status individuals have better mental and social wellbeing when they live in low status neighbourhoods compared to when they live in high status neighbourhoods.

In this chapter I analyse factors that may be intermediate between the experience of having socioeconomic status incongruent with one's neighbourhood and the subsequent consequences for physical health. These factors are those of mental and social wellbeing. **Mental wellbeing** is defined here as the range of mental health states from psychological frames of mind, such as self-esteem, to psychiatric disorders, such as depression and serious anxiety. **Social wellbeing** is defined here as the state of social relationships ranging from the structure of social networks, such as friendship with neighbours, to the function of social networks, such as the level of emotional support received.

The intention of investigating mental and social wellbeing here is to directly test the psychosocial pathways that are relevant to the primary aim of this thesis. Particularly, I investigate whether status comparisons and social support might explain the findings for socioeconomic incongruity and self-rated health and obesity from the last chapter.

4.1 Background: Mental and Social Wellbeing

Below are the two hypotheses that are tested in the analyses of this chapter:

1) Living in high status neighbourhoods is less beneficial for the **social wellbeing** of low status individuals compared to high status individuals.
2) Living in high status neighbourhoods is less beneficial for the **mental wellbeing** of low status individuals compared to high status individuals.

In Chapter 1, the two main **psychosocial theories** investigated by this thesis were stated after I discussed the research related to material and psychosocial causes of health inequalities. In this chapter, I expand on these theories to put them in the context of socioeconomic incongruity in the neighbourhood. One theory is that low status individuals have lower levels of **social support** when they live in high status neighbourhoods compared to low status neighbourhoods. In this section, I explain how I test this using measures of social wellbeing, specifically neighbourhood friendship and emotional support. The other theory is that low status individuals make more distinct and/or more frequent **status comparisons** when living in high status neighbourhoods. In this section, I explain how this is tested using a specific measure of mental wellbeing, self-esteem. Finally, I discuss how I test for the general psychological consequences of socioeconomic incongruity that may result from both social support and status comparisons using another measure of mental wellbeing, depression and serious anxiety.

Social Support and Socioeconomic Incongruity

Despite relatively consistent evidence that shows that a lack of social support can lead to poor physical and mental health, as I described in Chapter 1 and will discuss further in this chapter, there is little research regarding the level of social support received by individuals based on their socioeconomic congruity with their neighbours. Nevertheless, there has been distinct but related research in the form of epidemiological studies that focus on 'social capital' (Kawachi *et al.*, 1997, Kawachi *et al.*, 1999, Drukker *et al.*, 2003, Islam *et al.*, 2006), sociological studies on the socioeconomic make-up of social networks (e.g.

Wright and Cho, 1992), and qualitative case studies of social networks within specific neighbourhoods (e.g. Willmott, 1963, Popay *et al.*, 2003).

Social capital

Levels of social cohesion, trust, crime, collective participation and related variables make up the level of **'social capital'** in a neighbourhood (Putnam, 2000, Lin, 2001). A neighbourhood with a high level of social capital promotes social integration and a feeling of belonging, and as a result it has been associated with positive health amongst residents (Browning and Cagney, 2002, Wen *et al.*, 2003). At the end of Chapter 1 I hypothesised that in low status neighbourhoods, low status residents may receive higher levels of social support. However, research on social capital and its relationship with neighbourhood socioeconomic characteristics tends to support an opposing hypothesis - that low status neighbourhoods lead to poorer social relations. For example, in a study across states in the US, it was found that state-wide social capital is associated not just with absolute levels of state-wide deprivation, but also relative levels of state-wide deprivation (Kawachi *et al.*, 1999). Looking at a different geographic scale, a similar association was found in neighbourhoods in the Netherlands even after adjustment for socioeconomic characteristics at the individual-level (Drukker *et al.*, 2003).

However, despite these findings, it is not clear whether all residents, particularly low status individuals, that live in high status neighbourhoods benefit from the high levels of social capital that can often be measured in such neighbourhoods. This is a similar argument I make in the beginning of Chapter 2 where I argue that the ubiquitous association found between neighbourhood deprivation and poor health does not necessarily apply to residents of all socioeconomic status. Reliable evidence can only come from studies that test for cross-level interactions, or studies that analyse the effects of neighbourhood-level social capital within socioeconomic strata. At the same time, in studies of social capital, measures of neighbourhood status are mostly related to material disadvantage, and not the socioeconomic milieu (Browning and Cagney, 2002, Wen *et al.*, 2005, Islam *et al.*, 2006). As such, any associations found cannot be clearly understood in the context of socioeconomic incongruity.

If neighbourhood-level social support were found to have conclusive positive health effects for residents, the verdict as to whether low status individuals living in low status neighbourhoods benefit from such social support would still remain unclear. This is because, as discussed earlier in this chapter, social capital measures, which are related to social support, have been shown to associate negatively with neighbourhood deprivation (Drukker *et al.*, 2003, Islam *et al.*, 2006). As such, based on these observations, low status neighbourhoods are likely to have low levels of social support. However, there are two reasons why such observations do not necessarily mean that neighbourhoods with high densities of low status residents confer poor social support to those low status residents. Firstly, the observations are based on associations between social capital and area deprivation, and as discussed in an earlier chapter, area deprivation measures do not necessarily correlate closely with measures of the socioeconomic composition of areas.

In my analyses, I do not measure neighbourhood-levels of social capital. This is a large field of research and it is beyond the scope of this thesis to review it, or to investigate it analytically (see Lin, 2001, Islam *et al.*, 2006). I restrict my analyses to those that relate to socioeconomic incongruity and how this may affect the level of social support received by low status individuals.

Socioeconomic homogeneity of social networks

The second related area of research is not directly related to neighbourhoods. It simply addresses the general likelihood of friendship within and between socioeconomic groups. As would be expected, in analyses of peer networks it is found that they are predominantly made up of individuals from the same socioeconomic group (Wright and Cho, 1992). Indeed, certain socioeconomic scales are devised with the explicit interest of categorising individuals within peer groups. An example of such a scale is the Cambridge Social Interaction and Stratification Scale (CAMSIS), discussed in Chapter 1. When the Cambridge Scale was created, it was found that despite not specifying a status hierarchy, the network of peer and marriage affiliations was naturally ordered as a hierarchy, and that this hierarchy was closely associated with other status-based social groupings (Stewart *et al.*, 1980). The phenomenon of marriage and friendship within socioeconomic groups is not unexpected, but how the socioeconomic make-up of the neighbourhood influences the development of social networks in contemporary society is not well understood.

Qualitative case studies of neighbourhood-based social networks

Finally, perhaps the most relevant of these three related areas of research is that of qualitative case studies of specific neighbourhoods. These studies offer a deeper understanding about the reasons why residents find their neighbourhoods friendly or unfriendly. One such study was conducted on a large housing estate in Dagenham, east London (Willmott, 1963). This neighbourhood was mainly made up of working class households. When residents were asked about the friendliness of their neighbours and the estate as a whole, four in five replied positively. However, questions regarding friendship in particular received mixed responses. The author recognised four major factors that explained the differing responses: ‘conflicts between generations’, ‘differences in streets’, ‘privacy and conflicts’ and ‘difference in status’. It is the latter factor which is most relevant to this thesis. The author found that those who thought of themselves as either higher or lower status than the other residents of the housing estate, found the neighbourhood less friendly and had fewer friends.

Those who thought of themselves as higher status commented as follows:

> I’m a printer. Most of the people round here just work at Ford’s. I haven’t got much in common with these people; there’s no conversation at all. You see, they don’t come from my walk of life. I’ve got just a few friends on the estate and that’s the finish.
>
> Male printer (Willmott, 1963: 72)

> We try to stop Linda playing with the children next door. Most of the children round here speak real cockney, they’re really common. The parents don’t seem to want to better themselves or their children. We try not to have much to do with them.
>
> A clerk’s wife (Willmott, 1963: 73)

Those who thought of themselves as lower status, of whom there were fewer considering the working class composition of the housing estate, commented as follows:

> They are not at all friendly round here. They all seem to think they’re better than us. We’ve offered to help and they’ve refused. Sometimes they speak and sometimes they don’t. They blow hot and cold. They just don’t want to be friendly; they’re independent. We don’t even say “Good morning” to half of them.
>
> Female, occupation not stated (Willmott, 1963: 74)

> They’re too snooty to want to talk to us.
>
> Female, occupation not stated (Willmott, 1963: 74)

It must be noted that this case study was published in 1963 and the interviews that were undertaken by the author took place in 1958, 1959 and 1961. Since these interviews took place about half a century ago, the findings of this case study do not necessarily apply to neighbourhoods today.

In 2003, the findings of a similar, but broader and current, qualitative study was published (Popay *et al.*, 2003). In this study, individuals of various socioeconomic status living in high and low status neighbourhoods in different cities across the north west of England were included. The authors of this study found that the affinity that the participants had with their neighbours, what the authors called the 'ontological fit', was an important determining factor of positive identity. They found that low status individuals had poor relations with their neighbours when they lived in high status neighbourhoods. One participant described herself as *'a fish out of water'* and commented, *'I don't feel like a cul-de-sac'*[1]. Another participant specifically contrasted the friendliness of her current low status neighbourhood to her previous high status neighbourhood, and yet another described how she actively did not want her child to 'mix' (quotes below).

> [My previous neighbourhood was] a rather unfriendly middle class area... the people were quite stand-offish - it was as if money separated people. Now I have neighbours who are always willing to make themselves known to each other and to help each other. I mean you have your own life, your own friends, your own family, but it's like an extension of that when you feel comfortable with the people around you and that's what I feel here.
>
> Anonymous resident
>
> I don't want him out there. I don't want him mixing with them people. We're different.
>
> Anonymous resident
>
> (Popay *et al.*, 2003)

These findings show that some of the sentiment felt by socioeconomically incongruous people, described in the 1963 study, may still remain today. However, it must be noted that these are qualitative studies of some specific localities. As such, observations may not be representative of the wider population. Quantitative aspects of social networks, as they are influenced by socioeconomic incongruity in the neighbourhood, have not been addressed. For this reason, and because of the evidence that links social support and various health outcomes, the social networks of mothers in the Millennium Study will be analysed in this chapter.

1 'Cul-de-sac' used in this way refers to the 'middle class' in general.

Status Comparisons and Socioeconomic Incongruity

In Chapter 1, I discussed the theory behind negative self-evaluation and how this relates to health. People may compare themselves to their society as a whole, from which they may attribute a value to themselves, based on what they witness in life, at work, and through the media. This is the hypothesis that is relevant to the social gradient in health overall. In the context of socioeconomic incongruity, I suggest that people may compare themselves to others in their neighbourhood, which may affect how they value themselves depending on the socioeconomic milieu of their neighbourhood, and may also exacerbate or attenuate the comparisons that they make to society as a whole.

There is little direct research regarding the health impacts of status comparison against the neighbourhood in particular. However, from what there is, some suggestive evidence has arisen. A study in Canada was conducted to investigate which types of status comparisons to different reference groups were associated with self-rated health (Dunn *et al.*, 2006). In this study, reference groups included Canadians as a whole, Canadians of the previous generation, provinces, and neighbourhoods. It was found that, after adjusting for household income and educational attainment, income relative to province and neighbourhood averages remained significantly associated with low self-rated health. What is more, status comparisons made with those who had the highest incomes in the neighbourhood were the most strongly associated with low self-rated health. Whether these associations are mediated through self-evaluation is not clear, however similar findings in studies of happiness and satisfaction give some support for psychological mediation. For example, in a study in the US, it was found that higher average incomes in areas were associated with lower levels of happiness and satisfaction, after individual incomes were adjusted for (Luttmer, 2005). In other words, any person of a given income was found to be happier than a person of the same income who was living in a richer area.

In the Millennium Cohort Study, mothers were not asked how they viewed their status relative to their neighbours, or to society as a whole. This would have been an ideal measure of status comparisons, especially if participants were specifically asked to compare themselves to their neighbours. Instead, to capture an aspect of psychological wellbeing that is relevant to the hypothetical mechanism of self-evaluation, I use a measure of self-esteem in my analyses of the MCS to test the potential for socioeconomic incongruity to increase status comparisons. Although using self-esteem as a proxy indicator of status comparisons has limits, previous research has shown that measures of self-esteem are directly related to the process of comparing one's status to neighbours, peers, and society as a whole. This was shown in a study of adults living in the US, where between 30% to 40% of the association between income and self-esteem was explained when adjusting for perceived relative socioeconomic status (Rosenberg and Pearlin, 1978). The authors used a measure of status comparisons that was specific to whether participants considered themselves richer or poorer than a selection of comparison groups, including their neighbourhood, where 35% of the association was explained.

Psychological Distress from Low Social Support and Status Comparisons

Psychological distress, depression in particular, may play a role in the inducement of poor health through status incongruity, whether it is via low social support or stark status comparisons. Depression is an extreme form of psychological distress. In epidemiological settings it is measured using different scales that are continuous and often with a cut-off for specifying a 'case' of depression (Creed and Dickens, 2007). As it is the accumulation of depressive symptoms combined with the cumulative lack of positive emotions that forms the scale, depression is sometimes referred to as a 'syndrome'.

As with physical health outcomes, depression follows a social gradient (Kahn *et al.*, 2000). The reason for this is likely to be, in part, due to the strong association between depression and psychosocial factors (Stansfeld and Rasul, 2007). In Chapter 1, I defined psychosocial factors as psychological stimuli from the social environment that may lead to effects on health. In that chapter, I introduced the stress mechanisms that mediate between psychological stimuli and poor health (Brunner, 2002, Sapolsky, 2002, Mattei *et al.*, 2010). As well as leading to poor *physical* health, these psychological stress mechanisms have been shown to be associated with depression. For example, in about half of clinically depressed individuals, basal cortisol levels are elevated (Sapolsky, 2004: 298). At the physiological level, this may be explained by the fact that elevated cortisol can detrimentally affect three neurotransmitter systems that are therapeutically targeted by anti-depressant drugs (Sapolsky, 2004: 297-280). The salience of the effect of elevated cortisol has been demonstrated by observations of the anti-depressant effect of anti-cortisol drugs given to depressed individuals who have high cortisol levels (Sapolsky, 2004: 297).

With respect to the phenomenon investigated in this thesis, status incongruity in the neighbourhood, the onset of depression may simply be influenced in the same way as physical health - through the psychosocial stress that may be experienced by low status individuals in high status neighbourhoods, due to status comparisons and low social support. Below, I briefly discuss the theories, with varying levels of supporting evidence, that specifically associate depression with status comparisons and low social support.

- **Status comparisons, 'sickness behaviour' and depression**

  I have discussed how status comparisons may be more extreme for low status individuals who live in high status neighbourhoods compared to those who live in low status neighbourhoods. I explained how this could lead to more negative self-evaluation and shame based on the theories of Dickerson and colleagues (2004a, 2004b). These researchers posit that as well as leading to physiological damage through stress, negative self-evaluation can lead to cytokine-controlled ‘sickness behaviours’, behaviours that are not specific to any condition in particular, but are characterised by *“weakness, malaise, listlessness and inability to concentrate”* (Dantzer *et al.*, 2007).

  In a separate line of research, Dantzer and colleagues (2007) propose that the cytokine-controlled induction of sickness behaviours that occurs under some physical diseases may promote the onset of depression in some people, thus partly explaining the prevalent co-morbidity of depression in the physically ill. This proposal by Dantzer and colleagues (2007) offers an additional physiological mechanism that increases the risk of depression, distinct from the stress response. In light of the research by Dickerson and colleagues on sickness behaviour in people with negative self-evaluation (Dickerson *et al.*, 2004a, Dickerson and Kemeny, 2004, Dickerson *et al.*, 2004b), this mechanism may play a role in the onset of depression in the specific context of status comparisons, reinforcing the general effects of the stress response.

- **Social support, stress and depression**

  I have also discussed the evidence that links a lack of social support to poor physical health via stress, based on studies that measured cardiovascular tone, endocrine markers and mortality (Uchino *et al.*, 1996, Berkman and Glass, 2000, Stansfeld, 2006, Cole *et al.*, 2007). An altered stress response may be a common mediator of the psychosocial pathway regarding status comparisons and low social support, giving rise to both poor physical and poor mental health.

  Epidemiological analyses have shown associations between a lack of social support and depression. Using the Whitehall II cohort in the UK, emotional support, measured at baseline, was found to protect against psychiatric morbidity, measured four to five years later (Stansfeld *et al.*, 1998b). In a longitudinal study specific to women, it was found that those who had reported having social support for times of crisis were protected against subsequent depression (Brown *et al.*, 1986). In a longitudinal study specific to men, it was found that those who had a lack of social support had a particularly increased risk of subsequent depression six to eight months later when persistently unemployed (Bolton and Oatley, 1987).

Although status comparisons and low social support are plausible psychosocial pathways that are relevant to how status incongruity in the neighbourhood can affect depression, few studies have directly investigated potential cross-level interaction effects. Two such studies, one conducted in the US (Aneshensel *et al.*, 2007), and the other conducted in the UK (Stafford and Marmot, 2003), found no significant cross-level interaction effects.

In the US study, the depressive symptoms of just over 2,500 people over the age of seventy across urban census tracts throughout the country were analysed (Aneshensel *et al.*, 2007). Although no significant cross-level interaction terms were found after testing, this study also found no associations between a measure of neighbourhood deprivation and depression, adjusting for individual-level socioeconomic characteristics. This suggests that amongst this sample, the neighbourhood socioeconomic environment was not an important health-related factor. However, as the authors of this study discussed, because of the relative socioeconomic homogeneity within census tracts, it may not have been possible to find independent effects of the neighbourhood due to collinearity with individual status. At the same time, this would make it harder to find cross-level interaction effects, due to very low numbers of socioeconomically incongruent residents. What is more, as neighbourhood status was based on unemployment, poverty, educational attainment and receipt of government benefits - mostly measures of material deprivation - cross-level interaction is unlikely to have captured the phenomenon of being incongruous to the socioeconomic composition of the neighbourhood.

In the UK study, the depressive symptoms of about 5,000 civil servants across wards mostly within London were measured (Stafford and Marmot, 2003). This study has already been discussed in the review in Chapter 2 as analyses of self-rated health and waist-to-hip ratio were also conducted. Like the US study above, neighbourhood measures used in this study captured aspects of neighbourhood material deprivation, and not the social milieu of neighbourhoods. Other limitations of this study, in terms of identifying social milieu-related cross-level interaction effects, were discussed in Chapter 2.

4.2 Methods: Sample differences with last chapter and coding of outcomes

The methods used for the analyses in this chapter are built on those that were used in the previous chapter. The statistical analyses and presentation of results are exactly the same, therefore these can be referred to in Section 3.2. The differences between the methods used in this chapter and Chapter 3 are the specific outcomes that are analysed, and as a result, the way in which the sample is selected from the Millennium Cohort Study (MCS).

Sample differences from the previous chapter

For the analyses in Chapter 3, I excluded mothers who were not living in England, who were not White, and who had lived in their neighbourhoods for less than 18 months prior to the interview. As a result, the original sample of about 18,000 mothers from the first wave of the cohort study was reduced to approximately 6,000 mothers - about a third of the original. The rationale for the exclusion of mothers was explained in the last chapter.

Differences in sample selection

The questions regarding health and behavioural outcomes in the last chapter were asked in interviews during the first wave of the cohort study. The questions regarding mental and social wellbeing that are relevant to this chapter were not all asked in interviews during the first wave, therefore data from three different waves are analysed in this chapter. These waves take information from families when the cohort member was approximately 9 months (2000/1), 3 years (2004/5), and 5 years (2006). To ensure that mothers experienced the same neighbourhood environment throughout the three sweeps, only mothers who were living in the same neighbourhood across the three waves are included in analyses in this chapter. As a result of this exclusion, the analytical sample size is reduced further to less than a third of the original sample at the first wave. However, because the criteria for continuous residence in the same LSOA guarantees consistent neighbourhood exposure across the three sweeps, mothers who had lived in their neighbourhoods for fewer than 18 months at the time of the first wave interviews are no longer excluded, as in the previous chapter. The final analytical sample size is just over 4,800.

Differences in sample distribution across neighbourhood type by mothers' status group

The same geographic scale for neighbourhood is used here as in the previous chapter (MSOAs). Also, the same status categorisation of neighbourhoods is used (the social milieu based on occupational and educational ratios). Finally, the same status categorisation of mothers is used - five status groups based on the overlap of occupational class and educational attainment. There is a generally similar distribution of the analytical sample across the different neighbourhood types by mother's status group in this chapter compared to that of the previous chapter. These distributions are shown in Tables 4.1 and 4.2 below.

Table 4.1 Status Groups of Mothers based on Overlap of Occupational Class and Educational Achievement

Occupational Class (The highest occupational class between mother and partner, if not a single mother, based on the NS-SEC)	Educational Achievement (The mother's own educational achievement based on qualifications equivalent to NVQ)	Status Group of Mother	No. in analytical sample in **last chapter** (% from a total of 6,205)	No. in analytical sample in **this chapter** (% from a total of 4,871)
Managerial or Professional (NS-SEC 1 & 2)	Degree Level and Above (NVQ 4 - 5)	Highest Status	1,669 (27%)	1,316 (27%)
	2 or more A-levels and Below, including Access to Higher Education Courses (None to NVQ 3 & Overseas)	High Status	1,326 (21%)	1,040 (21%)
Intermediate (NS-SEC 3 & 4)	Any Education	Mid Status	1,243 (20%)	936 (19%)
Routine and Manual or Not Applicable (NS-SEC 5, 6 & 7 and N/A)	5 GCSE passes and Above (NVQ 2 - 5)	Low Status	1,079 (17%)	864 (18%)
	4 GCSE passes and Below (None to NVQ 1 & Overseas)	Lowest Status	888 (14%)	715 (15%)

In the table above, it can be observed that the proportion of mothers in each status group is not significantly different in the analytical sample of this chapter compared to the last chapter. The highest status group remains the group with the highest proportion of mothers, and the lowest status group remains the group with the lowest proportion of mothers.

Table 4.2 The distribution of each status group across neighbourhood types showing the differences in the analytical sample of this chapter compared to that of the last chapter

Status of Mother	Low Status Neighbourhoods (% within status group in neighbourhood type)			Mixed Status Neighbourhoods (% within status group in neighbourhood type)			High Status Neighbourhoods (% within status group in neighbourhood type)		
	Last Chapter		This Chapter	Last Chapter		This Chapter	Last Chapter		This Chapter
Highest Status	334 (20%)	↓	235 (18%)	509 (31%)		415 (32%)	826 (49%)		666 (51%)
High Status	487 (37%)	↓	376 (36%)	474 (36%)		395 (38%)	365 (28%)	↓	269 (26%)
Mid Status	598 (48%)		452 (48%)	415 (33%)		317 (34%)	230 (19%)	↓	167 (18%)
Low Status	660 (61%)		563 (65%)	290 (27%)	↓	220 (25%)	129 (12%)	↓	81 (9%)
Lowest Status	602 (68%)		509 (71%)	224 (25%)		177 (25%)	62 (7%)	↓	29 (4%)

NB: Downward arrows (↓) indicate a reduction in the proportion of mothers within a status group that resides in a particular neighbourhood type. This annotation is included to emphasise the proportional reduction of mothers that are status incongruent to their neighbourhood, after exclusion of mothers who do not reside in the same neighbourhood throughout the three waves of the cohort study.

In the table above, it can be observed that the distribution of mothers across neighbourhood types by status group is generally similar for the analytical sample in this chapter, compared to that of the last chapter. However, a noticeable difference is the proportional reduction of mothers that have an incongruent status to their neighbourhood (downward arrows). This implies that mothers who were status incongruent to their neighbourhood during the first wave of the MCS were more likely to move out of their neighbourhoods at some point between the first and third waves of the cohort study. Importantly, the findings from the analyses of this chapter must take into account that the sample analysed is of mothers who may be different to their counterparts who moved out. This is especially the case for those who are status incongruent to their neighbourhood, in that they stayed in the same neighbourhood despite a higher tendency of incongruent mothers to move out compared to congruent mothers.

Differences in sociodemographic profile

There were no significant differences in the overall sociodemographic profile between the analytical sample used in this chapter and that of the last chapter as shown in Table 4.3 below.

Table 4.3 Sociodemographic similarities between the analytical samples in the last chapter compared to that of this chapter

Sociodemographic factor	Last Chapter	This Chapter
Mean Age	31	31
% Not Married	38%	39%
% In Poverty	37%	37%
% In Social Housing	20%	22%

However, closer inspection shows that, in the case of lowest status mothers who live in high status neighbourhoods, there are certain differences. Specifically, in the analytical sample in this chapter, such mothers are slightly older, more likely to be married and less likely to be in poverty, whilst they are also more likely to live in social housing. Nevertheless, it must be noted that these differences are based on comparing small samples - of the lowest status group, only 61 mothers live in high status neighbourhoods in the analytical sample of the last chapter, and only 29 mothers live in high status neighbourhoods in the analytical sample of this chapter.

Social Wellbeing Outcomes in the MCS

Two social wellbeing outcomes are analysed in this chapter. One - **neighbourhood friendship** - is a structural measure of social wellbeing, and the other - **emotional support** - is a functional measure of social wellbeing. As discussed in reviews of social networks, social support and health, the structure of a network does not necessarily define its function for social support (Berkman and Glass, 2000, Cacioppo and Patrick, 2008).

Structural Measure of Social Wellbeing: Neighbourhood Friendship

In their review of social integration, social networks, social support and health, Berkman and Glass (2000) identify four specific ways in which a social network can vary structurally:

> 1) *Range or size* (number of network members)
>
> 2) *Density* (the extent to which the members are connected to each other)
>
> 3) *Boundedness* (the degree to which they are defined on the basis of traditional group structures as kin *[sic]*, work, neighborhood)
>
> 4) *Homogeneity* (the extent to which individuals are similar to each other in a network)
>
> (Berkman and Glass, 2000)

Regarding the neighbourhood however, in the MCS, only simple measures of the structure of a social network are available. Specifically, in the third wave of the cohort study, mothers are asked whether they have friends in their area. Although this question does not address details of social network structure as identified by Berkman and Glass above, analysis of the answers to the question may offer some understanding of the neighbourhood-related structural aspects of social wellbeing. Box 4.1 below details the coding of this outcome.

Note that during interviews in the first wave of the cohort study, mothers were asked how frequently they saw their friends. Responses to this question are not analysed here as the question does not specifically address social ties that are derived from the neighbourhood.

Box 4.1 Coding for Cases of 'No Neighbourhood Friends'

Mothers are first prompted that they are about to be asked questions regarding their neighbourhood in the following way:

> *"I'd like to ask some questions about your area. By area, I mean within about a mile or 20 minutes walk of here."*

After this, they are asked some questions that include two with specific relevance to social ties.

1) *"Are you friends with any other parents who live in this area?" - Yes / No*
2) *"Do you have any other friends or family living in this area?" - Yes, friends / Yes, family / Yes, both / No*

Mothers who answer *"No"* to the first question, **AND** also answered *"No"* or *"Yes, family"* to the second question are considered cases of **'no neighbourhood friends'**.

Family is not considered, as the interest in this thesis is to investigate whether status incongruity in the neighbourhood can subsequently affect social support derived through neighbourhood friendships.

Functional Measure of Social Wellbeing: Emotional Support

In Berkman and Glass's review (2000), they also identify the functions of social networks - in particular, the subtypes of social support.

1) Emotional: *"love and caring, sympathy and understanding and/or esteem or value available from others"*
2) Instrumental: *"help, aid, or assistance with tangible needs"* such as *"getting groceries"* and *"money, or labor"*
3) Appraisal: *"help in decision making, giving appropriate feedback, or help deciding which course of action to take"*
4) Informational: *"provision of advice or information in the service of particular needs"*

The emotional subtype of social support is the most relevant to the psychosocial pathway to health, and is therefore most likely to elicit the physiological pathways that are discussed in the previous section and in Chapter 1. As such the variable that best captures the emotional subtype of social support is used in the analyses of the functional aspect of the social network. This variable is the response to a statement regarding confiding and sharing of feelings that is asked of mothers during interviews in the first sweep of the cohort study. The coding of this measure is detailed in Box 4.2 below.

Box 4.2 Coding for Cases of 'Low Emotional Support'

Mothers were first prompted with the following text:

> *"The next few questions are about the personal help and support you might get. Please say how much you agree or disagree with each of the following statements."*

Mothers then read the following statement:

> *"I have no one to share my feelings with"*

They could then choose from the following responses:

1) *"Strongly Agree"*
2) *"Agree"*
3) *"Disagree"*
4) *"Strongly Disagree"*
5) *"Can't Say"*

Mothers who responded with *"Strongly Agree"* or *"Agree"* were considered cases of **'low emotional support'**

Mental Wellbeing Outcomes in the MCS

Depression/Serious Anxiety

As discussed in the previous section, in non-clinical research depression is usually measured on a scale of severity based on the balance between positive and negative responses to questions that assess the emotional state of an individual. A cut-off is used to define whether an individual may be categorised as a 'case'. In the MCS, questions have been asked that can be used in such a way. Below are three examples:

> How much have you been bothered by emotional problems?
>
> How much did personal or emotional problems keep you from usual activities?
>
> How much did physical/emotional problems limit social activities?

Although combining such questions would be useful for assessing depressive symptoms amongst the mothers, I have chosen not to do so because mothers have not been consistently asked these questions throughout the three waves of the MCS. Instead, I have chosen to use a combination of two simpler questions that are consistently asked in interviews across the three sweeps. These questions ascertain first, whether the mother has ever been diagnosed with **depression *or* serious anxiety**, and secondly whether the mother is undergoing treatment at the time of interview. The reason for choosing these questions is so that the onset of depression since the first interviews, and the currently treated episodes of depression at the time of the first interviews, can be combined to capture the overall experience of depression across the three waves. This is detailed below in Box 4.3. Although other methods could be employed to use the questions related to depressive symptoms, such as latent class modelling, in my analyses I use the most parsimonious method in order to arrive at clear results.

It must be noted that it is not possible to distinguish between cases of serious anxiety *without* depression from co-morbid cases of serious anxiety and depression. However, because of the high level of co-morbidity of depression with serious anxiety, this is unlikely to lead to significantly biased results. Depression and serious anxiety are biologically and symptomatically related to the extent that effective clinical treatment regimes for the two conditions overlap (Magalhaes *et al.,* Fainman, 2004). Antidepressants can be effective anxiety relievers, at higher doses, and cognitive behavioural therapy is used both in depression and most anxiety disorders (Fainman, 2004).

Box 4.3 Coding for Cases of Depression/Serious Anxiety

The following two questions were asked in all three waves:

1) *"Has a doctor ever told you that you suffer from depression or serious anxiety?"*
2) *"And are you currently being treated for this?"*

Mothers who answered *"Yes"* to the first question in the first sweep **AND** *"Yes"* to the second question in the first sweep are coded as 'cases'. The intention of this step is to define mothers who were experiencing an episode of depression/serious anxiety at the time of the first sweep as cases. Mothers who had experienced such an episode before the first sweep were not considered cases.

Mothers who answered *"No"* to the first question in the first sweep, then subsequently answered *"Yes"* to the first question in either the second or the third sweeps are coded as cases. The intention of this step is to define mothers who experienced an episode of depression/serious anxiety at any time between the first and third sweeps.

All other mothers in the analytical sample are coded as non-cases.

Low self-esteem

In the previous section, two studies of self-esteem were discussed (Rosenberg and Pearlin, 1978, Seeman *et al.*, 1995). In both of these studies, a measure of self-esteem is used based on a scale - the 'Rosenberg Self-Esteem Scale', hereon referred to as the Rosenberg Scale. This scale is similar to the scales of depression that are discussed above, in that it is based on the accumulation of negative responses to statements that assess oneself. The original adult version of the scale was based on ten statements, each with four responses to choose from on a Likert scale. For example, one statement says, *"I feel that I'm a person of worth, at least on an equal plane with others."* (U. of Maryland: online [accessed 2011]). A person may answer that they 'strongly agree', 'agree', 'disagree' or 'strongly disagree', and respectively these responses would score 3, 2, 1 and 0. As such, a participant can score from 0-3 in each of the ten questions, making a total maximum of 30 on the Rosenberg Scale with the highest self-esteem.

In the MCS, similar statements are presented to mothers. However, this is only done during interviews for the first sweep, and there are only six statements that are equivalents to the original adult version of the Rosenberg Scale. The maximum self-esteem a mother on the MCS can score is 18, and the lowest self-esteem is 0. With the responses to the six statements, I devised a modified version of the Rosenberg Scale. The details of this modified Rosenberg Scale are shown below in Box 4.4.

The same analytical sample is used for analyses of self-esteem as is used for analyses of depression/serious anxiety, so that findings are comparable. Within the analytical sample, the median and mean scores on the modified Rosenberg Scale are 13. The 10% of the mothers with the lowest self-esteem all scored less than 11. I used this as the cut-off point for defining cases of low self-esteem. It must be noted that this method of setting low self-esteem, where a percentile cut-off is used, identifies cases of low self-esteem that are *relative* to the rest of the analytical sample. As such, mothers who are considered to have low self-esteem are not considered as such based on standard cut-offs from previous research on similar samples. Although a literature-informed cut-off would be ideal, using a modified version of the Rosenberg Scale with six instead of ten responses to statements precludes this.

Box 4.4 Coding for Cases of Low Self-Esteem

Below are the six statements presented to the mothers which have equivalents on the original adult version of the Rosenberg Self-Esteem Scale.

1) *"On the whole, I am satisfied with myself."*
2) *"At times I think I am no good at all."*
3) *"I am able to do things as well as most other people."*
4) *"I certainly feel useless at times."*
5) *"All in all, I am inclined to feel that I am a failure."*
6) *"I take a positive attitude toward myself"*

Mothers could choose from these five responses:

A) *"Strongly Agree"*
B) *"Agree"*
C) *"Disagree"*
D) *"Strongly Disagree"*
E) *"Can't Say"*

Mothers who responded with *"Can't Say"* for any of the statements are treated as having missing data and are not included in the analyses.

The most negative responses (in terms of self-esteem) to statements were scored 0. For positive statements, the most negative response would be *"Strongly Disagree"* and for negative statements, the most negative response would be *"Strongly Agree"*. As such, the maximum cumulative score over the six statements, for the highest self-esteem, would be 18. The minimum cumulative score would be 0.

Mothers are considered 'cases' of low self-esteem if they were in the bottom decile of the scale amongst the analytical sample (cumulative score of < 11).

4.3 Results

As with the results section of the last chapter, there was a high quantity of information produced by the multiple analyses of the two different mental wellbeing outcomes and the two different social wellbeing outcomes. The results are presented in the same way as the last chapter. This order can be referred to in the beginning of the results section in Chapter 3. In brief:

1) Diagrams of the unadjusted rates of each outcome across neighbourhood types, stratified by mothers' status groups, are described.
2) Tables of results from stratified multilevel regression analyses are described.
3) Diagrams of the findings from the full multilevel logistic regression are described.

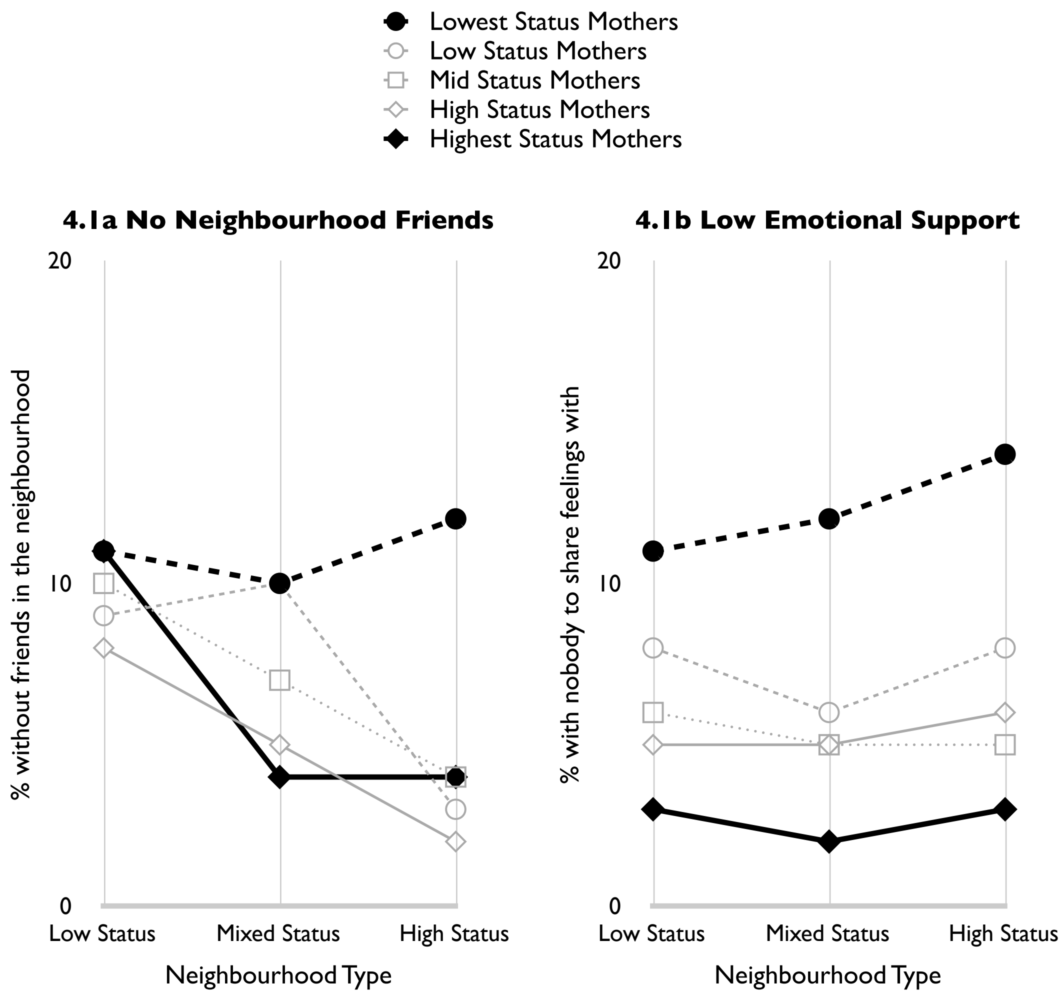
Note that sociodemographic descriptive tables are not presented in this section, as the sociodemographic characteristics of the analytical sample used for conducting the analyses of this chapter are very similar to those of the analytical sample used in the previous chapter.

Social Wellbeing

Of the analytical sample, 7% of mothers had **no neighbourhood friends** when they were interviewed in the third sweep of the cohort study. This rate was highest for the lowest status mothers at 11%, and lowest for the highest status mothers at 5%. There appears to be some variation in this rate by neighbourhood type for all status groups, apart from the lowest status group which has little variation, as can be observed in Figure 4.1a. In the case of the highest, high, mid and low status groups, mothers were least likely to have no neighbourhood friends in high status neighbourhoods.

Amongst the analytical sample, 6% of mothers had **low emotional support**. This rate was variable by status group as shown in Figure 4.1b. Amongst the lowest status mothers the rate was highest at 11%, and amongst the highest status mothers the rate was lowest at 3%. Within status groups there appears to be little variation by neighbourhood type, apart from for the lowest status mothers who are most likely to report low emotional support in high status neighbourhoods.

Figure 4.1 Percentage of mothers who have no neighbourhood friends and percentage of mothers who have low emotional support, by neighbourhood type, stratified by status groups of mothers



NB: These percentages are not adjusted for any factors. Also note that the y-axes are not on the same scale. Within the analytical sample, overall 7% of mothers had no friends in their neighbourhood (of 4,406) and 6% of mothers had no time with friends (of 4,831).

No neighbourhood friends: multilevel logistic regression analysis

Amongst the **highest status mothers**, 24% of all variation in the odds of having no friends in the neighbourhood was attributable to differences between neighbourhoods (empty model, Table 4.4). These mothers were significantly more likely to have friends in both mixed and high status neighbourhoods compared to low status neighbourhoods, by approximately three-fold. After taking this into account, the proportion of the variation in neighbourhood friendship due to neighbourhood differences was reduced to 15.2%.

Findings of the stratified analysis of the **lowest status mothers** were in contrast to those of the highest status mothers. Almost none of the variation in neighbourhood friendship amongst the lowest status mothers was due to between-neighbourhood differences. Neither sociodemographic controls nor neighbourhood type were significant predictors of the odds of having no friends in the neighbourhood in this status group.

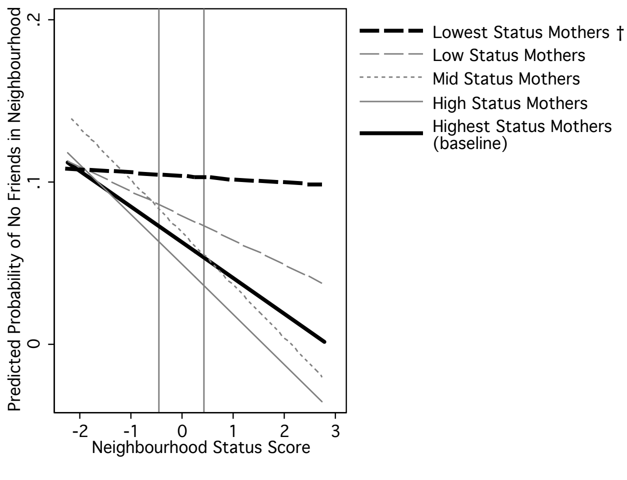
With the contrast in the findings for the lowest status mothers compared to the highest status mothers, one may expect to find that formal statistical testing would find significant cross-level interaction effects. Figure 4.2 illustrates the findings of such a test. Although the inverse association between neighbourhood status and the likelihood of having no friends in the neighbourhood appears to be much weaker for the lowest status mothers compared to the highest status mothers, this differential association is not significantly different based on conventional levels (cross-level interaction term p value = 0.057). As such, there is only suggestive evidence that, in the case of higher status mothers, higher status neighbourhoods promote neighbourhood ties, whereas in the case of lower status mothers, neighbourhood ties remain similar regardless of neighbourhood status.

Table 4.4 Results of Stratified Analyses of No Neighbourhood Friends (Odds Ratios)

	Highest Status Mothers			Lowest Status Mothers		
Included Factors	Empty	Controls	All	Empty	Controls	All
Sociodemographic Controls (relative to contrary)						
< 30 years		0.54	0.48		0.80	0.80
Not Married		1.31	1.22		1.13	1.12
In Poverty		0.89	0.83		1.03	1.04
In Social Housing		0.68	0.60		0.66	0.66
Neighbourhood Type						
Low Status			1			1
Mixed Status			0.33**			0.88
High Status			0.35**			1.00
% of total residual variance in friendship due to differences between neighbourhood	24.1%	25.0%	15.2%	0.0%	0.0%	0.0%

NB: The results of three separate multilevel logistic regression analyses are presented here for two specific status groups: the highest status mothers and the lowest status mothers, making a total of six analyses shown as columns. For each analysis, the intra-class correlation coefficient, or the % of variance due to between-neighbourhood differences is presented.

Figure 4.2 Probabilities of no neighbourhood friends predicted from full model§ plotted with linear fit against neighbourhood status score, stratified by status groups of mothers



§ Full multilevel logistic regression to predict odds of having no friends in neighbourhood by continuous neighbourhood status score. Adjusted for status group, age, marital status, household income category, housing tenure. Cross-level interaction terms included between neighbourhood status score and status group of mother.

† Association between neighbourhood status score and odds of having no friends in neighbourhood for the lowest status mothers is on the border of being significantly different to that for highest status mothers (Interaction term p = 0.057).

NB: Likelihood ratio test indicates that the model which includes cross-level interaction terms is on the border of being significantly a better fit of the data. Of the 8.4% of variation in the odds due to differences between neighbourhoods in the empty model, 1.9% remained after including all factors. More details are available in Table A4.1 in the Appendix.

Low emotional support: multilevel logistic regression analysis

Amongst the **highest status mothers**, 20% of the variation in the odds of low emotional support is attributable to differences between neighbourhoods (Table 4.5). However, as would be expected from the pattern amongst this status group in Figure 4.5b, none of the between-area variation in the odds of low emotional support is to do with the neighbourhood type.

Amongst the **lowest status mothers**, 10% of the variation in the odds of low emotional support is to do with between-neighbourhood differences. As with the highest status mothers, none of this variation is explained by the neighbourhood type.

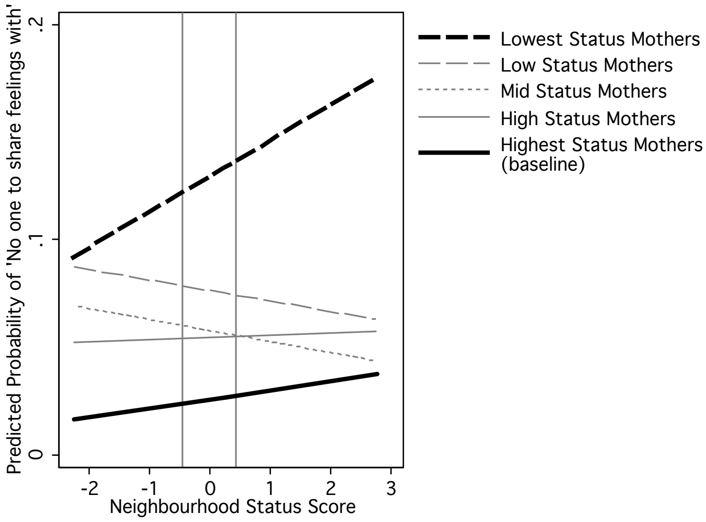
After testing for cross-level interaction effects, none of the associations between neighbourhood status and the odds of low emotional support, for any of the status groups, were found to be significantly different to that of the highest status mothers (Figure 4.3). These findings indicate that the likelihood of having no one to share one's feelings with, or to have low emotional support, has almost no relationship with neighbourhood status nor socioeconomic incongruity with one's neighbours.

Table 4.5 Results of Stratified Analyses of Low Emotional Support (Odds Ratios)

	Highest Status Mothers			Lowest Status Mothers		
Included Factors	Empty	Controls	All	Empty	Controls	All
Sociodemographic Controls (relative to contrary)						
< 30 years		0.46	0.47		0.64	0.65
Not Married		1.20	1.17		1.46	1.49
In Poverty		1.72	1.70		1.93	1.98*
In Social Housing		1.36	1.32		0.93	0.93
Neighbourhood Type						
Low Status			1			1
Mixed Status			0.62			1.20
High Status			1.02			1.60
% of total residual variance in support due to differences between neighbourhood	20.0%	22.2%	23%	10.2%	11.3%	10.5%

NB: The results of three separate multilevel logistic regression analyses are presented here for two specific status groups: the highest status mothers and the lowest status mothers, making a total of six analyses shown as columns. For each analysis, the intra-class correlation coefficient, or the % of variance due to between-neighbourhood differences is presented.

Figure 4.3 Probabilities of 'no one to share feelings with' predicted from full model§ plotted with linear fit against neighbourhood status score, stratified by status groups of mothers



§ Full multilevel logistic regression to predict odds of 'no one to share feelings with' by continuous neighbourhood status score. Adjusted for status group, age, marital status, household income category, housing tenure. Cross-level interaction terms included between neighbourhood status score and status group of mother.

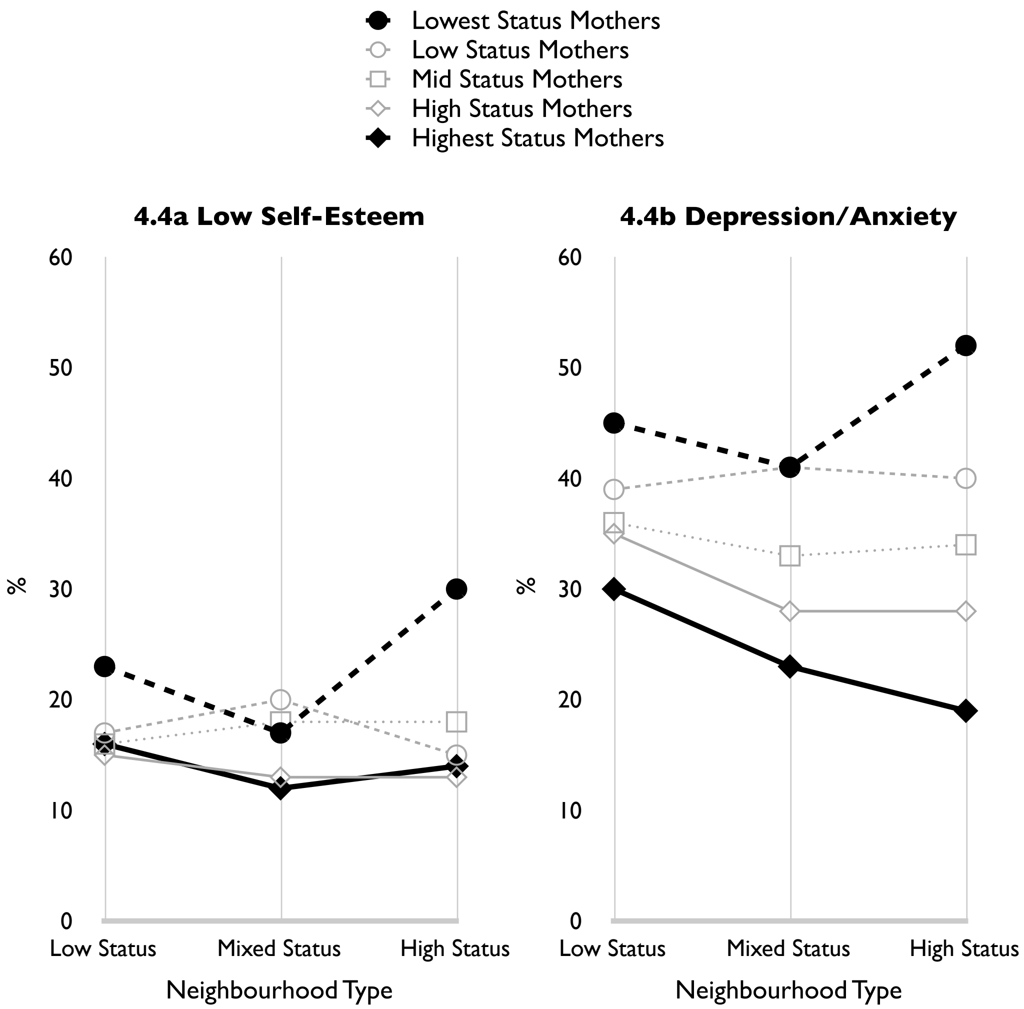
NB: Likelihood ratio test indicates that the model which includes cross-level interaction terms is not a better fit of the data. Of the 3.1% of variation in the odds due to differences between neighbourhoods in the empty model, 0.0% remained after including all factors. More details are available in Table A4.2 in the Appendix.

Mental Wellbeing

Overall, 16% of the sample had **low self-esteem** when they were interviewed during the first wave of the cohort study - less than half the prevalence of depression or serious anxiety based on the definitions of cases (see methods section for case definitions). The rate for low self-esteem differs by status group, whereby the lowest status group has the highest rate (22%) and the highest status group has the lowest rate (13%). Within status groups, there appears to be little variation in the rate of low self-esteem by neighbourhood status, apart from for the lowest status mothers. As such, there is an unclear pattern in rates of self-esteem by neighbourhood type, across mothers' status groups.

Within the analytical sample, 33% of mothers have experienced **depression or serious anxiety** over the five years when the three waves of the MCS were conducted. As with the rate of low self-esteem, this rate of depression or serious anxiety differs by status group. The lowest status group has the highest overall rate at 44%. The highest status group has the lowest overall rate at 22%. Within status groups, there appears to be some difference in the rate by neighbourhood type, especially for the highest and lowest status groups. There is some suggestive support for the relative status hypothesis from the pattern in Figure 4.4b. To recapitulate, in this hypothesis, low status individuals benefit less from high status neighbourhoods compared to high status individuals (see Chapter 2 to visually compare patterns).

Figure 4.4 Percentage of mothers who have experienced depression or severe anxiety and percentage of mothers who have low self-esteem, by neighbourhood type, stratified by status groups of mothers



NB: These percentages are not adjusted for any factors. Overall 33% of mothers have experienced depression/anxiety (of 4,871) and 16% of mothers have low self-esteem (of 4,283).

Low self-esteem: multilevel logistic regression analysis

Amongst both the highest and lowest status mothers, almost none of the variation in the odds of low self-esteem was due to differences between neighbourhoods (empty models in Table 4.6). For the **highest status mothers** this was expected given the pattern in 4.2b which showed no variation in low-self esteem rates across neighbourhood type for this status group. As shown in Table 4.6, none of the sociodemographic factors were significant predictors of low self-esteem for this status group.

For the **lowest status group**, it is perhaps surprising that almost none of the variation in the odds of low self-esteem was due to neighbourhood differences, given the pattern in Figure 4.4a. As with the highest status group, neither the sociodemographic controls, nor the neighbourhood type, were significant predictors of low self-esteem (last column of Table 4.6).

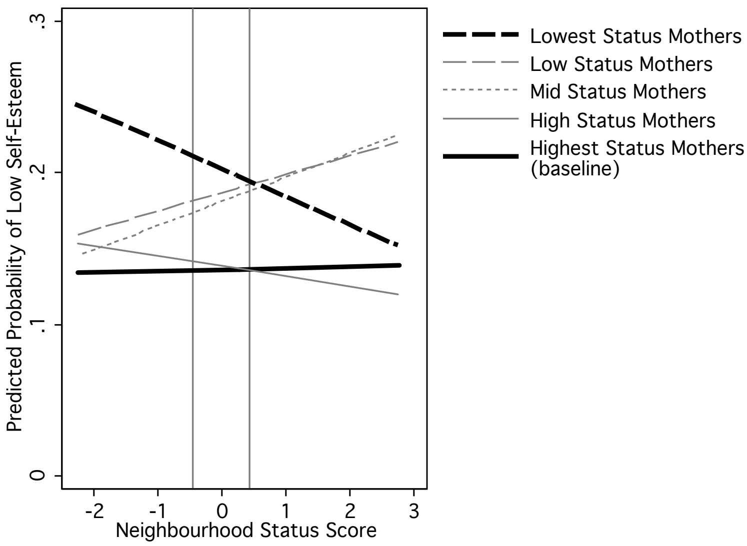
Despite the lack of significant neighbourhood effects, I tested whether any of the associations between neighbourhood status and the odds of low self-esteem, within status groups, may be significantly different when compared to that of the highest status group. Figure 4.4 shows the differing associations by status group, although none of these associations are indicated as being significantly different to that of the highest status group (solid thick line). In statistical terms, none of the cross-level interaction terms reached conventional significance levels, and the overall fit to the data was not significantly better when such interaction terms were included in the regression model. As such, the variation in low self-esteem amongst the mothers in the analytical sample is likely to be determined by factors other than the neighbourhood status or status incongruity as captured by cross-level interaction terms.

Table 4.6 Results of Stratified Analyses of Low Self-Esteem (Odds Ratios)

	Highest Status Mothers			Lowest Status Mothers		
Included Factors	Empty	Controls	All	Empty	Controls	All
Sociodemographic Controls (relative to contrary)						
< 30 years		1.01	1.01		0.93	0.95
Not Married		1.10	1.09		1.40	1.38
In Poverty		1.29	1.25		1.04	1.08
In Social Housing		1.92	1.86		1.29	1.27
Neighbourhood Type						
Low Status			1			1
Mixed Status			0.75			0.74
High Status			0.91			1.61
% of total residual variance in self-esteem due to differences between neighbourhood	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

NB: The results of three separate multilevel logistic regression analyses are presented here for two specific status groups: the highest status mothers and the lowest status mothers, making a total of six analyses shown as columns. For each analysis, the intra-class correlation coefficient, or the % of variance due to between-neighbourhood differences is presented.

Figure 4.5 Probabilities of low self-esteem predicted from full model§ plotted with linear fit against neighbourhood status score stratified by status groups of mothers



§ Full multilevel logistic regression to predict odds of low self-esteem by continuous neighbourhood status score. Adjusted for status group, age, marital status, household income category, housing tenure. Cross-level interaction terms included between neighbourhood status score and status group of mother.

NB: Likelihood ratio test indicates that the model which includes cross-level interaction terms is not a better fit of the data. Of the 1.1% of variation in low self-esteem due to differences between neighbourhoods in the empty model, 0.3% remained after including all factors. More details are available in Table A4.3 in the Appendix.

Depression or serious anxiety: Multilevel logistic regression analysis

Amongst the **highest status mothers**, 7.6% of all variation in the rate of depression or serious anxiety (depression/anxiety) due to differences between neighbourhoods (ICC in ‘empty’ model: first column of Table 4.7). After adjustment for sociodemographic controls 6.8% of variation in the rate remained between neighbourhoods. After taking account of neighbourhood type as well, only 5.1% of the variation between neighbourhoods was left unexplained. The accounted variation is due to the significant protective effect of high status neighbourhoods. In other words, the lower rate of depression/anxiety in high status neighbourhoods for the highest status mothers that can be observed in Figure 4.4b is found to be significant in the adjusted regression analysis shown in Table 4.7.

Amongst the **lowest status mothers**, less than 1% of all variation in the rate of depression/ anxiety was explained by differences between neighbourhoods (‘empty’ model: fourth column of Table 4.7). After adjustment for sociodemographic factors it was found that, for the lowest status mothers, not being married significantly increases the odds of depression/ anxiety by 56% compared to being married. Despite the seemingly high increase in the rate of depression/anxiety for the lowest status mothers who live in high status neighbourhoods compared to low status neighbourhoods that is observable in Figure 4.4a, neighbourhood type is not found to be a significant predictor of depression/anxiety for mothers in this status group.

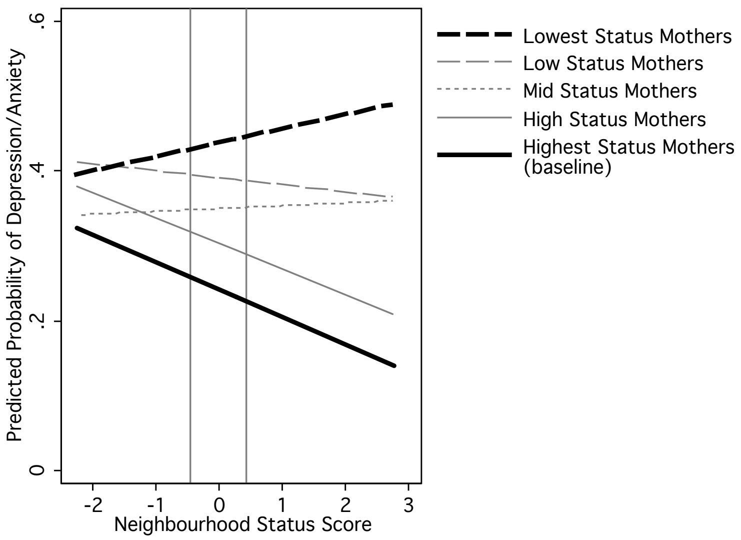
Figure 4.6 illustrates the results of the full multilevel regression model. Note that this differs to the two other models above, in that the full analytical sample with all status groups are included, sociodemographic variables are more detailed (more categories for each variable), and instead of including neighbourhood type as a categorical independent variable, the continuous neighbourhood score was used. As can be observed in Figure 4.6, the inclusion of cross-level interaction terms identified differential associations between neighbourhood status and depression/anxiety, but none were significantly different. This association was shown to be most strongly divergent in the case of the lowest status mothers, but the interaction term was still not significant ($p = 0.12$). Overall, as I indicated above, findings from depression/anxiety analyses give some suggestive support for the **relative status hypothesis**, but this is not based on statistically significant results.

Table 4.7 Results of Stratified Analyses of Depression/Anxiety (Odds Ratios)

	Highest Status Mothers			Lowest Status Mothers		
Included Factors	Empty	Controls	All	Empty	Controls	All
Sociodemographic Controls (relative to contrary)						
< 30 years		1.41	1.32		0.84	0.85
Not Married		1.25	1.22		1.56*	1.56*
In Poverty		1.02	0.99		0.83	0.85
In Social Housing		1.75	1.64		1.37	1.36
Neighbourhood Type						
Low Status			1			1
Mixed Status			0.75			0.92
High Status			0.59**			1.39
% of total residual variance in depression/anxiety due to differences between neighbourhood	7.6%	6.8%	5.1%	0.8%	1.1%	1.0%

NB: The results of three separate multilevel logistic regression analyses are presented here for two specific status groups: the highest status mothers and the lowest status mothers, making a total of six analyses shown as columns. For each analysis, the intra-class correlation coefficient, or the % of variance due to between-neighbourhood differences is presented.

Figure 4.6 Probabilities of depression/anxiety predicted from full model§ plotted with linear fit against neighbourhood status score stratified by status groups of mothers



§ Full multilevel logistic regression to predict odds of depression/anxiety by continuous neighbourhood status score. Adjusted for status group, age, marital status, household income category, housing tenure. Cross-level interaction terms included between neighbourhood status score and status group of mother.

NB: Likelihood ratio test indicates that the model which includes cross-level interaction terms is not a better fit of the data. Of the 4.0% of variation in depression/anxiety due to differences between neighbourhoods in the empty model, 1.3% remained after including all factors. More details are available in Table A4.4 in the Appendix.

Summary

Table 4.8 below is a summary of this results section. After analysing the **mental wellbeing** outcomes, I found only one significant result. This is that, for the highest status mothers, the odds of depression and serious anxiety was significantly reduced when they were living in high status neighbourhoods, compared to low status neighbourhoods. None of the cross-level interaction terms were significant.

After analysing indicators of **social wellbeing**, I found that highest status mothers were significantly more likely to have friends in their neighbourhood when they were living in high status neighbourhoods, compared to low status neighbourhoods. In contrast, the status of the neighbourhood where the lowest status mothers were living had no effect. In the full regression models, I found that including cross-level interaction terms significantly improved the statistical fit of the data, although this was only of borderline significance. I found that neither the highest nor lowest status mothers had any significant differences by neighbourhood status in their likelihood of having low emotional support.

Table 4.8 Summary of results of both stratified and full analyses, indicating where cross-level interaction effects are found

	Protective Effect of High Status Neighbourhood		**Findings from Cross-Level Interaction Tests**	
	Highest Status Mothers	Lowest Status Mothers	Model with interaction terms is better fit	Status group of mothers with significantly different association to highest status mothers
Mental Wellbeing				
Depression/Serious Anxiety	✓	✗	✗	None
Low Self-Esteem	✗	✗	✗	None
Social Wellbeing				
No neighbourhood friends	✓	✗	(✓)	(lowest status mothers)
Low emotional support	✗	✗	✗	(low status mothers)

NB: Brackets indicate that findings are not significant at conventional levels. In other words, p values between 0.05 and 0.1.

4.4 Discussion

The interpretation of the findings in this chapter is challenging. In the previous chapter I investigated whether the status incongruity experienced by low status mothers who live in high status neighbourhoods in England might be associated with ill health or poor health behaviours. I found that the likelihoods of low self-rated health and obesity were associated with such incongruity, in terms of significant cross-level interaction effects. Building on these findings, in the analyses of this chapter, I have investigated potential psychosocial pathways that may lead to such health-related associations.

I start by discussing the implications of this chapter's results for the two theoretical psychosocial pathways that I have focused on in this thesis: 1) status incongruity leading to increased status comparisons; 2) status incongruity leading to lower social support.

Implications of the findings on the social support theory

The analysis of neighbourhood friendship reveals a cross-level interaction effect of borderline significance. Amongst the high and highest status mothers, there is a decreasing risk of being locally disconnected in higher status neighbourhoods, whereas amongst the lowest status mothers, no such association is found (see Table 4.4 and Figure 4.6).

Explaining the significance of neighbourhood status for local ties amongst higher status mothers

The finding that high and highest status mothers are least likely to have friends in lower status neighbourhoods may be interpreted in line with the tendency for social networks to be socioeconomically homogeneous, which was discussed in the beginning of the chapter (Wright and Cho, 1992). This pattern would be expected, should the negative sentiments that were expressed by socioeconomically 'superior' inhabitants of the Dagenham estate - those documented by Willmott in the 1960s - be felt still today (Willmott, 1963).

A further explanation for the pattern of neighbourhood friendship amongst the high and highest status mothers may be related to the extent to which these mothers are geographically mobile. It has been observed that people of high socioeconomic status are highly geographically polarised between different local authorities in England, especially those holding degrees and those in professional occupations (Dorling and Rees, 2003). These highly mobile groups may find themselves temporarily in low status neighbourhoods, where they are socioeconomically incongruent. Such neighbourhoods, termed 'transit' neighbourhoods (Robson *et al.*, 2008), may not serve as a source of friendship for high status mothers. It is important to note that this may not necessarily be due to the socioeconomic composition of such neighbourhoods, but because of the transient role that they play for geographically mobile people.

Explaining the *lack* of significance of neighbourhood status for local ties amongst the lowest status mothers

If socioeconomic homogeneity were to have a strong effect on the formation of neighbourhood ties, then one would expect the lowest status mothers to have the highest risk of being locally disconnected in high status neighbourhoods. However, this was not found in the general analyses (although found in sensitivity analysis of London subset - see below). Instead, the lowest status mothers' risk of having no friends amongst the analytical sample did not vary by neighbourhood status (see Figure 4.6). Why were they not more locally connected when they were socioeconomically congruent in low status neighbourhoods, as found amongst the highest status mothers?

It must be noted that several factors are known to influence the formation of local friendships beyond status congruity. In a large study of neighbourhoods across Great Britain, conducted in the 1980s, three such factors in particular were found to be strongly and relatively consistently associated with the prevalence of local ties (Sampson, 1988). The first was the **stability of a neighbourhood**, measured as the rate of migration in and out of a neighbourhood. The second was the individual-level equivalent of this, the **length of an individual's residence** in a neighbourhood. The third was the **perception of safety**. Could these factors explain why the pattern of neighbourhood friendship found amongst the highest status mothers was not found for the lowest status mothers?

The first factor, neighbourhood stability, is an unlikely factor to explain why the lowest status mothers were not more locally connected in low status neighbourhoods. This is because the rate of neighbourhood instability has not been shown to be significantly different in low status neighbourhoods compared to high status neighbourhoods (Bailey and Livingstone, 2007). The second factor, the length of residence, may partly explain the lack of a pattern amongst the lowest status mothers. This is because, after inspection of the data, I found that amongst these mothers, the average length of time in residence by the third wave of the cohort study was about 6 and a half years in low status neighbourhoods, compared to 8 years in high status neighbourhoods. As such, the slightly shorter length of residence in low status neighbourhoods might counteract the positive effect of socioeconomic congruence on developing local connections in low status neighbourhoods. Finally, the third factor, the perception of safety, may reinforce this counteracting effect. Amongst the low and lowest status mothers, 12% of those who lived in low status neighbourhoods felt unsafe in their area, compared to 5% of those who lived in high status neighbourhoods. Of the highest status mothers who lived in low status neighbourhoods, only 4% felt unsafe in their area. This may be a reflection of previous work that has found that, despite the lower rates of burglaries and muggings committed against lower socioeconomic groups in the UK, such groups are more likely to feel unsafe compared to high socioeconomic groups, when walking in their own neighbourhood (Pantazis and Gordon, 1999).

In summary, the slightly shorter average length of residence, and the higher rate of feeling unsafe amongst the low and lowest status mothers, may counteract the positive effect of socioeconomic congruence on developing local ties. This balance of effects in low status neighbourhoods may explain the lack of significance of neighbourhood status for local ties amongst the lowest status mothers. Nevertheless, this is still distinct from the finding that high and highest status mothers are less likely to be locally disconnected in high status neighbourhoods (significant cross-level interaction term). Indeed, as discussed below, in London, the pattern found amongst the highest status mothers is reversed for the low and lowest status mothers.

London: 'gentrification' and 'second neighbourhoods'

After analyses of subsets of the analytical sample, I found that the cross-level interaction effect was most clearly demonstrated in London, where the proportion of low and lowest status mothers who have no neighbourhood friends is 8% in low status neighbourhoods, the same in mixed status neighbourhoods, then is significantly higher at 17% in high status neighbourhoods (see Figure A4.1 in the Appendix). Separate analyses that I conducted that used a measure of mothers' perception of the unfriendliness of their neighbours followed the same pattern in London (see Figure A4.2 in the Appendix). It may be the case that in London, the positive social effects of high status neighbourhoods, such as the slightly longer time in residence and better perception of safety, may not be as significant in counteracting the negative social effects of socioeconomic incongruity experienced by low and lowest status mothers.

Along with the South West and South East, London has the highest levels of socioeconomic inequality in England (Wilcox, 2005). It may seem that this alone might explain why socioeconomic incongruity may be more likely to lead to local disconnection in London compared to the rest of England, but this does not explain why the same pattern is not found for the rest of the south of England. I propose that there are two characteristics that are specific to very large cities such as London, which may play particular roles in explaining local disconnection for the socioeconomically incongruent. The first is the relatively fast pace and frequent occurrence of **'gentrification'**, which may have a particular relevance for long-term residents of a neighbourhood. The second is the particular extensiveness of the transport network, allowing the maintenance of **'second neighbourhoods'** from which to source social networks, which may have a particular relevance to people who migrate within the city.

‘Gentrification’ is the process whereby low status neighbourhoods receive a high influx of migrants who are of higher relative status, to the point where the socioeconomic composition of the neighbourhood is eventually changed (see next chapter for more detail). In a study of the most deprived 20% of neighbourhoods within urban areas in England, it was found that of the cities studied, London has the highest proportion of its deprived neighbourhoods that can be classified as gentrifying - or what the authors termed ‘improver’ neighbourhoods (Robson *et al.*, 2008). If this finding is also an accurate reflection of the recent history of London, then previously gentrifying neighbourhoods may now actually be gentrified, and no longer deprived. Indeed, some of these gentrified neighbourhoods may be captured in this chapter’s analyses as high status neighbourhoods.

Yet, some low status residents may have stayed in these neighbourhoods, and as a result of gentrification, these remaining - now incongruent - residents may have weaker ties to their neighbourhood due to the displacement of old neighbourhood friends and the incomplete integration of a new 'type' of neighbours.

On the other hand, of those low status mothers who have moved from low status neighbourhoods to high status neighbourhoods, social networks may remain centred around their previous neighbourhoods - what has been termed by researchers in the US as 'second neighbourhoods' (de Souza Briggs *et al.*, 2010). This particular phenomenon was found in evaluations of an intervention study conducted in the US, called 'Moving to Opportunity', whereby a random selection of participants from different large cities across the US were given the option of moving from deprived neighbourhoods to richer neighbourhoods within their cities. The most frequently found pattern of social network development was the maintenance of a core group of kin and friendship connections that was based not in the new neighbourhood, but in the old neighbourhood, supported by bus and train route links. Indeed, often, in cases where such connections could not be maintained because of distance or poor transport, participants who had moved to their new neighbourhoods relocated back to their original neighbourhoods.

Potentially, the combination of the effects of gentrification on mothers who are long-term residents, and the maintenance of second neighbourhoods by mothers who move, may explain the London-specific pattern where 17% of low and lowest status mothers have no neighbourhood friends in high status neighbourhoods, from a baseline of 8% in mixed or low status neighbourhoods.

Different results for 'actual' social/emotional support

The measure for neighbourhood friendship captures an aspect of the structure of social networks. However, as I discussed earlier in this chapter, whether somebody has friends in their neighbourhood does not necessarily mean that they receive a high level of social support. In other words, the structure of one's social network does not reveal exactly how it functions. The analysis of the functioning of the social network of mothers, in terms of receiving social support, was conducted using a measure of emotional support - whether they felt that they had somebody to share their feelings with. Note that it is the supportive aspect of social contact that has been most consistently associated with health outcomes. The results of this analysis of emotional support indicate no significant cross-level interaction effects. This is persistently the case after sensitivity analyses, including those that were specific to the north or south of England, or specific to London.

From the lack of any cross-level interaction effect on emotional support, one may conclude that status incongruity does not have an important influence on this functional aspect of social wellbeing. In the stratified analyses of emotional support, it was revealed that a relatively high proportion of the variation in emotional support was due to differences between neighbourhoods (20% amongst highest status mothers and 10% amongst lowest status mothers - see Table 4.5). The fact that these proportions did not change significantly and remain high after adjustment for sociodemographic controls, nor after simultaneous adjustment for neighbourhood status, means that other neighbourhood characteristics, or individual-level characteristics that are geographically segregated, are likely to be important influences on emotional support, and if neighbourhood status or incongruity were to have some role, it would be secondary to those of other characteristics. It must be noted however that the measure that I have used to capture emotional support is based on only one question, and therefore may be too limited for reliably measuring emotional support.

Implications of the findings on the status comparisons theory

As I discussed in the beginning of this chapter, the measure in the MCS that is most closely related to self-evaluation and status comparisons is self-esteem. The findings on self-esteem show that it is not significantly affected by status incongruity. As such, it may be concluded that the negative self-evaluation that results from upward status comparison is not significantly exacerbated by neighbourhood exposure to people of higher status.

The North: Socioeconomic segregation and stigma

Sensitivity analyses were conducted to inspect whether self-esteem effects may operate at a different scale, in particular parts of England, or whether further analytical sensitivity was required to find any cross-level interaction effects. I found that results were not changed by repeating analyses with the Rosenberg Scale modelled as a continuous outcome, nor by setting the neighbourhood context at the OA-scale instead of the MSOA-scale, nor by using the analytical sample from the previous chapter, which may be a more valid analysis as the questions used to produce the Rosenberg Scale were all asked at the first wave of the cohort study. However, when analyses were restricted to the north of England, I found that mid and low status mothers were more likely to have low self-esteem when they were living in increasingly higher status neighbourhoods[1] (see second column of ORs in Table A4.3 in the Appendix). These interaction terms were of borderline significance (for low status $p = 0.076$; for mid status $p = 0.082$).

With respect to status comparisons, it was surprising to find the effects of status incongruity on self-esteem most apparent in the north of England, as the south of England typically has higher levels of socioeconomic inequality. For example, the South West, London, and the South East, have the highest ratios of average mortgages to average incomes in England, reflecting the polarity amongst the inhabitants of those regions (Wilcox, 2005). It may be that a phenomenon other than exacerbated status comparisons may explain the effects on self-esteem in the north of England.

A potential phenomenon to explain the discrepancy between the north and the south of England is stigma that may be particularly experienced by low status mothers who live in high status neighbourhoods in the North. What might make such stigma particular to the North is the 'type' of status incongruity related to the neighbourhood. By type, I specifically differentiate between **'isolated'** individuals and **'segregated'** individuals. A lower status mother who lives in a high status neighbourhood may have no neighbours in her immediate surroundings, such as her street, who share similar socioeconomic characteristics. On the other hand, she may be part of a small community of neighbours

1 For the purposes of these analyses, neighbourhoods considered to be in the north of England are those in the following regions: North West, North East, Yorkshire and The Humber, West Midlands, and East Midlands. Neighbourhoods considered to be in the South of England are those in: London, East Anglia, South East, and South West.

who are socioeconomically similar, but differ from the surrounding neighbourhood. The former situation is what I refer to as being socioeconomically isolated, and the latter as being socioeconomically segregated (see next chapter for further details).

Based on the definitions above, in the North, 26% of the low or lowest status mothers in the analytical sample who live in high status neighbourhoods are socioeconomically segregated, compared to 13% in the South[1]. This may be reflective of previous findings that the most socioeconomically segregated local authorities and wards are located in the North and Midlands (Meen *et al.*, 2005). The stigma that may be particularly felt by low status mothers who are socioeconomically segregated, as opposed to isolated, may be related to the reputation that these low status enclaves take on within high status neighbourhoods. Indeed, in a study of areas in the Australian town of Victoria, it was found that stigma was most likely to be reported in deprived neighbourhoods, leading to both poorer health and worse life satisfaction (Kelaher *et al.*, 2010). This phenomenon, related to the segregated type of status incongruity, may explain the region-specific findings for self-esteem from these sensitivity analyses.

Implications of the findings on the role of depression or serious anxiety

Unlike low self-esteem, poor neighbourhood friendships, and low emotional support, depression and serious anxiety may develop further 'downstream' in the psychosocial health pathway. At the same time, they may also be a mediator of poor health behaviours and poor physical health. As such, mental health is potentially a sensitive measure of the health effects of status incongruity that is proximal both to eventual chronic health outcomes, and to the experience of status incongruity.

London and the South: Significant effects of status incongruity where inequality is highest

Despite its theorised central location in psychosocial pathways to health, the analysis of depression or serious anxiety showed no significant findings of cross-level interaction

1 Low or lowest status mothers who live in high status neighbourhoods (MSOAs) were defined as 'segregated' if they were living in low status OAs within the MSOA. They were defined as 'isolated' if they were living in mixed or high status OAs within the MSOA.

effects. Nevertheless, the results of the stratified analyses (Table 4.7) and visual inspection of the results of the full analysis (Figure 4.6) were suggestive of a detrimental effect of high status neighbourhoods for the lowest status mothers, whilst showing a significantly beneficial effect of such neighbourhoods for the highest status mothers. After conducting several sensitivity analyses, I found that when modelling neighbourhood status as a categorical instead of a continuous variable, the detrimental effect of high status neighbourhoods for lowest status mothers was indeed a significant departure from the association for highest status mothers (significant cross-level interaction term - see Table A4.5 in the Appendix). I also found that this detrimental effect of status incongruity was most pronounced in **London and the south of England** (see second and third columns of ORs in Table A4.4 in the Appendix). As already discussed, these are the parts of England where socioeconomic inequality is highest.

Mechanisms for the effects of status incongruity on depression and serious anxiety in London and the South

The fact that depression or serious anxiety is most affected by status incongruity in London and the South suggests that this outcome is sensitive to incongruity in the particular context of high socioeconomic inequality. It would therefore seem that more contrasting **status comparisons** would be a likely mechanism to increase the likelihood of depression or serious anxiety for the lowest status mothers living incongruently in high status neighbourhoods. This would be consistent with the explanations on self-evaluation, regarding the first theoretical incongruity-related mechanism discussed in the beginning of this chapter (also see Chapter 2). However, the measure that I have used in analyses in an attempt to capture status comparisons - self-esteem - is most clearly associated with status incongruity in the North, as opposed to London and the South. Of course, as discussed above, it may be the case that self-esteem is more strongly affected by stigma that is related to socioeconomic segregation, than negative self-evaluation that is related to direct status comparisons. As such, self-esteem may not be a particularly precise measure for capturing differences in status comparisons between neighbourhoods, despite its association with peer comparisons and self-evaluation in general (Rosenberg and Pearlin, 1978). Taking these things together, it is unclear whether the cross-level interaction effect for depression or serious anxiety that is found in London and the South is necessarily due to increased status comparisons for the lowest status mothers who are socioeconomically incongruent.

The second theoretical incongruity-related mechanism, discussed in the beginning of this chapter (also see Chapter 2), which has been found in previous studies to affect the progression of depression and anxiety, is that of **social support** (Brown *et al.*, 1986, Bolton and Oatley, 1987, Stansfeld *et al.*, 1998b). However, the measure I have used to capture social support - having somebody to share feelings with - is not associated with status incongruity in analyses in this chapter. As such, it is unlikely that this is the mechanism that drives the findings for depression and anxiety. Because of the uncertainty in the status comparison-based explanation, and the lack of findings regarding social support, other explanations must be considered outside those that I have outlined throughout this thesis. I have discussed some examples of these potential explanations above in relation to the findings in this chapter, such as the **stigma related to segregation** of low status enclaves within high status neighbourhoods, and the destabilising effects of **gentrification** on longterm low status residents.

Limitations

In the discussion section of the previous chapter, I discussed the key limitations of the types of analyses that I have conducted using the MCS. In particular, I discussed the issues of high variability within neighbourhoods, the dependence between individual and area-level factors, the cross-sectional nature of the measures used, and the lack of dynamic measures of neighbourhood social milieu (e.g. residential stability and socioeconomic trajectory). The analyses in this chapter are not free from these limitations (refer to the last chapter for a review of these limitations), and in addition, they may be particularly limited in identifying psychosocial health pathways for further reasons discussed below.

The **sample size** of the analytical sample used in this chapter is reduced because of the omission of mothers who moved neighbourhoods at any point between the first and third waves of the cohort study. This is especially problematic for the lowest status mothers, where only 29 mothers in this chapter's analytical sample were living high status neighbourhoods, compared to 62 in the analytical sample of the previous chapter. The failure to find cross-level interaction effects may be partly attributed to the the reduced sample size, although this cannot be ascertained. What is more, as I noted above, the remaining sample may be biased due to particular sociodemographic characteristics of mothers who stay in the same neighbourhood over the three sweeps of the MCS.

Two distinct **types of status incongruity**, socioeconomic isolation and socioeconomic segregation, are treated as the same phenomenon in the analyses throughout this chapter. This may have implications for the type of psychological pressures that are experienced, as discussed above. The next chapter will look at socioeconomic segregation within neighbourhoods in particular to assess whether low status enclaves within high status neighbourhoods are more disadvantaged than low status localities located within similarly low status neighbourhoods. For the purposes of the analyses using the MCS in this chapter, such a distinction between the two types of status incongruity in classifying mothers could not be made because of sample size restrictions.

The measures for the two **theoretical health pathways** - status comparisons and social support - were not necessarily captured with accuracy, especially in the case of status comparisons. However, it must also be noted that other pathways that could not be investigated in the MCS may be more accurate in depicting the health processes related to status incongruity. Examples that are discussed above include the effects of gentrification and the effects of segregation on reputation and stigma. Other examples might include the effects of status incongruity on the affordability of daily expenses, and on the provision of specialised services. Nevertheless, in this thesis I am interested in finding whether psychosocial health pathways in particular are triggered by status incongruity.

Chapter Conclusions

From the analyses reported in this chapter, there is no conclusive support for the hypotheses that were set out at the beginning of this chapter, which were that living in high status neighbourhoods is less beneficial for the 1) mental wellbeing and 2) social wellbeing of low status individuals compared to high status individuals. Instead, such cross-level interaction effects were not consistently evident. This is summarised in Table 4.9 below.

Table 4.9 Summary of findings after sensitivity analyses

	Specific findings for cross-level interaction effects (i.e. whether association between neighbourhood status and the outcome was different for lowest status mothers compared to highest status mothers)
Mental Wellbeing	
Depression/Serious Anxiety	Most pronounced in London and the South
Low Self-Esteem	Only found in the North
Social Wellbeing	
No neighbourhood friends	Most pronounced in London
Low emotional support	No indication of any cross-level interaction effects

Although for both measures of mental wellbeing, wellbeing is more improved by neighbourhood status for the highest status mothers, than for the lowest status mothers, these findings are specific to different parts of England. Particularly in London and in the South, there is a clear difference in the relationship between the likelihood of depression or serious anxiety and the neighbourhood status for the lowest status mothers, compared to the highest status mothers. For the likelihood of having low self-esteem, this differential effect is only found in the North.

The reasons for the contrasting geographical specificity of these cross-level interaction effects for the two mental wellbeing outcomes, may be because of the difference in the incongruity-related phenomena that each outcome is sensitive to. For example, low self-esteem may be particularly strongly influenced by the stigma due to socioeconomic segregation within neighbourhoods. This may be why cross-level interaction effects on self-esteem are only evident in the North, where lower status mothers are more likely to be segregated than in the South. However, because of the uncertainty in identifying which outcome is sensitive to which phenomenon, these findings have inconclusive implications for the theory that starker or more frequent status comparisons amongst the socioeconomically incongruent may lead to poorer mental wellbeing.

For measures of social wellbeing, only neighbourhood friendship is affected by status incongruity, and the effect is most pronounced in London. The finding that emotional support is not affected by status incongruity conflicts with the theory that high status neighbourhoods may lead to poorer functional social wellbeing, despite evidence for poorer neighbourhood ties.

At the beginning of this chapter, I described the theoretical role of status comparisons and social support in attenuating the detrimental health effects that low status individuals may be exposed to in low status neighbourhoods. Having analysed data from the Millennium Cohort Study that relate to indicators of both status comparisons and social support, the evidence that I have derived to support such theories is relatively weak. Nevertheless, as discussed in the previous chapter, using the same data, I found that the rates of low self-rated health and obesity amongst the lowest status mothers are not as strongly and beneficially associated with neighbourhood status as amongst the highest status mothers. It must be noted that analyses of depression or serious anxiety in this chapter follow the same pattern. Taking all things together, although some physical health, mental health and health behaviour outcomes are found to support the relative status hypothesis, any intermediate factors remain to be conclusively identified.

5

Local Segregation: Living in Low Status Enclaves within High Status Neighbourhoods

- **Aim of this chapter**
  The aim of this chapter is to investigate whether, in London, people living in low status city blocks within high status neighbourhoods experience better health, compared to those who live in low status city blocks within low status neighbourhoods.

The secondary aim of this thesis is to explore the health implications of the socioeconomic segregation of poor people within particular parts of a larger neighbourhood - what I refer to here as 'local segregation'. Although being isolated as the only poor person on an affluent street of a rich neighbourhood is a relatively rare situation, the local segregation of poor communities into enclaves within rich neighbourhoods has become relatively common in urban England. In the previous two chapters I have presented the results of analyses of the Millennium Cohort Study that may add to the understanding of local segregation. However, due to sample size constraints, those analyses were not specific to local segregation, therefore their findings are most appropriately interpreted in the context of general status incongruity. In this chapter, I use census data from London in 2001 in order to directly investigate the specific type of status incongruity that is characterised by local segregation. As such, in this chapter I address the secondary aim of the thesis.

5.1 Background

Populations in cities are unevenly distributed by age, ethnicity and socioeconomic status. In other words, cities are 'segregated'. This chapter is a study of the health effects of socioeconomic segregation in London, specifically the effects of socioeconomic segregation between small areas, referred to here as '**city blocks'**, within their larger neighbourhoods[1]. Before discussing what is currently known about the health effects of local socioeconomic segregation, and why it is important to investigate these health effects further, I begin with an overview of the origins and current levels of local segregation.

The Extent and Causes of Local Segregation

Patterns of socioeconomic segregation at many geographic scales are evident across the UK. One way of quantifying the extent of segregation for a particular socioeconomic group is by calculating the proportion of that group who would have to move location so that the group becomes evenly distributed across the UK. That proportion is called the **'dissimilarity index'**. In a study that used this measure to investigate the segregation of households between local authorities in Great Britain by different socioeconomic characteristics in 2001, it was found that, of all socioeconomic groups, council housing was the most segregated (Dorling and Rees, 2003). Almost a quarter of council housing residents would have had to relocate to other local authorities to be evenly distributed[2]. This figure was 9% for managers and senior officials, 11% for professionals, and 13% for degree holders. Compared to earlier census years, most socioeconomic groups had become more segregated by 2001.

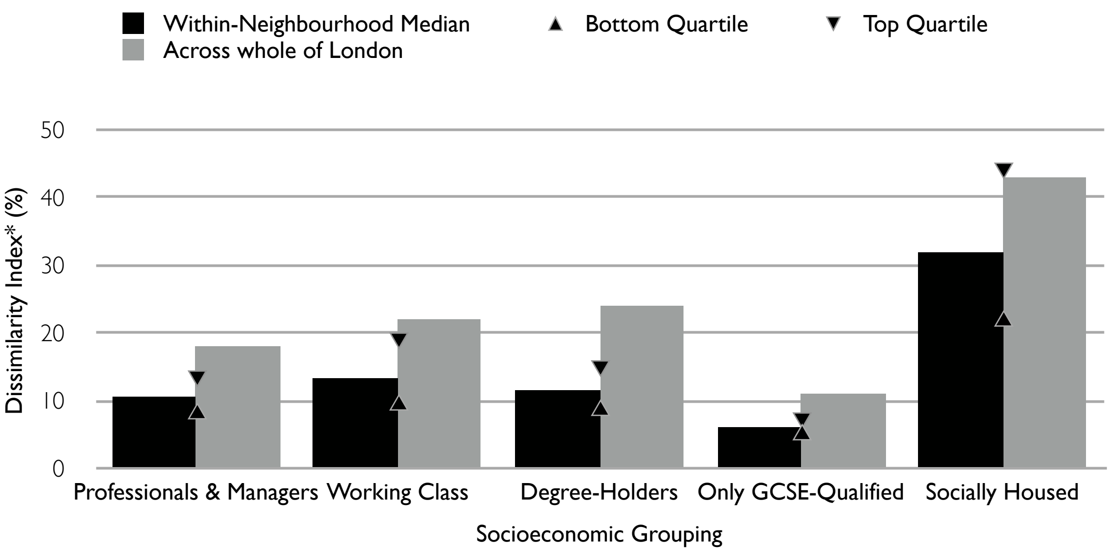
The dissimilarity indices above describe a Britain segregated across local authorities. This chapter is concerned with segregation on a smaller scale - what is referred to here as **'local segregation'**. Based on unemployment, the most segregated local authorities and wards in England are in the urban North and urban Midlands, thus it could be said these regions

1 City blocks are operationalised as census output areas (OAs), and neighbourhoods as middle-layer super output areas (MSOAs). See Methods section in this chapter for details.

2 The terms 'district' and 'local authority' are used interchangeably. Within London, local authorities are more commonly referred to as 'boroughs'.

have the highest levels of local segregation in England (Meen *et al.*, 2005). Within London, segregation can be measured across the entire city, and local segregation can be measured within individual neighbourhoods. Figure 5.1 below is a bar chart with the dissimilarity indices of various socioeconomic groupings in London. The light bars show levels of segregation across all neighbourhoods in London and the dark bars show the median levels of local segregation across smaller areas, what I refer to as 'city blocks', within neighbourhoods. Patterns of city-wide segregation and local segregation are similar, such that social housing is the most segregated socioeconomic grouping between neighbourhoods, as well as between city blocks within neighbourhoods.

Figure 5.1 Levels of City-Wide and Local Segregation for different Socioeconomic Groupings in London



* The Dissimilarity Index is the proportion of that group which would have to move so that the group becomes evenly distributed across all areas.

NB: I calculated Dissimilarity Indices for this chart using 2001 Census Data. The index for city-wide segregation across London (dark bars) represent segregation between MSOAs. The median index for local segregation within neighbourhoods (light bars) represent the average segregation between OAs (city blocks) within MSOAs. Note that although I refer to OAs as city blocks, the boundaries of a single OA does not always demarcate a single block. I use the term 'city block' for clarity in order to differentiate from 'neighbourhoods' which are made up of several city blocks.

There are several causes for urban populations in particular to be socioeconomically segregated in Britain. Historic foundations for urban segregation include 'suburbanisation' and 'gentrification'. **Suburbanisation** is the relocation of certain households to the fringes of cities. It developed through improved commuter access to city outskirts, but was predominantly pursued by households who had choice over where they lived - generally high-income families (Savage *et al.*, 2003: 83-87). The UK's pattern of suburbanisation is less extensive and more socially heterogenous than that of the US. This is partly because in the UK, a degree of suburban industrial resettlement offered local manual jobs, whilst some suburbs were planned with the idea of class mixing. For example, Bedford Park in Chiswick, created after the London Underground's District Line expansion in the 1870s, was planned with the intention to bring liberal professionals and artists alongside the middle class, similar to Hampstead Garden suburb, built in the north of London in the beginning of the twentieth century (Cheshire, 2007). Consequently, city-wide segregation through suburbanisation of high socioeconomic groups was accompanied by local segregation between socioeconomic groups within suburbs.

The inner city became more deprived, as it was left behind by high-income households that moved to the suburbs, and eventually became more diverse and locally segregated through gentrification. In broad terms, **gentrification** is the inflow of high-income city migrants from the suburbs and rural areas into previously deprived central areas in the city (Savage *et al.*, 2003: 87-94). The process increases local socioeconomic diversity, but despite that, different socioeconomic groups may settle in a segregated pattern within gentrifying areas, therefore creating local segregation. Gentrified areas are themselves often segregated from their wider surroundings.

As well as being a product of internal migration, socioeconomic segregation in cities partly reflect wider economic inequalities. It has been suggested that cities in the UK are particularly unequal because of the transition of industry from manufacturing to professional services that employ a highly-paid workforce, whose daily needs are catered for by low-paid routine workers (Savage *et al.*, 2003: 97-100). Regardless of how economic inequalities are generated and maintained in cities, the unequal distribution of income creates polarised selling and letting housing markets. The costs of living in the most desired areas are only affordable to a minority, and as the purchasing power of this minority increases so does the exclusiveness of the top end of the housing market. The geographic scale at which the housing market distinguishes areas varies, therefore the extent to which it promotes local segregation depends on the nature of the local market.

Finally, the state can contribute to local segregation in cities as they control the locations of council housing and pass regulations to diversify the tenure mix of new housing developments. The remaining council-owned housing stock has become lived in by steadily more impoverished households, leading to higher concentrations of deprivation in certain council estates where few tenants have bought their flats in the 'right-to-buy' scheme. If located in relatively wealthy areas, these estates become 'pockets' of deprivation, visible examples of local segregation of the disadvantaged. In order to break patterns of segregation, new housing developments in some of London's boroughs are obligated to include some affordable housing (Cheshire, 2007). Despite the intentions of the regulations to encourage socioeconomic diversity, private developers are permitted to distribute their affordable housing stock, such as mixed-equity schemes and council-rented units, in any spatial pattern throughout a new development. As a result, these developments can be characterised by socioeconomic segregation at a particularly small scale.

Local Segregation and Health

The cross-level interaction studies reviewed in Chapter 2 investigate individual health as affected by socioeconomic status in combination with the socioeconomic status of the residential areas. Those which analysed physical morbidity do not arrive at a consensus, although those which analysed mortality are relatively consistent in finding higher rates for low status individuals who are isolated in higher status areas, compared to their counterparts who live in low status neighbourhoods (Yen and Kaplan, 1999, Veugelers *et al.*, 2001, Roos *et al.*, 2004, Wen and Christakis, 2005, Winkleby *et al.*, 2006). Studies of the health effects of neighbourhood inequality are less consistent. Forty of these studies reviewed by Wilkinson and Pickett (2006) measured inequality at geographic levels equivalent to counties, census tracts and parishes. Twenty-six showed some evidence of an association between local inequality and poor health.

Overall the evidence from the studies above suggests that socioeconomic incongruity to the neighbourhood can be harmful to health, and that this is most clearly observed when measuring mortality. However neither the cross-level interaction studies nor the local inequality studies used methods that specifically measured the form of socioeconomic incongruity that results from local segregation, that which is experienced by living in a community that has a socioeconomic status similar to one's own but lower than the surrounding neighbourhood. This can be called **'community status relative to the neighbourhood'**, and is equivalent to the socioeconomic segregation of a small community within its larger neighbourhood. In this form of socioeconomic incongruity, low status individuals in high status neighbourhoods are not 'alone' in their experience of relative status as they live amongst a community within a small area that have the same status relative to the surrounding neighbourhood. As this is not explicitly measured in the cross-level interaction studies nor the local segregation studies, the understanding of the health effects of relative status to the neighbourhood in the context of local segregation cannot be reliably informed by their results.

Community status relative to the neighbourhood can be captured by measuring the level of inequality between areas within a neighbourhood. Such an ecological study which measured the inequality between wards within local authorities found a detrimental effect of inequality on health, controlling for deprivation (Ben-Shlomo *et al.*, 1996). In this study, the inter-quartile range of ward-level deprivation within each local authority was used as a measure of inequality. Although results from this study were interpreted in the same way as the local inequality studies reviewed by Wilkinson and Pickett (2006), the ecological study above had a measure of inequality that essentially also measured the local socioeconomic segregation between wards within local authorities, therefore the study's findings can be interpreted as a detrimental health effect of local segregation. However, the observed health effect in that study is measured at the level of the local authority, therefore the differential health effects for wards of different relative status cannot be derived. As a result, the findings from that study cannot be directly generalised to the health effect of community status relative to the neighbourhood, the principle aim in this chapter.

Local segregation and community status relative to the neighbourhood may come with health risks that are additional to those of *individual* status relative to the neighbourhood. These may come about as a consequence of the increased visibility that a socioeconomically isolated city block has compared to a 'lone' socioeconomically isolated household. On top of this, the segregation of poor city blocks into enclaves within rich neighbourhoods may be accompanied by other differences, such as differences in housing tenure and levels of deprivation. In this investigation, given its highly segregated distribution, housing tenure is analysed as a potential mediator of the pathway between local socioeconomic segregation and health. Possible mechanisms are explored in the discussion section.

As such, the two hypotheses that are investigated in this chapter are:

1) Neighbourhood socioeconomic status has a different association with the health of low status city blocks compared to high status city blocks
2) These differences in the health associations of neighbourhood socioeconomic status are explained by differences in levels of social housing.

The rationale for pursuing this investigation into local segregation is because of its practical relevance to low status people in England who are socioeconomically segregated into poor enclaves within rich neighbourhoods in the UK. Looking towards the future, these findings may offer some insight into the health and social implications of two housing policies in the UK: one that is currently being implemented, and one that is due to be implemented in the near future. The first policy is the regulation by some local authorities that stipulates that new housing developments must commit to providing some proportion of accommodation for social renters. The second policy is the planned reduction of housing benefit through a new maximum entitlement and a recalculation of Local Housing Allowance, the benefit given to claimants in private accommodation. The latter will change from the present method of matching the median local rental price to a new method of matching the bottom 30th percentile of local rental price. The first policy has the potential of increasing local socioeconomic segregation due to the practice of constructing accommodation for social renters in secluded parts of new developments. The second policy might also increase local segregation through limiting the choices of affordable accommodation to less desirable parts of high status neighbourhoods, whilst at the same time it may increase wider socioeconomic segregation due to the likely emigration of poor residents away from rich neighbourhoods. Since the second policy is most likely to have an effect on low status households in London, due to its high housing costs, this investigation is focused on this city. The health effects and their causes associated with socioeconomic segregation may suggest whether these policies are more likely to improve or worsen the health and social wellbeing of poor people in the UK, and in London in particular.

5.2 Methods

The methods I use for the analyses in this chapter are similar to those I used in the previous two chapters. The major differences are to do with the particularly diverse socioeconomic composition of London compared to the rest of the UK; and to the continuous nature of the health and social outcomes analysed in this chapter, which are area-specific proportions, compared to the bivariate health and social outcomes analysed in the previous two chapters.

Data and Areas Sampled

Apart from estimates of the Index of Multiple Deprivation (IMD), all data used in this study come from the 2001 UK Census Key Statistics, and Univariate Tables. Data were downloaded from 'Casweb' in 2010 (http://casweb.mimas.ac.uk). Casweb is the online data interface run by the Census Dissemination Unit (CDU) in Manchester.

The 2004 IMD is only used for discussion, and not analytical, purposes in this investigation. It was originally created by the Social Disadvantage Research Centre (SDRC) at the University of Oxford. The index was calculated for lower-layer super output areas (LSOAs). In this study, it was required at a smaller spatial scale, the output area (OA). Estimates of OA IMD rank were modelled by Oxford Consultants for Social Inclusion (OCSI). Details on the modelling are given by OCSI (http://www.ocsi.co.uk/news/2009/02/19/oa-imd-2004/). These IMD estimates were downloaded from the OCSI website.

This study is focused on the Greater London region, here referred to simply as London. In London, as measured by the 2001 census, there were 7.2 million residents living in 3 million households. The unit of analysis in this study is the OA, here referred to as the 'city block' and in some instances, the 'community'. In London, there are 24,140 city blocks. Note that they are not necessarily exactly contiguous blocks bounded by streets or roads. The term is used to approximate the spatial characteristics of a London OA. They are nested within 983 middle-layer super output areas (MSOAs), here referred to as ‘neighbourhoods’. Neighbourhoods contain 16-44 city blocks with a mean of 25.

Data from all London neighbourhoods were used in this study, but some city blocks were excluded. Specifically, 4,897 city blocks were excluded mainly to standardise geographical size and to constrain population density. City blocks in London are skewed towards having small geographical sizes, but the distribution of their sizes shows a very long tail made up of a minority with large size. For this reason the top decile by area size was excluded, removing 2,414 city blocks over 10 hectares from the sample. The smallest blocks had exceptionally high population densities, and in some cases, were extreme outliers. For this reason, the bottom decile by area size was also excluded, removing a further 2,428 communities under 1.38Ha from the sample. Examples of excluded large ‘city blocks’ include some that encompass parks, where geographical proximity between residents is not reliable. An additional 55 city blocks were excluded because the ‘City Block Status Score’, described below, could not be estimated. After exclusions, the number of city blocks, the analytical sample size, is 19,243, with a mean population size of 300, varying from 114-1229 (inter-quartile range: 259-335).

Spatial Scales: City Blocks within Neighbourhoods

OAs and MSOAs, the spatial units used to represent city blocks and neighbourhoods, respectively are described in the methods section of Chapter 3, and will not be described in detail here. OAs are used in this study to operationalise geographic communities as the unit of analysis. The reason for choosing OAs as the unit of analysis is because they are the smallest scale with available population data. This maximises the chance of homogeneity, which allows for a more reliable interpretation of analyses, and minimises the risk of the ‘ecological fallacy’, whereby average characteristics and associations are inappropriately assumed to be valid for all residents of an area. Nevertheless, it is understood that despite the small size of OAs in London, many are likely to be heterogenous in sociodemographic characteristics. OAs are simply the scale where populations are least heterogenous. The choice of MSOAs to represent neighbourhoods is explained in the methods section of Chapter 3. The way in which OAs fit within MSOAs is also shown in Chapter 3 (Figure 3.3).

City Block and Neighbourhood Status Scores

In this study, the exposure of interest is the socioeconomic composition of a city block relative to the socioeconomic composition of the neighbourhood within which it is located. This way socioeconomic incongruity of city blocks can be captured. Regarding the larger neighbourhood, what is important to this investigation is the probability of coming into contact with people and places of higher or lower socioeconomic status. In order to capture this, I use occupational and educational ratios at the level of both the city block and the neighbourhood. More detail regarding the rationale for using ratios is discussed in the methods section of Chapter 3.

The way in which census data is used to create the ratios to create a status score at the city block and neighbourhood scales is also explained in the methods section of Chapter 3. However, because of the higher average educational qualifications in London compared to the rest of England, the educational ratio that I use in the analyses in this chapter is slightly different to that used in the previous two chapters. In the previous two chapters, the proportion of residents in an area with qualifications beyond secondary education was divided by the proportion of residents in an area with no qualifications. This is because in England, the average proportions of people with these two levels of qualification are approximately equal. For the analyses in this chapter, the proportion of residents in an area holding degrees was divided by the proportion with secondary education and below. Descriptions of these levels of qualification are as follows:

- **Degree-holder:** Includes a first degree, a higher degree, qualified teacher status, medical doctor qualification, dentist qualification, and nurse qualification.
- **Educated up to Secondary Education:** Educated up to an equivalent of 1 A-level.

As with the previous two chapters, the educational and occupational ratios were subsequently standardised into their z-scores for neighbourhoods, and separately for city blocks. The mean of each area's two z-scores were taken as their **'Status Score'**. A high status area would have a high score, and vice-versa. In London, both raw ratio scores were normally distributed across city blocks and neighbourhoods. For both levels, the z-scores for occupational and educational ratios were highly significantly correlated with each other, and the resulting distribution of the status scores across London was normal.

Dependent Variables: Health and Housing

The unit of analysis in this study is the city block. As aggregated, rather than individual outcomes, are analysed, the study is ecological. The outcomes are measured as proportions of residents or households in a community, referred to here as either rates or proportions.

Social Housing

A household is classed in rented social housing if the inhabitants rent through the local authority or a housing association. The number of households in the city block that are in social housing divided by the total number of households is the measure of the level or proportion of social housing that is used in the analyses here.

Limiting Longterm Illness and Low Self-Rated Health

The health outcomes analysed in this study are the proportion of individuals in particular age-groups suffering from limiting long-term illness (LLI) or low self-rated health (SRH) in a city block. This information is available from the census, and was coded as below.

Box 5.1 Coding of Health Outcomes

During completion of the census, in the first page the following question is asked,

Over the last twelve months would you say your health has on the whole been:

Good?/Fairly Good?/Not Good?

The number in the city block over 50 that answered *'Not Good'* divided by the total number in that block over 50 was coded as the **50+ low self-rated health rate**. The same was done for those aged 35-49 to create the **35-49 low self-rated health rate**.

At the top of the second of three personal forms in the census, the following question is asked,

Do you have any long-term illness, health problem or disability which limits your daily activities or the work you can do?

**Include problems which are due to old age.*

Yes/No

The number in the city block over 50 that answered *'Yes'* divided by the total number in that block over 50 was coded as the **50+ limiting longterm illness rate**. The same was done for those aged 35-49 to create the **35-49 limiting longterm illness rate**.

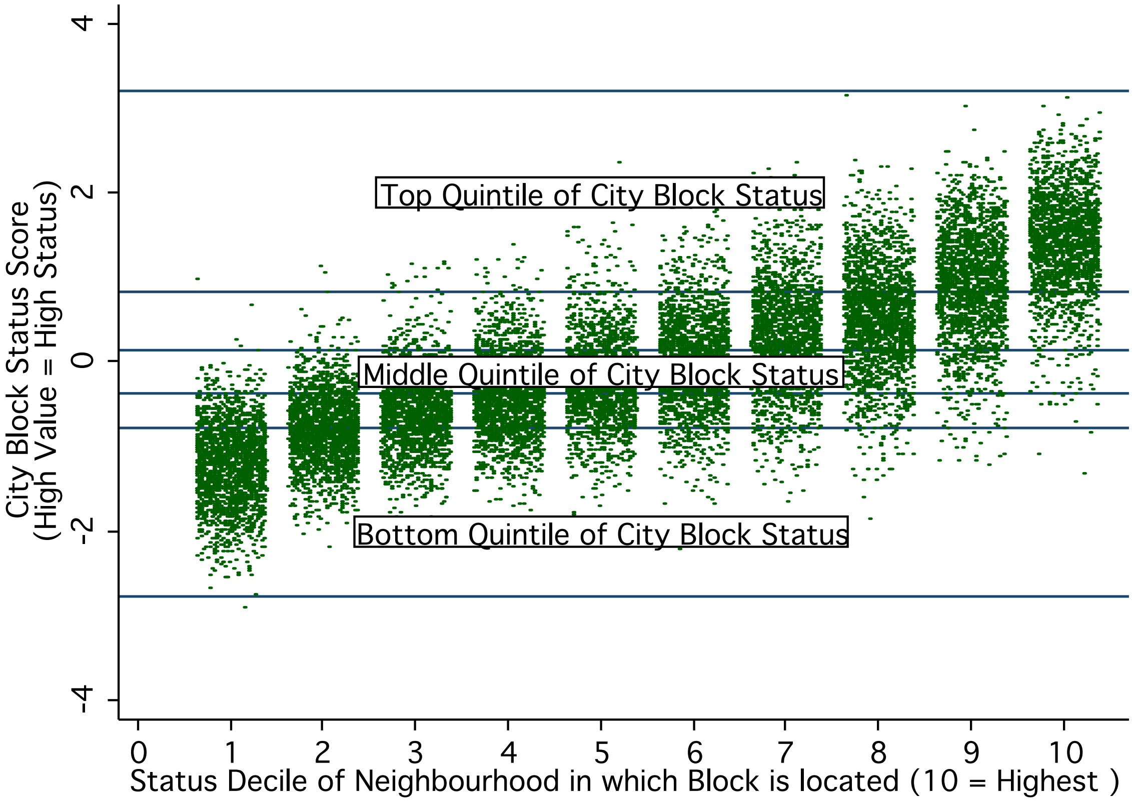
NB: Analyses were age-specific so that results would not be confounded by the age profiles of city blocks. LLI and low SRH below the age of 35 was not analysed because the nature of conditions that may cause poor health at those younger ages are unlikely to be the result of long-term exposure to neighbourhood factors

Statistical Analysis: The Validity of Comparison Groups

This investigation is intended to test whether any inequalities in health between low and high status city blocks are made worse when the surrounding neighbourhood is composed of high status individuals. Note that city blocks are areas nested within neighbourhoods, and so two local city blocks would be within the same surrounding neighbourhood. The approach that I use in the analyses below is to focus on two distinct samples of high and low status city blocks as comparison groups, then analysing how their respective health outcomes are associated with the socioeconomic status of surrounding neighbourhoods. For example, the health outcomes of the lowest status city blocks can be compared across different neighbourhoods, whilst, at the same time, the outcomes of the highest status communities can be similarly compared across neighbourhoods. To test the hypotheses of this investigation, it is important to establish whether neighbourhood status is shown to associate with the health outcomes of low status city blocks differently to high status city blocks. The difference in these associations may be in direction or strength.

A critical assumption in this method of testing is that the status of city blocks within each status category, say of the lowest status category, is comparable across neighbourhoods of all status. Figure 5.2 below is a distribution of city blocks by their status score on the *y* axis, and by the status score of the neighbourhoods in which they are located on the *x* axis. Each green dot represents a city block, and the blue horizontal lines divide the city blocks into quintiles of status, the highest at the top, and the lowest at the bottom. In the top quintile, the highest status city blocks aggregate in the highest status neighbourhoods. In the bottom quintile, the lowest status city blocks aggregate in the lowest status neighbourhoods. If one were to analyse the relationship between neighbourhood status and the health outcomes of city blocks within either of these quintiles, the analysis would likely be confounded by the relationship between the status score of city blocks and their health outcomes. To avoid the potential confounding of such an analysis, the comparison groups used in this study are the second highest quintile and second lowest quintile of city blocks.

Figure 5.2 Uneven distribution of city block status score across neighbourhood status deciles, in the top and bottom city block status quintiles



NB: Each green dot represents a city block. Its position on the *y* axis represents its status score, with the highest status city blocks at the top. Its position on the *x* axis represents the status of the neighbourhood within which it is located, with the highest status to the right. As such, city blocks represented on the top right of this graph are the highest status city blocks located within the highest status neighbourhoods in London.

Another method would be to adjust for any potential confounding factors in a regression analysis. Using this method, city blocks from the 'actual' top and bottom quintiles of status could be analysed. Although the adjustment of confounding factors is frequently used, in the case of severely aggregated data points as seen in the distribution above, simple adjustment by regression is not a sufficient technique to ensure that associations are valid throughout the range of the exposure variable. For example, in the case of the highest status city block quintile above, an adjusted association between neighbourhood status and city block health outcomes would be strongly influenced by the association seen in city blocks located in higher status neighbourhoods. This is because most of these city blocks of the highest status are within the highest status neighbourhoods. Estimated regression coefficients would, in effect, be extrapolated to 'hypothetical' city blocks in lower status neighbourhoods. In statistical terms, the unobservable data points are called the 'counterfactual', as they are counter to fact (Oakes and Johnson: 370).

Another way of expressing the above, is that, for city blocks in the top status quintile, any estimated association between neighbourhood status the health outcomes of city blocks, whether or not adjusted, is not a valid estimate for the city blocks in low status neighbourhoods, i.e. the counterfactual. In turn, for city blocks in the bottom status quintile, the estimated association of neighbourhood status on the health outcomes of city blocks is not valid for city blocks in *high* status neighbourhoods, as the aggregation of these lowest status city blocks occurs opposite to the highest status city blocks. Consequently, the association between neighbourhood status and health on the two extreme status quintiles of city blocks cannot be validly compared to each other, because their estimates would be biased to the distribution of city blocks across neighbourhoods of different status. For this reason, it is preferable to compare the second highest and second lowest status quintiles of city blocks.

Multilevel linear regression analysis using Stata version 10 is used to test for the effect of neighbourhood status as a continuous exposure on the health outcomes of city blocks. Regressions are separate for the two comparison groups, which are respectively the second lowest and second highest status quintile of city blocks based on their status scores. The specification of models are detailed in the tables of the results section below.

5.3 Results

Results are presented here to resemble the results sections of the previous two chapters. This is to maintain consistency and simplicity in presentation of complex results. As with the previous two chapters, unadjusted associations are presented first, followed by multi-stage regression tables. As there is no restriction on revealing geographic locations when using census data, as compared to using data from the Millennium Cohort Study, I also present some descriptive spatial analyses in the discussion section. I continue to use a dashed line to represent the health patterns for low status groups, in this case low status city blocks, and a solid line to represent the those for high status groups, in this case high status city blocks. Before presenting the analyses of low self-rated health and limiting longterm illness, I first show the socioeconomic differences within city block status categories, including the differences in levels of social housing that I adjust for in regression analyses.

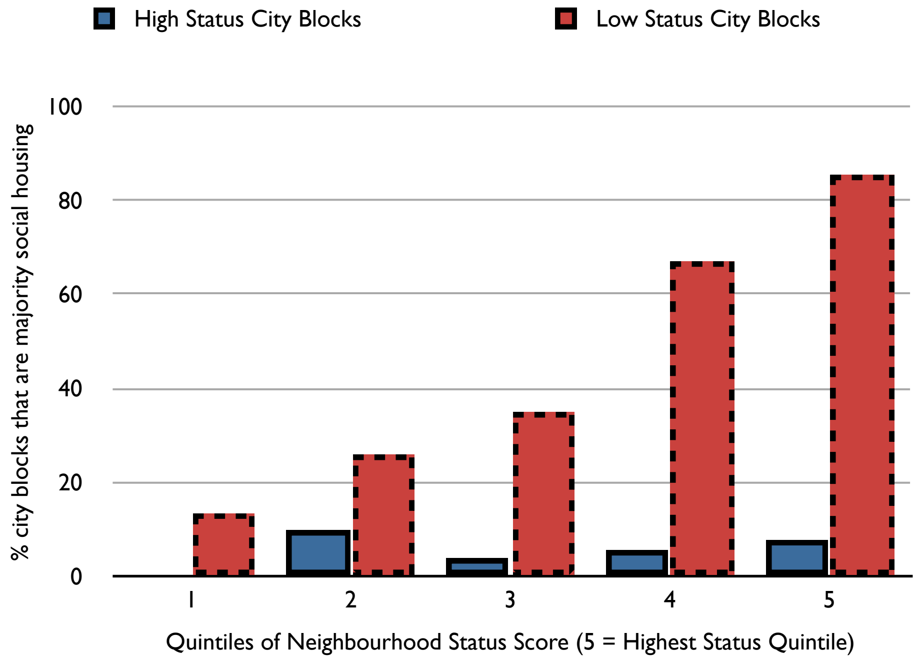
Housing and Compositional Differences within City Block Status Categories

The proportion of housing in city blocks that is socially rented is not normally distributed and does not have a linear relationship with the neighbourhood status score. To illustrate the association with social housing and neighbourhood status, I have first divided neighbourhood status into quintiles, with the fifth quintile containing the highest status neighbourhoods. I then divided city blocks into quintiles of the level of social housing. The highest quintile includes all city blocks where 51% or more of housing is socially rented. In Figures 5.3, it can be seen that social housing in low status city blocks is most abundant in the highest status neighbourhoods, whereas in high status city blocks, there is no pattern.

On average, nearly a fifth of housing in high status communities is socially rented (mean = 0.19), whereas in low status communities that figure is close to a third (mean = 0.31). Across neighbourhood status score quintiles, the percentage of ***high* status city blocks** that are majority social housing - where more than 51% of housing is socially rented - varies with a minimum of 0% in the lowest status neighbourhoods, to a maximum of 9% in the second lowest status neighbourhoods. Although the differences across neighbourhood status quintiles are significant (Pearson's Chi-squared $p < 0.001$), there is no consistent association. On the contrary, the percentage of ***low* status city blocks** that are majority social housing has a positive association with neighbourhood status. The percentage of low status city blocks that are majority social housing varies from 13% in the lowest status neighbourhoods, increasing for each quintile to a maximum of 85% in the highest status neighbourhoods.

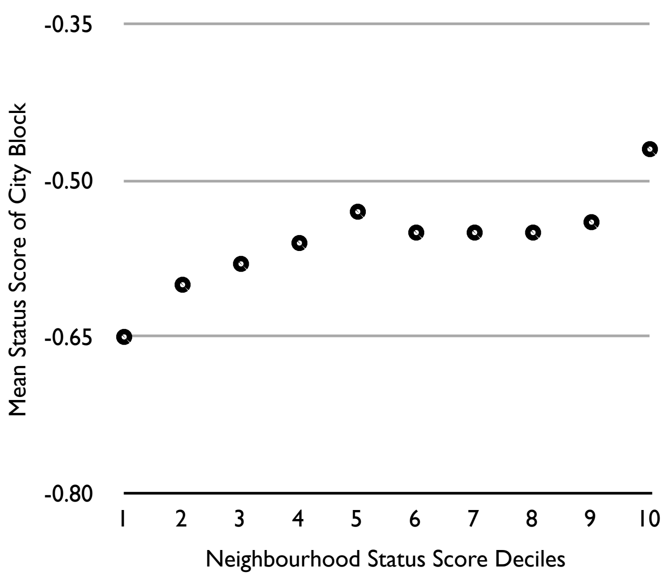
Despite the higher levels of social housing in low status city blocks that are located in high status neighbourhoods, when looking at the finer gradations of the city block status score, those blocks had higher status social composition. I illustrate this in Figure 5.4 below. In this figure, I have plotted the mean status score of low status city blocks for each decile of neighbourhood status. As can be observed, there is a positive association between the mean city block status score and neighbourhood status. The score flattens after the fourth neighbourhood status decile, but increases again after the ninth decile. This association may confound any associations between neighbourhood status and rates of poor health in city blocks, therefore for all of the multilevel regression models below I have adjusted for the city block status score.

Figure 5.3 Percentage of low status city blocks with high social housing* increasing with neighbourhood status contrasted to that of high status city blocks



* City blocks with high social housing are those where >51% of housing is socially rented, either from the local council or from housing associations. I also refer to these as 'majority social housing city blocks'.

Figure 5.4 Finer gradations in status amongst low status city blocks associated with neighbourhood status.



NB: The range of status scores for low status city blocks is from -0.79 to -0.36, which is depicted approximately by the limits of the graph's y axis.

Low Self-Rated Health

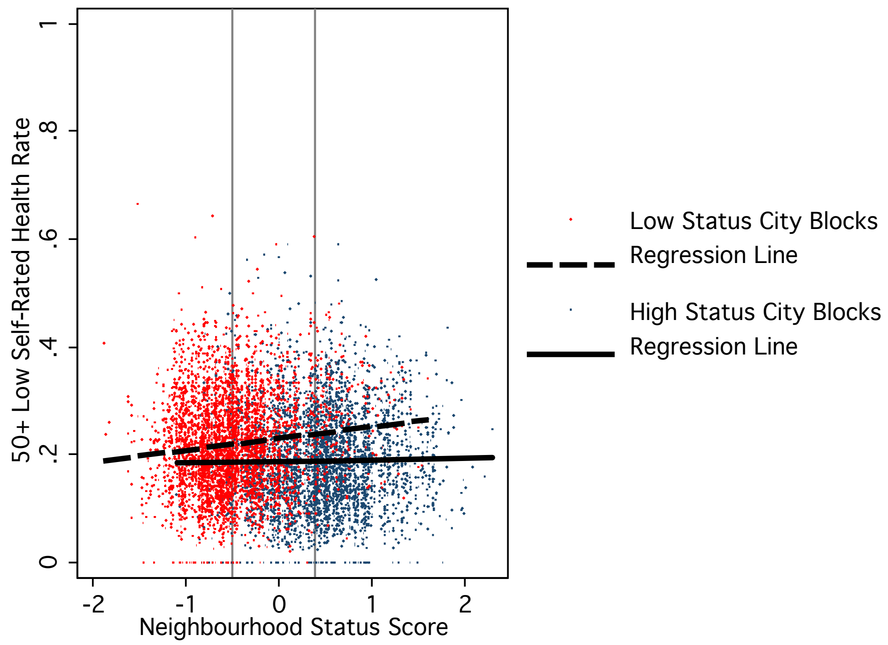
Unadjusted associations between the rates of low self-rated health in city blocks and the status score of their larger neighbourhood are shown as scatter plots in Figures 5.5A and 5.5B. I have shown the rates separately for people aged 50 and over, or for people aged 35-49. Within each graph I plot a different regression line for high status city blocks (solid line) and for low status city blocks (dashed line). Note that these are unadjusted. Most prominent in these graphs is that the variability in rates across city blocks is high, especially amongst those over 50. Much of this variability is left unexplained by neighbourhood status, as indicated by the relatively flat regression lines across the broad spread of data points.

Within high status city groups, an average of 19% of those **over 50** have low self-rated health. In low status city groups, this rate is higher at 22%. As can be observed in Figure 5.5A, the rate in high status city blocks is not significantly associated with neighbourhood status. On the other hand, the rate in low status city blocks is positively associated with neighbourhood status; this is significant ($r = 0.11$, $p < 0.01$). These unadjusted analyses suggest that neighbourhoods with higher status have a detrimental association with the health of low status city block populations aged 50 and over.

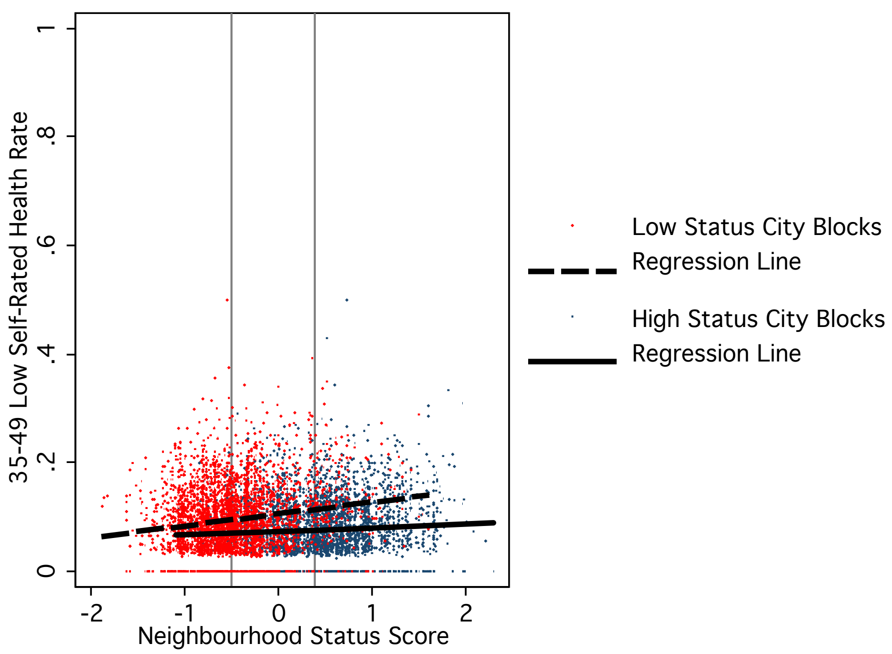
A similar picture can be observed for those **aged 35-49**, although overall, rates are lower (see Figure 5.5B). The average rate for high status city blocks is 8%, slightly lower than that for low status city blocks which have an average rate of 9%. These rates for both high and low status city blocks are positively associated with neighbourhood status. However across high status city blocks the association is much weaker ($r = 0.06$, $p < 0.01$), compared to across low status communities ($r = 0.16$, $p < 0.01$). For all of the significant associations stated above, over 95% of the variance is left unexplained.

Figure 5.5 Difference by city block status in the association between the low self-rated health rate within the city block and the status of the larger neighbourhood

A: Low Self-Rated Health Amongst Residents **Aged 50 and Over**



B: Low Self-Rated Health Amongst City Block Residents **Aged 35-49**



NB: Neighbourhood Status Score = standard deviation of occupational ratio and educational ratio combined (increasing score = higher status). Vertical lines are guides to divide city blocks into those within high status neighbourhoods (right of right-hand line), those within low status neighbourhoods (left of left-hand line), and those within mixed neighbourhoods (between lines). Note that these definitions are based on tertiles of the neighbourhood status score.

Multilevel regression analyses were used to assess how well neighbourhood-level variation is accounted for by several factors, and to determine whether any observed positive associations between neighbourhood status and the rate of low self-rated health found above remain after statistical adjustment. Firstly, comparisons between the empty model and the second model presented in the following tables, are intended to show whether neighbourhood status can explain some of the variation in rates between neighbourhoods. At the same time, this model improves on the unadjusted analyses above as it shows whether neighbourhood status has a significant association with the rate of low self-rated health, after adjustment of the finer gradations of city block status. Secondly, comparisons between the second model and the third model are intended to show whether differences in the levels of social housing can explain any association found between neighbourhood status and the rate of low self-rated health.

In Table 5.1, it can be observed with the empty model that 31% of the variation in **50+ low self-rated health rates** across *high* status city blocks can be attributed to differences between their larger neighbourhoods. After accounting for neighbourhood status in the second model, none of this variation was explained, despite it having a weak positive association with the rate of low self-rated health. However, the level of social housing in the city block was highly significant, such that from 31%, only 12% of the between-neighbourhood variation remained after taking this into account in the third model. Also, after taking into account social housing, neighbourhood status was no longer significant. Amongst the *low* status city blocks, findings are similar. However, the explanatory power of the status of the larger neighbourhood was more significant, which is shown by its ability to explain further variation between neighbourhoods from 37% in the empty model to 35% in the second model; and its persistent positive association with the low self-rated health rate in the third model, despite taking into account differences in the levels of social housing.

The findings for **35-49 low self-rated health rates** presented in Table 5.2 are similar to those above amongst people over 50. The major difference is that less variation in the rates across city blocks was attributable to differences between neighbourhoods. Also, in the case of low status city blocks, the positive association between neighbourhood status and the rate of low self-rated health was completely explained when taking into account levels of social housing.

Table 5.1 Results of Regression Analyses of Low Self-Rated Health for Residents Over 50, Stratified by City Block Status (Regression Coefficients)

	High Status City Blocks			Low Status City Blocks		
Model:	Empty	2	3	Empty	2	3
Neighbourhood Status Score		0.01*	-0.01		0.02**	0.02**
City Block Status Score		-0.04**	-0.01*		-0.06**	-0.02*
% Social Housing in City Block						
0-3			baseline			baseline
3-10			0.03**			0.02**
10-25			0.06**			0.05**
25-51			0.10**			0.08**
>51			0.14**			0.13**
% of total residual variance in low SRH due to differences between neighbourhood	31%	31%	12%	37%	35%	15%

NB: Status Scores are modelled as continuous variables. It is the average of two measures: 1) the z-score of the occupational ratio; 2) the z-score of the educational ratio. Given that rates are modelled as proportions, to give an example from above, in the third model, amongst low status city blocks, an increase of one unit of the neighbourhood status score increases the percentage of people over 50 with low self-rated health in the city block by 2 percentage points.

Table 5.2 Results of Regression Analyses of Low Self-Rated Health for Residents Aged 35-40, Stratified by City Block Status (Regression Coefficients)

	High Status City Blocks			Low Status City Blocks		
Model:	Empty	2	3	Empty	2	3
Neighbourhood Status Score		0.01**	0.03		0.02**	0.00
City Block Status Score		-0.03**	-0.02**		-0.04**	-0.01
% Social Housing in City Block						
0-3			baseline			baseline
3-10			0.02**			0.01**
10-25			0.03**			0.02**
25-51			0.05**			0.05**
>51			0.09**			0.08**
% of total residual variance in low SRH due to differences between neighbourhood	25%	25%	7%	36%	34%	15%

NB: To give an example from above, in the second model, amongst low status city blocks, an increase of one unit of the neighbourhood status score increases the percentage of people aged 35-40 with low self-rated health in the city block by 2 percentage points. To give another example, in the third model, amongst high status city blocks, compared to blocks with low levels of social housing (0-3%), city blocks with majority social housing (>51%) have a higher rate of low self-rated health by 9 percentage points.

Limiting Longterm Illness

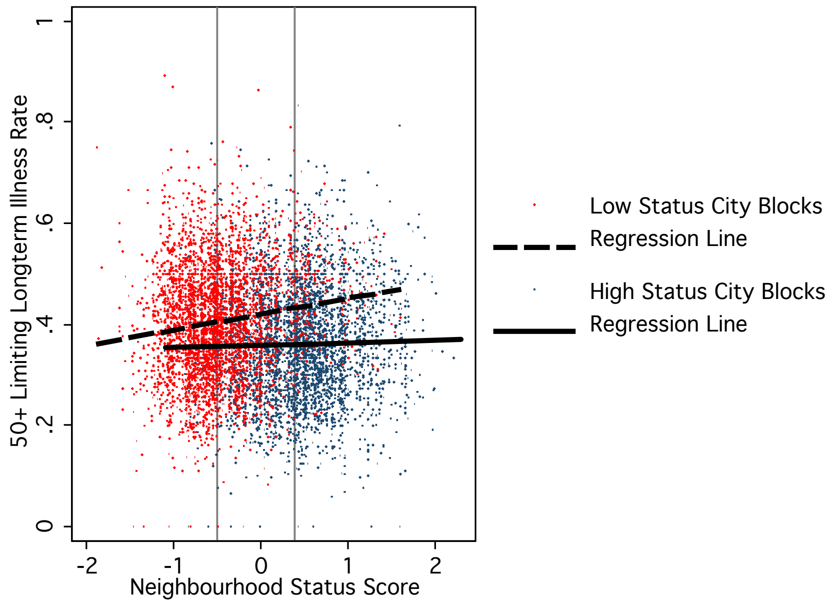
What follows is a repeat of the analyses above, but this time looking at the rate of limiting longterm illness (LLI) in city blocks. In short, the scatter plots in Figures 5.6A and 5.6B are very similar to those of Figures a and b. The rates of limiting longterm illness for both residents over 50 and those aged 35-49 are highest in low status city blocks, and these rates are most strongly, and positively, associated with neighbourhood status amongst low status city blocks.

For *high* status city blocks, the **50+ LLI rate** has a mean of 36%, which is significantly lower than the mean amongst *low* status city blocks at 40%. As with low self-rated health The 50+ LLI rate has no significant association with neighbourhood status amongst *high* status city blocks (Figure 5.6A). However, this association is significant amongst *low* status city blocks. As with low self-rated health, these unadjusted analyses suggest that neighbourhoods with higher status have a detrimental association with the health of low status city populations aged 50 and over.

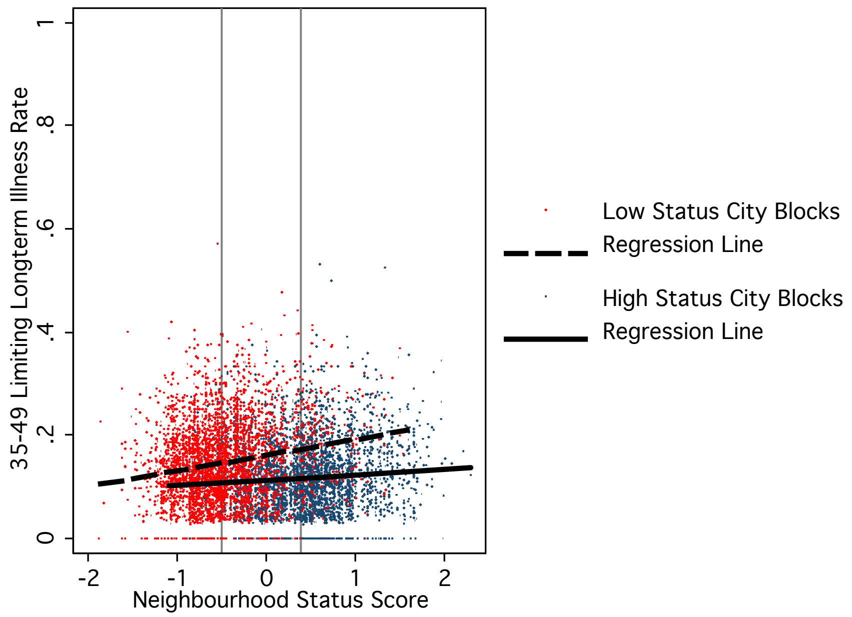
A similar picture can be observed with **35-49 LLI rates**, although rates are lower overall (see Figure 5.6B). The mean rate for high status communities is 12%, which is significantly lower than the mean rate amongst low status city blocks at 15%. The 35-49 LLI rate for both high and low status city blocks are positively associated with neighbourhood status. However , as with low self-rated health, this association is weaker amongst *high* status city groups only ($r = 0.08$, $p < 0.01$) compared to *low* status city groups ($r = 0.18$, $p < 0.02$). For all of the significant associations stated above, over 95% of the variance is left unexplained.

Figure 5.6 Difference by city block status in the association between the limiting longterm illness rate within the city block and the status of the larger neighbourhood

A: Low Self-Rated Health Amongst Residents **Aged 50 and Over**



B: Low Self-Rated Health Amongst City Block Residents **Aged 35-49**



NB: Neighbourhood Status Score = standard deviation of occupational ratio and educational ratio combined (increasing score = higher status). Vertical lines are guides to divide city blocks into those within high status neighbourhoods (right of right-hand line), those within low status neighbourhoods (left of left-hand line), and those within mixed neighbourhoods (between lines). Note that these definitions are based on tertiles of the neighbourhood status score.

For limiting longterm illness, multilevel analyses were used for the same reasons as for self-rated health: to assess how well neighbourhood-level variation is accounted for by several factors and to assess whether any observed positive associations between neighbourhood status and LLI rates found above remain after statistical adjustments (See above for a description of the way to interpret comparisons between statistical models).

In Table 5.3, it can be observed that 26% of the variation in **50+ LLI rates** across *high* status city blocks can be attributed to differences between the larger neighbourhoods in which they are located. Although there was a weak positive association between neighbourhood status and 50+ LLI rates in these city blocks, it did not explain any more between-neighbourhood variation. However, as for low self-rated health, taking into account the level of social housing in city blocks explained a lot of the variation in the LLI rate between neighbourhoods. This adjustment left only 12% of the between-neighbourhood variation in LLI rates, and removed the significance of neighbourhood status. Amongst the *low* status city blocks, the association between neighbourhood status and the 50+ LLI rate was stronger. This is shown by the fact that it explains some of the variation between neighbourhoods when comparing the second model to the empty model. However, when the levels of social housing are taken into account, the positive association between neighbourhood status and the 50+ LLI rate amongst low status city blocks is not just attenuated, it is reversed.

When the same models are run to analyse **35-49 LLI rates**, results are very similar, therefore I only summarise them here (refer to Table 5.4 for details). The major differences with these analyses are: 1) the persistence of the association between neighbourhood status and LLI rates in high status city blocks; 2) no reversal in the association between neighbourhood status and LLI rates in low status city blocks when taking social housing into account; and 3) the slightly weaker strength of the association between social housing and LLI rates.

Table 5.3 Results of Regression Analyses of Limiting Longterm Illness for Residents Over 50, Stratified by City Block Status (Regression Coefficients)

	High Status City Blocks			Low Status City Blocks		
Model:	Empty	2	3	Empty	2	3
Neighbourhood Status Score		0.01**	0.00		0.04**	-0.01**
City Block Status Score		-0.07**	-0.04**		-0.08**	-0.03*
% Social Housing in City Block						
0-3			baseline			baseline
3-10			0.03**			0.03**
10-25			0.07**			0.07**
25-51			0.12**			0.10**
>51			0.18**			0.17**
% of total residual variance in LLI due to differences between neighbourhood	26%	26%	12%	35%	33%	11%

NB: Status Scores are modelled as continuous variables. It is the average of two measures: 1) the z-score of the occupational ratio; 2) the z-score of the educational ratio. Given that rates are modelled as proportions, to give an example from above, in the second model, amongst low status city blocks, an increase of one unit of the neighbourhood status score increases the percentage of people over 50 with LLI in the city block by 4 percentage points.

Table 5.4 Results of Regression Analyses of Limiting Longterm Illness for Residents Aged 35-49, Stratified by City Block Status (Regression Coefficients)

	High Status City Blocks			Low Status City Blocks		
Model:	Empty	2	3	Empty	2	3
Neighbourhood Status Score		0.02**	0.01*		0.03**	0.00
City Block Status Score		-0.04**	-0.02**		-0.05**	-0.01
% Social Housing in City Block						
0-3			baseline			baseline
3-10			0.02**			0.01**
10-25			0.05**			0.03**
25-51			0.08**			0.06**
>51			0.12**			0.12**
% of total residual variance in LLI due to differences between neighbourhood	29%	29%	9%	43%	40%	22%

NB: To give an example from above, in the second model, amongst low status city blocks, an increase of one unit of the neighbourhood status score increases the percentage of people aged 35-40 with LLI health in the city block by 3 percentage points. To give another example, in the third model, amongst high status city blocks, compared to blocks with low levels of social housing (0-3%), city blocks with majority social housing (>51%) have a higher rate of LLI health by 12 percentage points.:

5.4 Discussion

This chapter addresses whether the prevalence of low self-rated health (SRH) and limiting longterm illness (LLI) in populations of city blocks in London depends on the status of the neighbourhoods within which the city blocks are located. Secondly, any observed patterns in LLI and low SRH prevalence by neighbourhood status are compared between high and low status city blocks. Analyses that adjusted for the finer gradations of city block status find that, for both age-groups, the prevalence of LLI and low SRH in low status city blocks in particular increases with higher neighbourhood status. Although over 90% of the overall variation in rates remains to be explained in these models, these findings are relevant to my thesis on the health effects of status incongruity in the neighbourhood, considering that the direction of the association of status of the wider neighbourhood to the health of residents of low status city blocks is the opposite of what one might predict based on studies of average area deprivation and health.

The comparison of the pattern observed across neighbourhood status for low status city blocks, to that of high status city blocks, reveals that although in some models, LLI and low SRH prevalence in high status city blocks also increases with higher neighbourhood status, the association with neighbourhood status is much weaker. This differential effect of neighbourhood status, stronger for low status city blocks, supports the hypothesis that socioeconomic incongruity in the neighbourhood, or low community status relative to the neighbourhood, has detrimental health effects.

Interpretations

When the level of social housing in city blocks is included in analyses, little or no association remains between neighbourhood status and city block prevalence of LLI and low SRH prevalence. In other words, the levels of social housing in city blocks either mediates or confounds the association between neighbourhood status and LLI and low SRH prevalence in city blocks. The way in which the level of social housing may mediate this association can be hypothesised in two ways that are not necessarily exclusive: 1) material and 2) psychosocial. Alternatively, the attenuating effect of social housing may be interpreted as due to the ability of the levels of social housing to more sensitively capture the socioeconomic make-up of city blocks.

Material explanation

The material interpretation of the attenuating effect of social housing relies on there being tenable physical health risks of living in high social housing city blocks. As I discussed in Chapter 1, housing quality has been shown to impact health. However, in that discussion, I focused on housing conditions, but not housing tenure, which is the measured variable here. Notably, social housing is not necessarily characterised by inferior housing conditions. In a report on housing quality and housing tenure, where housing was classified as physically ‘unfit’ based on *"disrepair, structural stability, dampness, lighting, heating and ventilation, water supply, drainage, facilities for food preparation and the presence, location and functioning of the WC, bath or shower and wash hand basin"*, it was found that the housing tenure with the highest proportion of unfit housing in England as a whole is 'private rented' at 10% (Sharp, 2005). Amongst social housing, only 4% of local authority accommodation and 3% of housing association accommodation is unfit, comparable to 'owner-occupied' at 3%. In the same report, housing was categorised as ‘fuel poor’ if 10% of total household income was spent on fuel *"in order to maintain a satisfactory heating regime"*. It was found that in England, private rented accommodation is most likely to be fuel poor at 13%. Amongst social housing, only 10% of local authority accommodation and 5% registered social landlord accommodation are fuel poor, whereas 8% of owner-occupied housing is fuel poor. Based on these two health-relevant material measures of housing conditions, it would seem unlikely that material housing factors can explain how high levels of social housing would mediate the association between higher neighbourhood status and poorer health in low status city blocks. Indeed in a review of housing and health, Stafford and McCarthy (2006) concluded that *"tenure is not a strong discriminant for housing characteristics"*. Nevertheless, this may be an area of research which could be expanded by understanding how the quality of social housing might vary from city to city.

In further analyses not detailed here, I found that levels of contextual deprivation at the level of the city block (based on the index of multiple deprivation) follow a similar pattern to levels of social housing. The percentage of low status city blocks that are highly deprived (in the most deprived quintile in London) increases with every higher quintile of neighbourhood status, with the exception of the highest quintile. This figure ranges from 19% in the lowest status neighbourhoods to 45% in the highest status neighbourhoods (See Figure A5.1 in the Appendix). In other words, low status city blocks located in higher status neighbourhoods are more deprived than low status city blocks located in lower status neighbourhoods. As with social housing levels, this pattern is not observed with high status city blocks. Importantly however, because the index of multiple deprivation is a composite measure which incorporates measures that are not material in nature, including health-related measures, this does not necessarily fit with a material explanation. It is for this reason that I have not included this index in the main analyses.

Psychosocial explanation

The psychosocial interpretation of the attenuating effect of taking into account social housing relies on there being tenable psychosocial health risks of living in high social housing city blocks. The principle of this interpretation is that living in social housing may lead to negative self-evaluation, and that this may be even more pronounced when living alongside higher status city blocks (see Chapter 1 for a discussion of self-evaluation and its health effects).

In the UK, residing in social housing is a source of **stigmatisation**. In an historical account of council housing in the UK, the author Lynsey Hanley laments the way in which the image of council estates has become progressively worse in the eyes of both the British public and the inhabitants of social housing themselves (Hanley, 2007).

> Estates have come to mean more as ciphers for a malingering society than as a place where people actually live. In the eyes of many people, council estates are little more than holding cages for the feral and the lazy.
>
> The council tenants of today, in comparison with those of thirty, forty or fifty years ago, don't see their home as a reward or a privilege, because it is precisely the opposite.
>
> (Hanley, 2007: 146 & 147)

A study of areas in the Australian town Victoria tested to see what types of areas are most likely to lead to feelings of stigma amongst residents (Kelaher *et al.*, 2010). The study found that residents sampled from areas that were characterised with high levels of both social housing and deprivation were most likely to report feeling stigmatised. The scale of the areas from which samples were identified ranged from segments of suburbs to entire suburbs of Victoria, therefore they are not directly comparable to the London city blocks analysed here. However, within areas in the study, there was a tendency to blame particular parts for any problems linked with the area. Those parts were places with the highest levels of social housing. By attributing blame towards those parts and by portraying their residents as *"profoundly different to those around them"*, those residents were *"further stigmatized and isolated"*. One particular street was given the label 'The Bronx', as a slur that evoked images of 'ghetto' surroundings in New York. This practice is also common in Paris where the high social housing areas around the outskirts, known as the 'Red Belt', are given names such as *'little Chicagos'*, *'Harlem'* and *'Le Bronx'* (Wacquant, 2008: 170).

The study of areas in Victoria also found that feeling stigmatised was associated with poorer self-rated health and worse life satisfaction. The authors of the study discussed their overall findings with causal explanations related to the stress response elicited in residents, and their own negative self-evaluation, specifically their *"appraisal of the threat a particular situation may pose to their social identity"*. These authors' interpretations are in line with the hypotheses that I have discussed in several points in this thesis, regarding negative self-evaluation and socioeconomic incongruity.

In light of findings on stigma, health and social housing, and in light of the British media's portrayal of social housing, it is probable that the London city blocks studied here may present the same risks of stigmatisation and negative self-evaluation to their residents, specifically when those city blocks are made up of high levels of social housing and are visible to higher status communities. In Figure 5.7 I visually illustrate this. This is an image that I captured from 'Google Maps' of a particular Islington authority housing estate which is represented in my analyses as a low status enclave within a high status neighbourhood. The actual housing estate is the city block at the bottom of the image. Directly above it is a crescent of owner-occupied houses inhabited by high status residents, as indicated by my analyses. In London, this image is characteristic of the vivid juxtaposition of low status communities amongst high status communities, within the same neighbourhood. Importantly, in low status neighbourhoods, within which city blocks are predominantly inhabited by low status residents, not only is there less contrast in architectural juxtaposition, but housing is less dense and social housing is not the dominant tenure for low status residents. The stigmatising effect of social housing, the tenure choice to which low status residents appear to be constrained in high status neighbourhoods, may explain why higher neighbourhood status is not associated with a lower prevalence of poor health in socioeconomically incongruous low status city blocks, but the opposite.

Figure 5.7 The visible contrast of a low status city block (bottom of image) within a high status neighbourhood in the borough of Islington due to architectural differences in housing tenure

NB: This crescent is visible in the map of Highbury in Figure 5.9. Note that the orientation in the image above is South on the top and North on the bottom, whereas in Figure 5.9 maps are orientated with North on the top. The low status city block in the bottom of the image above is the low status city block located nearest the centre of the map of Highbury in Figure 5.9.

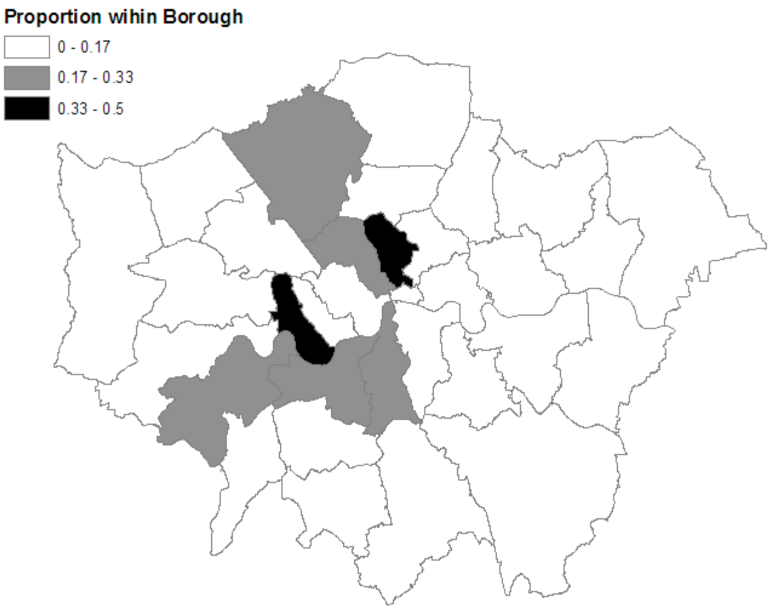
Housing and Area Affordability

The material and psychosocial explanations for the reasons why social housing may mediate the association between neighbourhood status and the poor health in low status city blocks need not be exclusive. Importantly, health effects that result from either material or psychosocial mechanisms are ultimately caused by the same underlying pressures: that high status neighbourhoods necessarily limit low status individuals' **choice of where precisely to live**, as I have just discussed above. Where private rents and house prices are higher, i.e. high status neighbourhoods, low status individuals may only be able afford to live in social housing and/or locations within that neighbourhood that are at the bottom of the housing market and tend to be deprived.

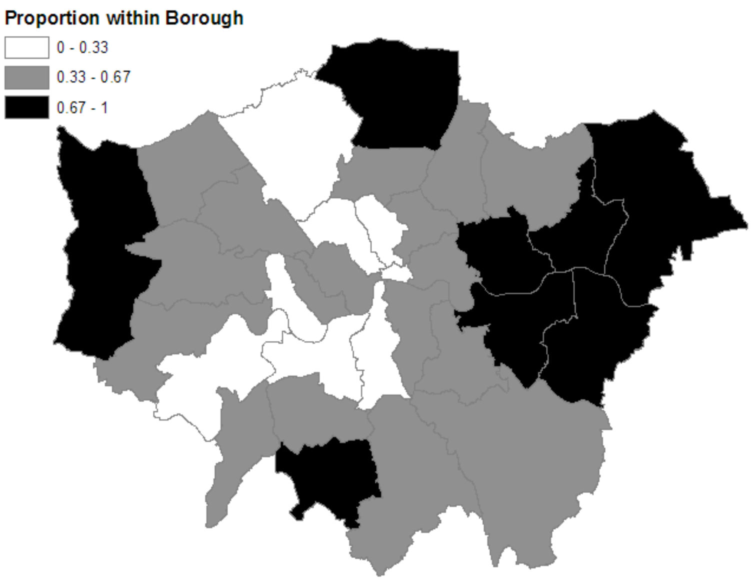
London is second only to the South West as the region in the UK with the highest mortgage costs relative to average income (Wilcox, 2005). This presents a particularly limiting constraint on the housing choices of the income poor in London. Within London the extent of this discrepancy in housing cost and income is most pronounced towards the centre of the city. Over a third of the low status city blocks sampled in this study from the central boroughs of Hammersmith & Fulham and Islington are situated in high status neighbourhoods (boroughs shaded black on top map of Figure 5.8 - Islington is further east). These are the two boroughs in London where low status city blocks are most likely to be juxtaposed against high status city blocks as illustrated in the image above. In the low status city blocks of Hammersmith & Fulham, on average, 63% of households are in social housing. In Islington this figure is 71%. In contrast, across the whole of London, the housing tenure in low status city blocks is on average 31% social housing. The boroughs where low status city blocks are most likely to be located within low status neighbourhoods are found around the outer edge of the city (boroughs shaded black on bottom map of Figure 5.8). Low status city blocks in these boroughs have low levels of social housing. For example, in the easternmost borough of Havering where 93% of its low status city blocks are in low status neighbourhoods, the average percentage of social housing in the borough’s low status city blocks is 5%.

Figure 5.8 Maps to illustrate the distinct spatial distribution of incongruous low status city blocks compared to those located within low status neighbourhoods

Proportion of Boroughs' Low Status City Blocks
located in **High** Status Neighbourhoods



Proportion of Boroughs' Low Status Communities
located in **Low** Status Neighbourhoods



NB: Note that the definition of low status city blocks used to create these maps is the same as used in the analyses of the results section. Low status city blocks are those in the second lowest quintile based on the city block status score. See the methods section for the reasons for this definition. This same definition is used in the maps for comparability with the statistical results.

To further illustrate how the levels of social housing differ so much in low status city blocks, depending on whether they are in high status neighbourhoods towards the city centre, or in low status neighbourhoods towards the edge of the city, I have produced maps of two neighbourhoods that overlay the locations of low status city block with the levels of social housing (Figure 5.9). One of these is a high status neighbourhood, Highbury, located in the central borough of Islington; whilst the other is a low status neighbourhood, Hornchurch, located in the outer borough of Havering.

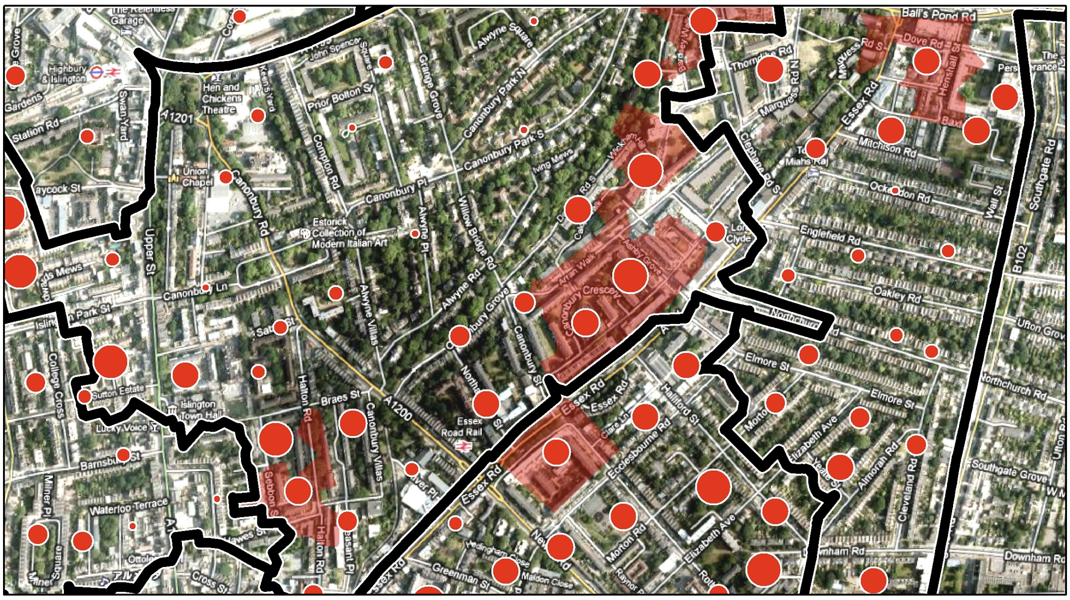
The housing prices for rent or purchase in the outer boroughs of London are lower than the central boroughs. This may explain why the communities in these boroughs that are populated by residents of lower socioeconomic status do not have high levels of social housing. Low status residents in these boroughs have greater choice of housing tenure because of affordability and are not segregated within communities of social housing. However, it must be noted that some of this choice in housing is governed by the availability of social housing provided by local authorities and housing associations. Housing security is likely to deteriorate in the central boroughs of London after the introduction of the current governments new social housing rules, thus potentially heightening the psychosocial stress of residents in low status communities living in those boroughs. In Highbury, it can be observed that there are only a few isolated low status city blocks; every one of these city blocks visible in this map has a high level of social housing. In Hornchurch, almost all city blocks in the neighbourhood are of low status. In contrast to the low status city blocks in Highbury, in Hornchurch they have low levels of social housing. Note that these differences are despite the fact that the low status city blocks in Hornchurch and Highbury have residents with similar occupational and educational status.

Figure 5.9 Maps to illustrate the higher levels of social housing in low status city blocks within high status neighbourhoods compared to within low status neighbourhoods

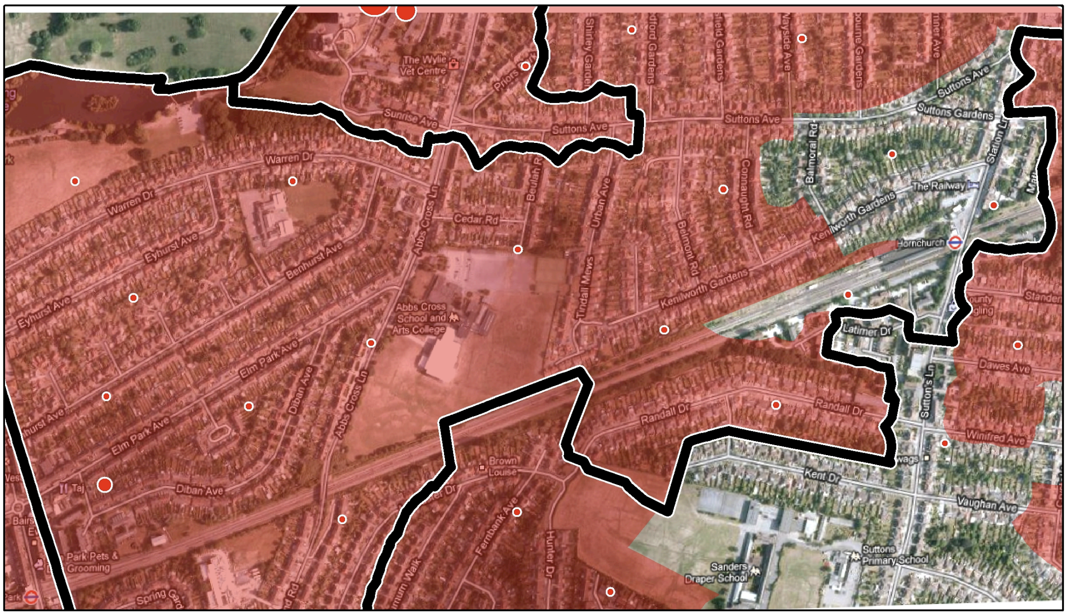
% Social Housing in Block

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- Low Status Blocks
- Neighbourhood Borders

Highbury, below, is a High Status Neighbourhood in the Borough of Islington



Hornchurch, below, is a Low Status Neighbourhood in the Borough of Havering



NB: In these maps, instead of just including city blocks in the second lowest status quintile, to allow for a more comprehensive map, all in the lowest tertile were included. Also, the boundaries of city blocks are not drawn, but the centre of each one is indicated by a red dot, whose size represents the proportion of social housing in the block.

Levels of deprivation, based on the index of multiple deprivation, follow a pattern similar to that described for social housing above. Just over a quarter of the low status communities sampled in this study across the whole of London are deprived (in the top quintile of IMD), but in Islington this figure is about 90% (of 53) and in Hammersmith & Fulham it is 60% (of 34), compared again to Havering where under 2% of its low status city blocks (n = 134) are deprived. Whether the mediation of poor health in low status city blocks found in high status neighbourhoods is governed predominantly by material or psychosocial mechanisms associated with social housing and deprivation, the underlying lack of housing choice due to affordability determines the ensuing exposure to health risks.

Capturing Unmeasured SES

The final interpretation of the attenuating effect of social housing on the association between neighbourhood status and poor health in low status city blocks is that taking into account levels of social housing improves on the status score of city blocks in measuring the socioeconomic composition of these blocks. In other words, if the true socioeconomic characteristics of city blocks still have considerable variation within the same status categories based on the status score used in this study, including additional measures such as levels of social housing in statistical analyses may serve to explain some of that variation. If this is the case, the prevalence of LLI and SRH in low status city blocks may increase with neighbourhood status because those communities in higher status neighbourhoods have lower socioeconomic compositions. The observed health differences could therefore be interpreted as reflecting the general social gradient in health, and not necessarily caused by the health effects of socioeconomic incongruity in the neighbourhood. However, the underlying reasons why the true socioeconomic status of city blocks should decrease as the surrounding neighbourhood status increases would be a phenomenon that is not easily explained.

Limitations

This study is a **cross-sectional** analysis of London using data that was collected in 2001. Because of this, the socioeconomic trajectories of city blocks and neighbourhoods at the time of measurement is not taken into account. Since the health measures, especially LLI prevalence amongst residents in older ages, is likely to reflect the prevalence of chronic conditions that had developed over a long time, it is not possible to be certain that the majority of the social environmental exposure experienced by residents are reliably represented by measurement at a single time-point. Secondly, the cross-sectional nature of the data does not take into account patterns of migration in and out of areas, therefore further limiting the reliability of the 2001 socioeconomic measures to represent residents' chronic social environmental exposure. Thirdly, the cross-sectional analysis does not allow reliable inferences to be made regarding the direction of causation, as having a limiting longterm illness or having low self-rated health may bias people's choice of where to live.

As discussed above, the **geographic distribution** of data is biased. For example, low status city blocks in high status neighbourhoods tend to be located towards the centre of London, whereas low status city blocks in low status neighbourhoods tend to be located towards the edge of London. There may be differences between city blocks located towards the centre compared to those towards the edge that are related to their centrality in the city, independent of the socioeconomic juxtaposition of communities. These differences that may affect health include type of occupation, availability of green space, accessibility to public transport, and commuting environment (Macintyre and Ellaway, 2000, Stafford and McCarthy, 2006). Also, the stability of populations may be different in central compared to peripheral locations, therefore geographically biasing the reliability of socioeconomic area measures at capturing chronic social environmental exposure.

The **measures of city block and neighbourhood status** may themselves be a limitation. As discussed above, levels of social housing may capture components of socioeconomic status that the status score of the city block is not sensitive enough to pick up. The neighbourhood status score may similarly lack sensitivity. The area status score in this study is designed to measure the socioeconomic composition in areas, based on ratios of high and low occupational class and educational qualifications. Socioeconomic composition may be measured more precisely by including other factors including the level of unemployment in an area, but this comes with other limitations. One such limitation is that some people classified as unemployed by the census may have sources of income and wealth that would otherwise classify them with higher socioeconomic status than associated with unemployment. Another such limitation is that unemployment may be caused by limiting longterm illness itself. As such, unemployment levels were not included in calculating the city block and neighbourhood status scores.

Finally, the analytical strategy of this study relies on testing two **comparison groups**, namely low status city blocks and high status city blocks. As discussed in the methods, the low status blocks are in fact those in the *second* lowest quintile of the community status score, and the high status blocks are those in the *second* highest quintile. This strategy is used to improve the comparability of the distributions of high and low status city blocks across neighbourhoods of different status, so that spurious extrapolations of neighbourhood effects would not be made. An alternative method would be to use the 'true' low and high status city blocks as comparison groups, and to employ 'propensity score analysis' methods as described by Oakes and Johnson (2006). However, this method is most reliable when exposure variables are binary. In the case here, the primary exposure variable, neighbourhood status, is analysed as a continuous score, thus the propensity score analysis would produce results that are less easy to interpret. For this reason, the most parsimonious method was used. Nevertheless, the high status city blocks sampled in this study are aggregated towards high status neighbourhoods, and low status city blocks towards low status neighbourhoods. Despite the differential aggregation of data between comparison groups, the quantity of data points in most neighbourhood status categories may be considered high enough to make valid comparisons.

Chapter Conclusions

In this chapter I set out to investigate whether neighbourhood status has a different association with health amongst *low* status city blocks compared to *high* status city blocks. I found this to be the case in London, whereby the rates of both limiting longterm illness and low self-rated health in *low* status city blocks are higher when they are located within high status neighbourhoods, whereas either a weaker or no such association was found amongst *high* status city blocks. The second aim of this chapter was to find whether the difference in the association in low status city blocks compared to high status city blocks could be accounted for by different levels of social housing across neighbourhood status. I also found this to be the case in most analyses.

My interpretation of the fact that the higher levels of social housing in low status city blocks that are located in high status neighbourhoods explain the poorer levels of health range from material explanations to psychosocial explanations. However, I also discussed the issue of how higher house prices in high status neighbourhoods necessarily constrain poor people's choices of where exactly to live in such neighbourhoods. Consequently, it is the discrepancy in incomes and the costs of living that may ultimately lead to any health risks that may be derived from living in a high status neighbourhood. Whether the health risks are psychosocial or material in nature may be less important than the ensuing exacerbation of health inequalities via a constraint in choice. As such, any reduction in the discrepancy in incomes and living costs, such as through a reduction in income inequalities, may be a goal worth pursuing to reduce local socioeconomic segregation and its potential health effects.

At the beginning of this chapter, I explained that some of the rationale for investigating the health effects of the socioeconomic incongruity of low status city blocks in high status neighbourhoods is to help understand the unintended health and social implications are of two particular housing policies. I will discuss this further in the next and final chapter, where I will draw together the findings of all the analyses that I have conducted in this thesis.

6

Discussion and Conclusions

In this final chapter, I will discuss all of the findings from this thesis together, in order to evaluate how they have contributed towards its two aims. The first of these aims is to increase the understanding of the relative contribution of psychosocial mechanisms versus material mechanisms in explaining the social gradient in health in the UK. The second of these aims is to examine the health impacts of the segregation of people from low socioeconomic backgrounds into specific parts of rich neighbourhoods. I will discuss whether investigations into the simple question, *'Are poor people healthier in rich or poor areas?'*, are adequate in satisfying the aims of this thesis.

6.1 Summary of Findings

Before discussing the particular aims of this thesis, and before evaluating the design of my methodology for answering the questions posed, I first briefly summarise the findings as a whole.

In Chapter 3, I investigated the health and health behaviours of individuals of different status living in different neighbourhoods. In Chapter 4, I investigated whether any of the patterns found in Chapter 3 might be reflected in patterns in what I hypothesised to be potential mediating mental and social wellbeing factors. Finally in Chapter 5, instead of looking at low status individuals and their neighbourhoods, I looked at low status city blocks and their wider neighbourhoods.

Differences in the Findings on Mortality versus Morbidity

As discussed in Chapter 2, to get an informative answer to the question regarding whether poor people are healthier in poor areas as opposed to rich areas, it was necessary to look for different gradations of health benefits that poor people may have in poor areas. Even an attenuated benefit for poor people living in rich areas, when compared to the benefit received by rich people, is an interesting finding, as it implies a balance of opposing health risks. Translating the literal sense of the thesis question into an analytical framework, I developed hypothetical models of the differential effect of neighbourhood status on health depending on the status of the individual. These were as follows:

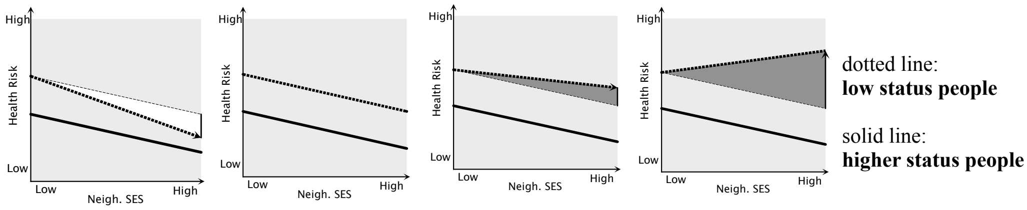
- **Null**: In this hypothesis the health of both low status and high status individuals benefits equally from high status neighbourhoods.
- **Double Jeopardy**: In this hypothesis the health of low status individuals benefits more than that of high status individuals in high status neighbourhoods.
- **Relative Status**: In this hypothesis the health of low status individuals benefits less or not at all from high status neighbourhoods compared to high status individuals (attenuated/zero benefit model). The health of low status individuals may even be detrimentally affected by high status neighbourhoods under this hypothesis (net disadvantage model).

In the review in Chapter 2, I found fairly consistent support amongst cross-level interaction studies of mortality for the net disadvantage model of the relative status hypothesis. More than half of the mortality studies supported this model, and only two had findings that supported the opposite hypothesis - double jeopardy. However, amongst the cross-level interaction studies that analysed measures of physical morbidity, findings were not as consistent, and none supported the net disadvantage model of the relative status hypothesis. This inconsistency in the findings amongst studies of physical morbidity was part of the impetus for further analytical investigations into physical morbidity that I conducted in Chapter 3.

As I summarise in Table 6.1 below, the findings of my analyses in Chapter 3 were also inconsistent, and as with the physical morbidity studies I reviewed, none support the net disadvantage model of the relative status hypothesis. The findings of my analyses of obesity and low self-rated health follow the attenuated/zero benefit model of the relative status hypothesis, no clear patterns emerge from my analyses of limiting longterm illness, and the findings of my analyses of smoking support the double jeopardy hypothesis. When discussing the inconsistencies in the findings amongst studies of physical morbidity in the review in Chapter 2, I referred mostly to methodological limitations in the study designs. For example, I pointed out how measures of neighbourhood status may not have captured the socioeconomic composition of areas accurately as they were often focused on material disadvantage. The importance of choosing the correct measure of neighbourhood status in order to capture socioeconomic incongruity was exemplified in one of the studies of mortality where separate cross-level interaction analyses were conducted, one using a measure of neighbourhood status that took indicators of social composition into account, and another using a measure that predominantly took indicators of poverty and material deprivation into account (Yen and Kaplan, 1999). The former had results supporting the net disadvantage model, whilst the latter had results supporting the double jeopardy model. In my analyses of physical morbidity in Chapter 3, I specifically created a neighbourhood measure of status that took into account the social composition explicitly, and my regression analyses were adjusted for two separate individual-level socioeconomic characteristics to ensure that any cross-level interaction effects would not be masked. Despite these methodological improvements from the physical morbidity studies that I reviewed, none of the results from my analyses of health or behaviours followed the patterns of the majority of the results from the mortality studies that I reviewed.

Table 6.1 Summary of Findings from this Thesis

Supported Model
(Effect of high status neighbourhood on low status people)



	DOUBLE JEOPARDY (Greater Benefit)	NULL (Equal Benefit)	RELATIVE STATUS (Attenuated/ Zero Net Benefit)	RELATIVE STATUS (Net Disadvantage)	NONE (No Clear Patterns)
Chapter 3 Health and Behaviours of Mothers	• Smoking		• Obesity • Low Self-Rated Health		• Limiting Longterm Illness
Chapter 4 Mental & Social Wellbeing of Mothers			Main Analyses: • No Neighbourhood Friends • Depression/ Anxiety *Subset Analyses:* • *Low Self-Esteem in the North*	*Subset Analyses:* • *No Neighbourhood Friends in London* • *Depression/ Anxiety in London & the South*	Main Analyses: • Low Emotional Support • Low Self-Esteem
Chapter 5 Health in Locally Segregated City Blocks				• Low Self-rated Health • Limiting Longterm Illness	

Whether the discrepancy between the findings amongst studies of mortality and those amongst studies of physical morbidity, including my own findings in Chapter 3, may be due to the differences in what is captured by mortality compared to physical morbidity, and the differences in the contexts within which the participants in these studies are exposed to, are discussed below.

The Emergence of Effects from Prolonged Exposure and the Importance of Context

Differences in mortality that were found in the studies that I reviewed in Chapter 2 may reflect differences in health risk that have accumulated over long periods. The mothers in the MCS that were included in my analysis were, on average, considerably younger than the ages at which participants in studies of mortality died. As such, the health risks related to socioeconomic incongruity for these mothers may not have taken their toll to the same extent as for participants in mortality studies. Indeed, after inspection of the different types of limiting longterm illness that were prevalent amongst the mothers in the MCS, only a small proportion were physical, and of those most were unrelated to social or environmental exposures.

On the other hand, some of my analyses in Chapter 4 had similar findings to the mortality studies. Findings from analyses of social and mental wellbeing indicate that, in certain contexts, socioeconomic incongruity was associated with poorer friendship ties and higher likelihood of depression or serious anxiety. It may be the case that effects on social and mental wellbeing precede those on physical morbidity.

Importantly, the analyses above also revealed the importance of context. It is only in London where the findings for both depression or serious anxiety and a lack of neighbourhood friends indicated that low status mothers were disadvantaged when living incongruently in high status neighbourhoods, compared to when living in low status neighbourhoods (see Table 6.1). When discussing this, I noted that London may be a unique environment in the UK because of the dynamic nature of its neighbourhoods due to ‘gentrification’ and also because of the extensiveness of its public transport network. I also noted that London has a particularly high level of socioeconomic inequality for the UK, a contextual similarity with four of the six studies of mortality in the US that found higher morality rates when poor people lived in rich places. It may be that the reason why both my findings from analyses of depression or serious anxiety and poor friendship ties in

London and the studies of mortality in the US both support the net disadvantage model is because they are both conducted in contexts of exceptionally high levels of socioeconomic inequality, thus exacerbating psychological impacts on health.

In Chapter 5, my findings give further suggestive support to the interpretation that the detrimental impacts of socioeconomic incongruity arise in the context of inequality after exposure over a prolonged length of time. In this chapter, I restricted my analyses to London, where inequality is high, and I looked particularly at the rates of physical morbidity amongst older people, who have had a longer time to accumulate health risks. The results of my analyses in this chapter suggest that high status neighbourhoods are associated with a net health disadvantage towards low status residents who are segregated into low status enclaves in such neighbourhoods. Adjustments for levels of social housing mostly removed this association. However, as I discussed in Chapter 5, social housing may be the very thing that embodies inequality most vividly, and may potentially create a setting in which inequality is most consciously experienced (Hanley, 2007, Wacquant, 2008, Kelaher *et al.*, 2010). The fact that it explains the net disadvantage of high status neighbourhoods for low status people is an important finding.

Throughout this thesis, I have discussed what my findings might mean for psychosocial health mechanisms, such as those relating to the local segregation of social housing, and I discuss these further towards the end of this chapter. However, before this, I explore how well my methods have been designed for tackling the question at hand, and I provide alternative interpretations of my findings.

6.2 Evaluation and Alternative Explanations

The methods that I have used throughout this thesis have been relatively simple in contrast to the complexity of their task to identify whether psychosocial impacts on health may be strong enough to overpower any counteracting material impacts. As such, the process of analysis has presented several limitations, whilst it has also led to alternative interpretations of findings. This is also true for my secondary aim of identifying the health effects of socioeconomic segregation. In this section, I evaluate how effective my methods have been for meeting my aims, looking particularly at analytical limits due to:

- The **'ceiling-threshold'** problem: extremes of socioeconomic disadvantage.
- The **'fish out of water'** problem: distinctiveness of socioeconomically incongruent people.
- the **'intricacies of wealth'** problem: extremes of socioeconomic advantage.

Ceiling-Threshold Effects

In the analyses of the Millennium Cohort Study, I found that most cross-level interactions were due to the combinations of: 1) an association between neighbourhood status and health outcome for the highest status mothers; and 2) the lack of an association between neighbourhood status and health for the lowest status mothers. In terms of the psychosocial-material argument, I have discussed the finding of a lack of associations for the lowest status mothers as potentially due to the balance between psychosocial and material neighbourhood-related mechanisms. However, as I have discussed, there are other interpretations. One such interpretation is that the pattern of health and social factors amongst the lowest status mothers is due to a 'ceiling-threshold effect'. This interpretation is as follows: The lowest status mothers, regardless of where they live, have reached a 'ceiling' of risk, thus attenuating any further detrimental effects of low status neighbourhoods. At the same time, their socioeconomic status is below a certain 'threshold', where neighbourhood mechanisms are no longer effective, thus preventing any beneficial influences of high status neighbourhoods.

The hypothetical demonstration of a threshold effect has a potentially plausible basis. With the example of obesity, I found that, for the lowest status mothers, none of the variation in the risk of obesity could be attributed to differences between neighbourhoods. For the highest status mothers, the proportion of the overall variation in obesity risk that could be attributed to neighbourhood differences was approximately 11% after adjustment for mothers' sociodemographic characteristics. From this, it does appear that being in the lowest status group creates an 'impermeability' to neighbourhood-derived effects. The logical explanation for this is that the influence of individual-level factors has reached such a high point that contextual factors become unimportant. In other words, mothers who experience life with the lowest qualifications, whose partners' or own jobs are the least paid, become so caught up with the problems that relate to these disadvantages, that the type of neighbourhood they live in may not matter anymore.

It must be noted that the ceiling-threshold problem does not affect the findings for the analyses in Chapter 5 of local segregation in London. This is because in these analyses I found that the neighbourhood does matter for low status residents. I found that the rates of ill health in low status blocks were in fact higher in high status neighbourhoods, compared to in low status neighbourhoods. At the same time, the results of other studies that found higher mortality rates amongst poor people living incongruously in high status neighbourhoods cannot be explained in terms of ceiling-threshold effects.

Fish out of Water

In their review of area health effects, Pickett and Pearl (2001) described the adjustment of individual socioeconomic status in analyses of associations between area socioeconomic status and individual-level health outcomes as being limited because of this fact: those individuals who live in areas that are incongruent to their own socioeconomic status, whose own status are controlled for, are *'fish out of water'*. They are rare in their incongruity, and may therefore be unrepresentative of their socioeconomic group. As such, generalising the findings of analyses that control for their socioeconomic characteristics may not be valid.

Distinctiveness in Occupation

In my analyses of the Millennium Cohort Study, and of city blocks in London, I have looked into the distinctiveness of low status mothers and low status blocks located in high status neighbourhoods. Specifically, I have tried to identify characteristics that are unique to these incongruent residents, not necessarily related to their socioeconomic status, that may explain any patterns in health or social wellbeing that I have found. In the analyses of the Millennium Cohort Study, I described the sociodemographic variation that remains within mothers' status groups, and why it was necessary to adjust for these characteristics (see Figure 3.6 in Chapter 3). An additional assessment that I undertook was related to the type of occupations that the incongruent low status mothers had, compared to congruent low status mothers. I detail this here.

Overall, based on the nine SOC2000 major occupational categories, the majority of the lowest status mothers that I included in analyses were either in 'elementary occupations' or were unemployed. The next two most common types of occupations were 'sales and customer services' and 'personal services'. The only perceivable distinctiveness in the occupational mix of low status mothers who were living incongruently in high status neighbourhoods was that relatively fewer of them were employed as 'process, plant and machine operatives' compared to in low status neighbourhoods. This occupational category includes textile workers, coal miners, quarry workers, sewerage workers, carpet fitters, factory workers, scaffolders, and road construction workers. As discussed in Chapter 1, hazards in very specific occupations can create differences in cause-specific mortality rates. However, the fact that there are relatively more of the lowest status mothers employed as process, plant and machine operatives when they live in low status neighbourhoods, does not explain my findings.

The occupational differences described above are based on studying the frequency distribution of lowest status mothers across job titles, separately for those in high status neighbourhoods and for those in low status neighbourhoods. The number of mothers classified as lowest status and living in high status neighbourhoods was small, therefore it was only possible to identify which particular major occupational categories were over-represented, but not which particular job titles were over-represented. Testing out differences in job titles between the lowest status mothers who were living incongruently or congruently may have allowed better insight into health-relevant differences. Consider the difference between a domestic worker who finds themselves living in an affluent neighbourhood for a short-term job, and a factory worker who finds themselves living in the low status neighbourhood they have known from a young age, who had simply chosen the most readily available profession. The domestic worker may use her neighbourhood solely as a temporary base for work, therefore reducing the importance of her current neighbourhood in influencing her health. The factory worker may use her neighbourhood as a longterm base for family and social life, therefore implicating the social and material environment in influencing her health. Indeed, in Chapter 4 I found that mothers who were incongruent to their neighbourhood during the first wave of the cohort study were more likely to have moved to a new neighbourhood by the third wave, than mothers who were congruent to their neighbourhood. As such, it is possible that the general lack of associations between neighbourhood status and health for the lowest status mothers was due to the fact that socioeconomic incongruence tends to be a temporary state, therefore contextual health effects may derive predominately from exposure to different neighbourhoods from other points in life.

Distinctiveness in Housing and Geographic Context

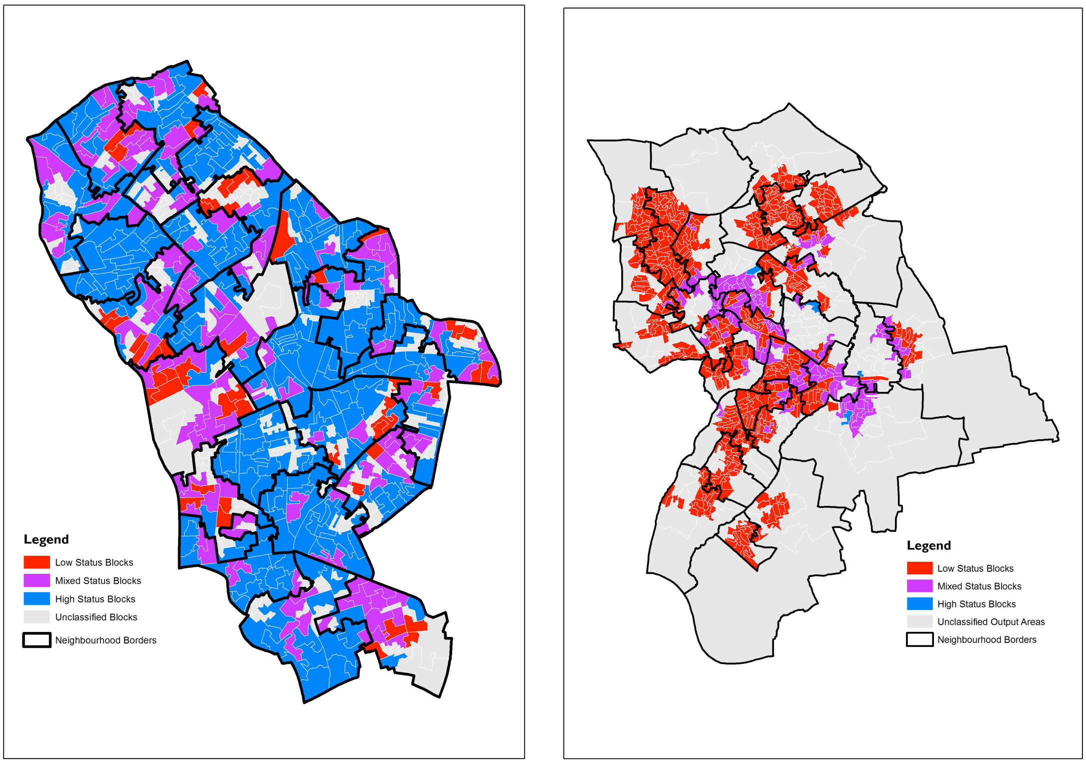
In my analysis of local segregation in London, I found that low status city blocks were predominantly composed of social housing when located in high status neighbourhoods, whereas in low status neighbourhoods, they were made up of a mix of housing tenures. Additionally, I went on to discuss how, in the case of London, socioeconomically incongruent low status city blocks are much more commonly found towards the centre of the city. As such, any other material or psychosocial health-damaging factors, that relate to living centrally in a city, may explain my finding that incongruent low status city blocks have higher rates of ill health.

In the discussion of Chapter 5 I focus on the potential effects of stigma, illustrated especially by the juxtaposition of prominent blocks of social housing beside blocks of affluent housing. However, as can be seen in Figure 6.1 below, it is not just housing tenure and the contrasting juxtaposition of housing that differs between areas where low status blocks are incongruent and where they are congruent. Particularly clear is the difference in green space. The grey blocks in the map of the borough of Havering are predominantly suburban areas, where the interface between city and countryside begins to emerge. From a comparison of the maps in Figure 6.1, there is a clear visual contrast in this respect. In Chapter 1, I discussed the potentially healthy impact of green space on the encouragement of positive health behaviours. Of course, this figure illustrates only two boroughs as examples, Islington and Havering. However, it vividly exemplifies the importance of other factors in explaining contextual health effects, and the limitations of data-driven analyses of these effects in general.

Figure 6.1 Maps to illustrate the low availability of open space to incongruent low status city blocks that are mostly located towards the centre of London, compared to the high availability of open space to congruent low status city blocks that are mostly located towards the edge of London

Borough of Islington

Borough of Havering



NB: These maps are not drawn to an equivalent scale. Havering, the easternmost borough in London is about twice the geographic size of Islington, a central borough of London. The grey output areas are city blocks that have not been classified in my analyses if Chapter 5, mostly because they were made up of low densities of residents due to open/green space such as parks and fields.

Intricacies of Wealth

I have tried to derive alternative explanations of my findings from the perspective of the persistence of ill health amongst poor people (the ceiling-threshold effect), and from the perspective of the unique circumstances of poor people living incongruently (fish out of water). The final alternative interpretation is from the perspective of the diversity and intricacies of wealth amongst rich people. As I pointed out above, in the analyses of the Millennium Cohort Study, I found that most cross-level interaction effects were due to the combinations of: 1) an association between neighbourhood status and the outcome for the highest status mothers; and 2) the lack of an association between neighbourhood status and the outcome for the lowest status mothers. Here, I discuss the possibility that the association found amongst the highest status mothers is a residual association driven by unmeasured socioeconomic differences amongst these mothers that are picked up by measurement of the status of their neighbourhoods.

The distribution of income across the population in the UK is uneven (Hill *et al.*, 2010). Plotted as a histogram, it has a characteristic long tail towards the higher incomes, which represents a much higher variation in income amongst people who earn above the median, compared to those who earn below the median. Considering this higher variability in income amongst richer people, it is likely that the mothers that I have classified in the highest status group have a higher variability in income, wealth and other socioeconomic indicators compared to those that I have classified in the lowest status group. As such, there is a possibility that the adjustments that I have made in my analyses to account for these differences between neighbourhood types, namely housing tenure, income, and marital status, may not completely account for all socioeconomic differences amongst the highest status mothers, despite being sufficient to account for such differences amongst the lowest status mothers. If indeed the status of the neighbourhoods within which the highest status mothers live indicate individual-level socioeconomic differences beyond those that were adjusted for, the associations that I found between neighbourhood status and the health of the highest status mothers may be related to further, more intricate, differentials in socioeconomic status.

Although it may be the case that the associations between neighbourhood status and health for the highest status mothers are confounded by residual socioeconomic differences, this raises the question of why there are such intricate differences in health amongst those who are already categorised as the highest status - those who have high qualifications and are managers or professionals, or whose partners are managers or professionals. Essentially, this leads back to the material-psychosocial debate that has been the primary focus of this thesis. Are those further socioeconomic differences indicative of past and present risk to health-relevant material exposure, or is the potential for the psychosocial mechanism of status comparisons more relevant to health? This final alternative explanation for my findings only serves to increase the need to resolve this debate.

6.3 Implications for Understanding the Health Impacts of Local Socioeconomic Segregation

As I have described at several points in this thesis, the phenomenon of local socioeconomic segregation is a specific type of status incongruity in neighbourhoods. In my investigation of this phenomenon I have been particularly interested in the health of low status people whose immediate surroundings have socioeconomic characteristics that match their own, but at the same time, contrast to the wider neighbourhood. My findings from analyses of the Millennium Cohort Study in Chapters 3 and 4 could not specifically address this subtype of status incongruity because of a limitation in sample size. Nevertheless, the analyses of census data and my interpretations of findings in Chapter 5 have been guided by the methods and results of Chapters 3 and 4. What is more, without the constraints that are made necessary by the special license guidelines in using the geographically linked MCS data, I have been able to present qualitative comparisons between specific neighbourhoods to illustrate the complexity of the environment of socioeconomically segregated low status residents. This has helped in synthesising the findings across the chapters, in order to reach a deep, but also broad, understanding in order to cautiously address the secondary question in this thesis: what are the health impacts of local socioeconomic segregation?

Stigma and Local Segregation

The single most important finding that relates to my secondary aim in this thesis is that low status city blocks in London do not have better rates of health when they are segregated within high status neighbourhoods, compared to when they are located amongst other low status city blocks within low status neighbourhoods. Indeed, low status blocks have higher rates of low self-rated health and higher proportions of residents with limiting longterm illness when in high status neighbourhoods. This is an important contribution to our understanding of the health impact of local segregation.

I went further to try to explain the health associations with local segregation and found that they are explained by the much higher rates of social housing and higher levels of material deprivation in these blocks, compared to those in low status neighbourhoods. I suggested that these findings potentially reflect the stigmatising effect of social housing and particularly deprived enclaves, especially when juxtaposed to an affluent environment. On the other hand, I discussed how these findings may indicate physical health risks associated with social housing and material deprivation, whilst above, I also highlighted the possible confounding related to the centrality and lack of green space in segregated low status blocks. The plausibility of these other explanations necessitate that conclusions from this thesis are made cautiously. Nevertheless, the explanation that connects the findings from the separate analyses across my thesis, is that of stigma.

Stigma is a connecting theme resulting from specific findings on self-esteem in the MCS analyses as well as the findings on the mediation of health disadvantage in the context of local segregation. In the analyses of self-esteem amongst the mothers in the MCS in Chapter 4, I found that cross-level interaction effects were most evident in the north of England. I suggested that this may be explained by the fact that a higher proportion of the status incongruent low status mothers in the North were socioeconomically segregated, compared to those from the South. As a result, the findings for self-esteem in the North may reflect the sensitivity of this measure to capturing the detrimental effect of stigma related to local segregation of low status residents to particular parts of a neighbourhood. In light of the findings from the analyses in Chapter 5 that are specific to local socioeconomic segregation, the suggestion that this type of status incongruity can lead to stigma is supported, albeit indirectly via the potential for the perception of social housing to lead to the stigmatisation of its residents. In Chapter 5, I discussed the likelihood of stigma targeted at local blocks of social housing, and I can summarise the consequent effects on health here in the words of Lynsey Hanley in her history of social housing in the UK,

> "I wonder whether the man who lives on a council estate is more likely to die early because he has eaten more pies than his owner-occupying compatriot, or because the cumulative stress of knowing that he is at the bottom of life's laundry pile has caused fatal damage to his immune system. Then again, he might have eaten all those pies in order to comfort himself about his relatively low position in the social hierarchy."
>
> (Hanley, 2007: 146)

As I have indicated, from the analyses in this thesis, I cannot conclusively attribute the findings of detrimental associations amongst locally segregated low status blocks to stigma alone. Also, it must be noted that these associations are not strong, and that the majority of the variability in health amongst low status blocks are not explained by neighbourhood differences. Nevertheless, the fact that high status neighbourhoods are associated to any extent with detrimental health for low status residents is not an intuitive finding, and it is worthwhile to investigate its causes further.

Mixed Versus Segregated Neighbourhoods

Whatever the underlying factors that drive my findings above on health and socioeconomic segregation, the question remains: should people of different socioeconomic status be discouraged from living within the same neighbourhood? When asked, *'Are poor people healthier in rich or poor areas?'*, some people may consider the question to provoke an argument for or against the general spatial segregation of people by income, for the sake of their health. In response to this, I suggest that the way in which socioeconomic residential 'mixing' within neighbourhoods is spatially organised is likely to determine whether any health risk becomes apparent. In order to explain the rationale for this response, I draw from research on neighbourhood diversity and trust by Eric Uslaner.

Uslaner's research has found that mixing of different types of people within neighbourhoods does not necessarily lead to a breakdown in trust, as has been argued by some researchers, including Putnam (2000). Uslaner specifically identifies segregation as the reason why trust breaks down between different types of people. In an analysis of neighbourhoods in the US and the UK, he found that segregation, especially in diverse communities, diminishes trust more strongly than unsegregated mixing within neighbourhoods (Uslaner, 2010). Indeed amongst unsegregated mixed neighbourhoods, he found that where social ties were strong, levels of trust were higher. Although these analyses were specific to ethnic segregation and ethnic mixing, they are potentially relevant for socioeconomic segregation. These findings on trust are likely to have implications for social ties as well as stigma, and consequently for health.

Using data from the MCS, I find similar results to those above, but in the context of socioeconomic segregation and psychological distress. Amongst the lowest status mothers who were socioeconomically segregated in the analytical sample in Chapter 4, almost half had been diagnosed with depression or serious anxiety. Compared to the other form of status incongruity - socioeconomic isolation - where fewer than a third had been diagnosed with depression or serious anxiety, it is likely that the phenomenon of local socioeconomic segregation is a particularly detrimental situation for mental wellbeing. However, as I noted earlier, dividing the MCS sample of the lowest status mothers into those who are segregated and those who are isolated creates groups with small sample size. As such, observations are only suggestive.

Taken together, a cautious conclusion is that local socioeconomic segregation into poor enclaves within rich neighbourhoods is likely to be detrimental to health. This is especially the case in the context of inequality, given the power of the housing market to spatially segregate poor people into undesirable and visually potent locations within affluent neighbourhoods.

The Dilemma for Policy

I have noted that the findings from this investigation into local socioeconomic segregation may be important in terms of understanding the potential health and social impacts of current and future housing policies in the UK. It would seem that any policy that further promotes local segregation would lead to detrimental health effects and the exacerbation of health inequalities. As such, one may suggest that the current policy of some local authorities to commit some proportion of every new housing development to social housing would be desirable, so long as the visible difference in housing types is not as distinct as what can be observed in some segregated low status city blocks. At the same time, it may be desirable that housing developers ensure a low level of segregation, and place different housing tenures throughout their sites. Secondly, one may suggest that the forthcoming policy to restrict housing benefits to a new minimum in the case of council housing, and to a lower baseline in the case of assistance for private renters, will have detrimental effects for the health of poor people who end up with more restricted local choices of accommodation, and ultimately become more segregated.

However, the corollary of the suggestions above is that people of low status should be encouraged to live either in a scattered fashion amongst people of different socioeconomic status in mixed neighbourhoods, or at greater scales of segregation, so long as local socioeconomic segregation within neighbourhoods is avoided. The implication of the latter is that large 'ghettoes', much like those that exist in an ethnic form in the US, are good. However, this has been shown to have economic effects that ultimately lead to poor health (Williams and Collins, 2001, Wacquant, 2008). The implications of the former strategy would be to encourage diversity in social connections and promote integration, as called for by proponents of integration such as Halpern and Uslaner (Halpern, 1993, Uslaner, 2010). However, despite the good intentions of such a policy to encourage unsegregated mixing, whether such an arrangement in a neighbourhood would necessarily lead to social cohesiveness, trust, integration, and ultimately improved health, is not clear. Indeed, in my analyses of social ties amongst mothers in the MCS I found that those in high socioeconomic groups were least likely to have friends in their neighbourhood when living in low status neighbourhoods.

The current levels of socioeconomic inequalities in the UK may be so high that integration across the disparate lives of people who belong to different socioeconomic groups may not be possible for the majority of neighbourhoods, whether or not people of different status are segregated within them. Firstly, there exists a substantial gulf in the capabilities for social participation that can be exemplified by differences in dining out (Warde *et al.*, 1999), as much as by a multitude of social activities. Secondly, research into people of low status who take on the life styles of people of high status have indicated a psychological and health cost. For example, a study in the US found that in a sample from a black community in the South, those who possessed material goods and had exposure to mass media beyond what would be expected for their occupational class had higher arterial blood pressures (Dressler, 1990). This may explain why in one study of mortality in the US that I reviewed in Chapter 2, as well as having a higher likelihood of premature death, low status men who were living in high status neighbourhoods were more likely to be hypertensive (Winkleby *et al.*, 2006).

It would appear that in a society with high levels of inequality, both local socioeconomic segregation and socioeconomic isolation may be detrimental to health. The former is imposed by a constraint in the choice of accommodation that leads to living in stigmatising circumstances. The latter is fairer in concept, due to ideas on integration, but without a reduction in differences in capabilities across society as a whole, integration is unlikely to occur.

6.4 Implications for the Material-Psychosocial Debate in Health Inequalities

In this final section of my thesis I address the primary aim that I specified at the beginning of the thesis, to contribute to the debate about the relative importance of psychosocial causes over material causes of ill health and unhealthy behaviours, in the context of neighbourhoods. As I have alluded to above and in the conclusion of Chapter 4 in particular, there are no clear conclusions from my findings as to whether psychosocial or material causes are more powerful in determining the health of poor people in rich areas. However, the novelty of using social incongruity in the neighbourhood as a perspective from which to explicitly address material-psychosocial debates is a contribution to the understanding of conflicting mechanisms.

Evidence for the Strength of Psychosocial Causes Versus Material Causes

Throughout this thesis I have tried to interpret any detrimental associations between high neighbourhood status and ill health with a particular focus on status comparisons and social support. As I discussed above, within the context of inequality, particularly in London, there is some evidence from my analyses that detrimental psychosocial factors are associated with status incongruity. Low status mothers are more likely to have no friends from the neighbourhood when they live in high status neighbourhoods in London. At the same time, they are more likely to have been diagnosed with depression or serious anxiety when they live in these neighbourhoods.

Although these findings are evidence that psychosocial risk factors are associated with status incongruity, they do not necessarily imply that psychosocial factors mediate physical morbidity. From my analyses of physical morbidity, there is only suggestive evidence for this implication. This is because the invariance of low self-rated health and obesity amongst low status mothers by neighbourhood status, despite associations amongst high status mothers, may be interpreted as being due to balancing health risks between psychosocial and material causes. A supporting explanation that I discussed earlier in this chapter is that the mothers in the MCS were not old enough to capture the chronic psychosocial effects of status incongruity on physical health. Despite the temptation to attribute such invariance in the health of low status mothers to a balance of conflicting material and psychosocial factors, it is important to take on board the caveats that I noted earlier in this chapter and to accept that the alternative explanations that I discussed may turn out to be important: namely ceiling-threshold effects, the confounding effect of being a 'fish out of water', and the residual confounding due to intricacies of wealth amongst the highest status mothers.

Finally, another problem with using socioeconomic incongruity as a tool for testing the relative strengths of material and psychosocial mechanisms is that, in the context of socioeconomic incongruity, they do not necessarily operate in just one direction. In other words, the health of poor people may suffer in rich neighbourhoods due to material, as well as psychosocial, mechanisms. At the same time, their health may suffer in poor neighbourhoods due to psychosocial, as well as material, mechanisms. To give an example of the former, rich neighbourhoods may limit the disposable income of poor people substantially because of the costs of living in such areas, especially if renting privately. A drop in financial ability may have material effects on health through limiting choice in social activities to those that are cheaper but not necessarily as healthy. I have discussed this in the context of eating out in Chapter 1. To add to the complexity of potential effects of socioeconomic incongruity, lower disposable income may also lead to detrimental psychosocial effects. For example, instead of choosing less healthy restaurants, a poor person with little money left over after rent in a rich neighbourhood may decide not to eat out altogether, or may decide not to partake in a range of social activities. This may potentially lead to social isolation and its detrimental effects on physical and mental health.

Certainly these interpretations are far from conclusive. Nevertheless they are of interest not just for debating different causes of health inequalities, but for the understanding of socioeconomic incongruity and local socioeconomic segregation in general. Despite this, it is important that investigations into the psychosocial mediation of health continue and that researchers develop innovative avenues of research.

Psychosocial Factors and People's Everyday Lives

In any investigation regarding an academic debate, such as the one here, the utility of such a debate must be discussed. Some have called for an end to the debate over material versus psychosocial causes of health inequalities (Adler, 2006) that has been ongoing in the disciplines of public health and epidemiology (Lynch *et al.*, 2000, Wilkinson, 2000, Singh-Manoux *et al.*, 2005). In Chapter 1 I stated that the rationale behind pursuing the debate in this thesis was for the different policy approaches that must be advocated for depending on whether material or psychosocial causes of health inequality are more important. Proponents for the material side of the debate call for a reduction of poverty, whereas proponents for the psychosocial side of the debate call not just for a reduction of poverty, but also for a reduction of inequality from top to bottom. As I have discussed, this is because psychosocial explanations include status comparisons across all socioeconomic strata, and societal inequality as a whole has been argued to have independent effects that compromise social relationships across society (Kawachi and Kennedy, 1999, Wilkinson and Pickett, 2007, Kondo *et al.*, 2009).

Beyond this, in my own view, finding the dominant mechanisms that create inequalities in health, especially the social gradient in health, may allow researchers in public health to understand what aspect of people's lives they hope to change. I argue that if it is conclusively found that psychosocial mechanisms dominate the production of health inequalities, the moral impetus for reducing such inequalities becomes even greater. This is not just because of a humanitarian duty to increase life expectancies across all socioeconomic groups, nor is it necessarily because of fairness in what people should expect regarding their health. This is because a domination of psychosocial mechanisms in health inequalities would imply that societal inequalities are consciously felt throughout people's lives. As such, identifying the importance of psychosocial mechanisms, also indicates whether research to reduce health inequalities will also improve wellbeing and quality of life. Following this line of reasoning, it is important that research on this topic broadens to incorporate a range of academic disciplines, in order to verify proposed scientific mechanisms and test their validity in explaining the experience of people's daily lives. Research of this type is becoming more common, which is a positive prospect for the future of this field. For example, there is ongoing research on the relationship between endocrine pathways and wellbeing across the life course (Worthman, 2002), marrying the disciplines of physiology, psychology and epidemiology. Finally, this is not to say that material mediation of health inequalities is not consciously felt. The key theoretical difference between material and psychosocial explanations of ill health is that psychosocial causes are generally hypothesised to affect physical health after chronic psychological exposure, whereas material causes are thought to affect health through an accumulation of different physical exposures. As such, in order to produce observable inequalities in physical morbidity and mortality, mediation through psychosocial mechanisms necessarily imply a pervasive and persistent experience of psychological distress throughout people's lives.

Appendices

Chapter 1 Appendix

Box A1.1 National Statistics Socioeconomic Classification

The NS-SEC is based on the differences between employment conditions and relations. Factors taken into account include payment by wage or salary, promotional prospects, job security and levels of autonomy (Shaw *et al.*, 2007: 117). Examples of analytic classes are given below (adapted from White *et al.*, 2007).

	Analytic Classes	**Examples**
1	Large employers, higher managers	Senior officials in national and local government, directors and chief executives of major organisations, officers in the armed forces
1	Higher professionals	Civil engineers, medical practitioners, physicists, geologists, IT strategy and planning professionals, legal professionals, architects
2	Lower managerial, professional	Teachers in primary and secondary schools, quantity surveyors, public service administrative professionals, social workers, nurses, IT technicians
3	Intermediate	NCOs and other ranks in the Armed Forces, graphic designers, medical and dental technicians, Civil Service administrative officers and local government clerical officers, counter clerks, school and company secretaries
4	Small employers and own account workers	Hairdressing and beauty salon proprietors, shopkeepers, dispensing opticians in private practice, farmers, self-employed taxi drivers
5	Lower supervisory and technical occupations	Bakers and flour confectioners, screen-printers, plumbers, electricians and motor mechanics employed by others, gardeners, rail transport operatives
6	Semi-routine occupations	Pest control officers, clothing cutters, traffic wardens, scaffolders, assemblers of vehicles, farm workers, veterinary nurses and assistants, shelf fillers
7	Routine occupations	Hairdressing employees, floral arrangers, roundsmen and women, sewing machinists, van, bus and coach drivers, labourers, hotel porters, bar staff, cleaners and domestics, road sweepers, car park attendants

Chapter 2 Appendix

Table A2.1 Summary of cross-level mortality studies (table spans both pages)

Ref	*Outcome*	*Sample*	*Areas (avg size)*	*Area SES*
Studies Supporting Double Jeopardy				
Borrell et al 2004	11-year all-cause mortality	14004 elderly white & black adults aged 45-64, from the '87-89 Atherosclerosis Risk in Communities Study, 4 sites in NC, MS, MN & MD, USA	597 Census Block Groups (1000)	Race-specific tertiles based on household income; owner-occupied value; % receiving interest, dividends or rent; % ≥25 w hschool dip.; % ≥25 w degree; % manag/prof
Davey Smith et al 1998	15-year all-cause mortality	14952 elderly adults aged 45-64 years, from the '72-76 Renfrew/Paisley General Population Study, Scotland, UK	14 Post Code Sectors (5000)	Carstairs index split into 7 categories based on male unemployment, overcrowding, car ownership, and % SC IV & V
Studies Supporting Null Hypothesis				
Bosma et al 2001	6-year all-cause mortality	8506 young people and adults aged 15-74 years, from the '91 GLOBE Study, Eindhoven, Netherlands	86 Administrative Neighbourhoods (2221)	4 separate indicators split into quartiles: % primary schooled only, unskilled manual workers, unemployed/disabled, & severe financial problems
Marinacci et al 2004	10-year all-cause mortality	2520732 young people and adults aged ≥15, from the '71, '81 & '91 Turin Longitudinal Study, Turin, Italy	23 Administrative Neighbourhoods (41139)	3 cats. based on % ≤primary school, manual job, renting, no indoor bathroom, overcrowded, single parent households w children. The 3 cats. made up of quintiles 1&2, 3, and 4&5 based on index

Individual SES	*Cofactors*	*Type of Model (Interaction test)*	*Cross-level effects and interactions*
Household income (Lowest SES: < $25,000 for whites; <$12,000 for blacks)	Sex, age, site	Poisson regression (Likelihood ratio tests for cross-level interactions)	Mortality rates decreased with increasing area SES. Pattern less consistent with highest income participants (graphical), but no significant cross-level interactions.
Social Class (Lowest SES: RGSC IIIM, IV or V)	Sex, age	Cox regression (Exact cross-level interaction tests not specified)	Both manual/non-manual more likely to die in deprived areas. Pattern clearest for manual: manual in most deprived areas vs non-manual in least deprived areas, men's OR=2.28 & women's OR=1.67. Equivalent figures for non-manual (1.70 & 0.94) were not significant. Cross-level interactions not significant.
Multi (Lowest SES: Primary education, unskilled manual worker, unemployed/ disabled or with severe financial problems)	Sex, age, baseline health status	Multilevel logistic regression (Exact cross-level interaction tests not specified)	No significant cross-level interactions whether area SES is modelled continuously or as quartiles. Individual SES-specific associations between health and area SES not reported.
Multi (Lowest SES: Either ≤Primary school educated; or No indoor bathroom/heating)	Sex, age, area of birth, education/ housing conditions	Multilevel poisson regression (Wald tests for cross-level interactions)	No significant cross-level interactions. Individual SES-specific analyses not reported, therefore mortality associations with area SES by individual SES unknown.

Ref	*Outcome*	*Sample*	*Areas (avg size)*	*Area SES*
Turrell et al 2007	3-year all-cause mortality	5995661 adults aged 25-64, from the '98-00 Australian Bureau of Statistics, Nationwide, Australia	1317 Statistical Local Areas (15000)	Quintiles based on % low income, low educational, high public housing, high unemp.
Studies Supporting Relative Status (Attenuated/Zero Benefit)				
Ecob & Jones 1998	15-year all-cause mortality	287787 adults aged 25-74, from the '71 ONS Longitudinal Study, England & Wales, UK	Wards (5500)	% Professional (based on average of wards belonging to same Craig-Webber type)
Studies Supporting Relative Status (Net Disadvantage)				
Roos et al 2004	9-year all-cause mortality	10148 adults aged 18-74, from the '90 Nova Scotia Nutrition Survey, and '96-97 National Population Health Survey, Nova Scotia & Manitoba, Canada	Census Enumeration Areas (1000)	6 different variables, each cut into three categories and analysed separately: Household income; Dwelling value; Unemployment; Education, Single mothers, Socioeconomic factor index
Veugelers et al 2001	9-year all-cause mortality	2116 adults aged 18-74, from the '90 Nova Scotia Nutrition Survey, Nova Scotia, Canada	705 Census Enumeration Areas (1000)	5 different variables, each cut into three categories and analysed separately: Household income; Dwelling value; Unemployment; Education, and Single mothers

Individual SES	*Cofactors*	*Type of Model (Interaction test)*	*Cross-level effects and interactions*
Occupation (Lowest SES: Blue collar [Manual/ Tradesperson])	Sex, age (area-level)	5-level multilevel logistic regression (Wald-like tests for cross-level interactions)	No significant cross-level interactions for male blue collar workers compared to professionals, although significant for white collar workers (middle occupational group: clerks, salespersons & personal service workers). Male white collar workers sig. lower mortality than professionals in lowest area SES (RR=0.78). Interactions less clear for women
Social Class (Lowest SES: RGSC IV & V)	Sex, age, housing tenure, car ownership, economic activity	Logistic regression (Likelihood ratio tests for cross-level interactions)	For men, probability of dying decreases with increasing % professional in area. Rate of decrease greater for higher SES individuals. Cross-level interaction significant for men, but not women.
Household income (Lowest SES: < $20,000)	Sex, age, smoking status, BMI, diabetes	Multilevel logistic regression (Test for cross-level interactions: Ratio of diffs. in avg. mortality between various paired household income groups within disadvantaged compared to advantaged areas.)	Lowest income group less likely to die in disadvantaged vs advantaged areas based on area income (M[anitoba]OR=0.57, N[ova Scotia]OR=0.75), and education (M.OR=0.72, N.OR=0.67). Directions of these relationships are opposite to higher income groups, but association significant only by area income in Manitoba. Significant tests for cross-level interactions only in Manitoba when area SES measured by income or education
Household income (Lowest SES: < $20,000)	Sex, age, smoking status, BMI, diabetes	Multilevel logistic regression (Difference of log income ORs in disadvantaged vs advantaged areas tested to determine cross-level interaction)	Lowest income group less likely to die in disadvantaged vs advantaged areas based on area income (OR=0.75), education (OR=0.67) and % single mothers (OR=0.65). Associations not significant, but directions are opposite to higher income groups. Significant tests for cross-level interactions, but not when area SES measured by dwelling value or unemployment

Ref	*Outcome*	*Sample*	*Areas (avg size)*	*Area SES*
Wen & Christakis 2005	6-year post-hospitalisation mortality	10557 elderly Medicare benificiaries diagnosed with stroke, myocardial infarction, congestive heart failure, hip fracture or lung cancer, from the '93 Care after the Onset of Serious Illness data set, Chicago, USA	51 Zip Codes (30000)	Continuous score based on factor analysis of % ≥ $50,000 household income, <federal poverty threshold, and graduates
Winkleby & Cubbin 2003	3 to 11-year all-cause mortality	423568 black, white and Mexican-American adults aged 24-64, from the '87-94 National Health Interview Survey, Nationwide, USA	Census Tracts (4000)	Gender & race-specific tertiles based on % no highschool, median income, % bluecollar & % unemployed
Winkleby et al 2006	17-year all-cause mortality	8197 adults aged 25-74, from the '79-90 Stanford Heart Disease Prevention Program, Monterey, Salinas, Modesto & San Luis Obispo, CA, USA	82 Census Tract & Block Groups (4000)	3 cats. based on principal components analysis of % ≥25 w <highschool edu., household income, housing value, % blue collar, % unemp. Cats. made up of bottom 25%, middle 50% & top 25%
Yen & Kaplan 1999	11-year all-cause mortality	996 adults aged 36-96, from the '83 Alameda County Study, CA, USA	Census Tracts (4000)	Quartiles based on per capita income, % white collar, & overcrowding

Individual SES	*Cofactors*	*Type of Model (Interaction test)*	*Cross-level effects and interactions*
Poverty status (Lowest SES: Medicaid recipient)	Sex, age, race, diagnosis, comorbidity	Cox regression with robust standard errors (Likelihood ratio tests for cross-level interactions)	Poverty group had worse survival in more advantaged areas (HR=1.04 borderline sig.), opposite to the effect on the non-poverty group (HR=0.94 sig.). Cross-level interactions significant.
Household income (Lowest SES: Bottom gender & race-specific quartile)	Sex, age	Descriptive gender & race-stratified age-adjusted cross-tabulation (No cross-level interaction tests)	Cross-level results are descriptive only (graphical). Lowest income Mexican-Americans have highest age-adjusted mortality in highest SES areas. No cross-level patterns for black or white sample.
Income & Education index (Lowest SES: Bottom city-specific tertile)	Sex, age	Cox regression (Cross-level interactions tested with significance of Cox interaction terms)	Lowest SES group had higher mortality in highest vs lowest SES areas (women RR=1.69, men RR=1.21). Directions of relationships are opposite for highest SES group. Significant cross-level interactions even after adjustment for baseline risk-factors.
Household income (Lowest SES: ≤ $12,000)	Sex, age, smoking, perceived health status	Multilevel logistic regression (Exact cross-level interaction tests not specified)	High-income participants most likely to die in most deprived areas (Compared to counterparts in least deprived areas OR=1.93). In contrast, low-income participants most likely to die in least deprived areas (Compared to high-income in least deprived areas OR=5.51, whilst in most deprived areas OR=1.98). Significant associations and cross-level interactions with or without adjustments for smoking and perceived health status.

Table A2.2 Summary of cross-level morbidity studies (table spans both pages)

Ref	*Outcome*	*Sample*	*Areas (avg size)*	*Area SES*
Studies Supporting Double Jeopardy				
Hou & Myles 2005	Self-rated health	34613 aged 12+, from the Statistic Canada's 1996/97 National Population Health Survey (NPHS), Canada's 25 Census Metropolitan Areas, Canada	Census tracts (4000)	Quintiles of Median Income
Kobetz et al 2003	Self-rated health	1996 aged 50+, from the North Carolina Breast Cancer Screening Program (NC-BCSP), North Carolina, US	56 Census tracts (4000)	Area Poverty Rate: Poverty area if >20% live below poverty line (<$12K for family of 4)
Stafford & Marmot 2003	Self-rated health / Waist:Hip Ratio	5539 Civil servants. 'Essentially an office-based working cohort', from the Whitehall II, mainly London & Southwest, UK	2112 Wards (5500)	10th centile, median, and 90th centile based on Townsend Index: % households with access to a car; % owner occupiers; % unemployed; % overcrowded
Stafford et al 2001	Self-rated health	6901 non-industrial civil servants aged 35-55. 'Essentially an office-based working cohort', from the Whitehall II, mainly London & Southwest, UK	1831 Wards (5500)	Quintiles of Townsend Index: % households with access to a car; % owner occupiers; % unemployed; % overcrowded

Individual SES	*Cofactors*	*Type of Model (Interaction test)*	*Cross-level effects and interactions*
Family Income (Lowest SES: Bottom sextile of income (approx.))	Education (University/ Not), Ethnicity (White/Non-White)	Hierarchical ordinal logistic regression (Cross-level interaction test: Coefficients of different income groups allowed to vary by neighbourhood, then regressed against neighbourhood status)	Adjusting for individual SES, ethnicity, demographic variables, and neighbourhood inequality, neighbourhood median income was associated with good SRH. Modest indication that the lowest income group benefits more from neighbourhood affluence than the highest income group. Cross-level interaction terms are not significant.
Family Income (Lowest SES: < $12K)	Race (Black or White), Education (High School completed or Not) and Employment Status (Unemployed or Not)	Generalized Etimating Equations (Significance of coefficients for interaction terms in regression models were used to determine significance of cross-level interaction effects)	Compared to living in neighbourhoods not in poverty, living in those that were in poverty significantly increased the chance of women's poor SRH by 35%. Significant after adjusting for individual SES. The SRH of women who were in poverty themselves was more strongly associated with neighbourhood poverty, than the SRH of other women.
Employment grade (Lowest SES: Clerical and support)	None	Multilevel logistic regression and multilevel linear regression (Wald test for cross-level interaction effects)	Poor SRH, high waist/hip ratio and poor mental health were associated with increasing area deprivation after adjusting for employment grade. No cross-level interaction effects between employment grade and area deprivation. Some indication, especially for high waist/hip ratio, that civil servants of low employment grade are most strongly affected by area deprivation.
Employment Grade (Lowest SES: Clerical and support)	Household Deprivation Score (6-point scale on financial difficulty with food, clothes, and bills)	Multilevel logistic regression (Changes in model fit were statistically tested to determine significance of cross-level interaction effects)	Civil servants in wards of the most deprived quintile had 29% increased likelihood of poor SRH, adjusted for individual SES. No significant cross-level interaction effects. Some indication that the SRH of clerical/support grade civil servants was more strongly associated with area deprivation than that of administrative grade civil servants.

Ref	Outcome	Sample	Areas (avg size)	Area SES
Studies Supporting Null Hypothesis				
Adams et al 2009	Obesity, Smoking, Metabolic Syndrome, Physical Inactivity & Risky Alcohol Use, Health-related QoL	4060 adults 18 years or over from electronic white pages, from the North West Adelaide Health Study, Adelaide suburbs, Australia	Collectors' Districts (200)	Quintiles of Index: % < \$15.6K, <\$15K w. kids, unemployed, lower-skill workers, ≥15 years w. no qual., single parents, separated/divorced, renting from gov., no car, ≥2 families in household, not fluent in English
Dibben et al 2006	Low Birthweight	300000 Mothers, from the ONS postcoded birth records, England, UK	LSOAs (1500)	Quintiles based on Index of Multiple Deprivation (IMD).
Diez Roux et al (2001)	CHD events incidence	13009 45-64 years, from the Atherosclerosis Risk in Communities Study, 4 sites in US, US	595 Block Groups (1000)	Race-specific tertiles based on factor analysis (6 variables for income & wealth): log median income; log median value housing; % households receiving rent/interest/ dividends; %≥25 w high school & %≥25 completed college; %≥16 executive/ managerial/professional.
Diez Roux et al 1997	CHD prevalence	12601 aged 45-64, from the Atherosclerosis Risk in Communities Study, Various, US	567 Census block-groupss (1000)	Various: Education (% >25 w/ incomplete high school); Income (median household income); Occupation (% not professional, managerial or executive).

Individual SES	*Cofactors*	*Type of Model (Interaction test)*	*Cross-level effects and interactions*
Education or Income (Lowest SES: High School or < $2K)	None for cross-level description	Descriptive tables stratified by education, and separately by income.	Significant area SES effects found only for Obesity, Health-related QoL, and Smoking, but not for other outcomes. 5-7.2% of variance was at the area level. No formal tests for cross-level interactions. Descriptive analyses show no indications of cross-level interactions.
Social Class & Income (based on occupation) (Lowest SES: RGSC V & low household income)	None	Multilevel logistic regression (Significance of cross-level interaction effects determined by testing improvement on model fit)	Living in areas of income deprivation sig. assoc. w. risk of low birthweight, adjusting for individual factors. Association strongest for mothers aged 30-34, and non-sig. for very young mothers. No sig. cross-level interaction effect between income/social class and area deprivation. Slight indication that area deprivation had a stronger association with low birthweight and very low birthweight for mothers in the lowest household income group/ lowest social class.
Income (Lowest SES: < $25K for Whites, < $8K for Blacks)	None	Descriptive charts of incident rates by race, income category, and area SES. Adjusted for age, study site and sex.	After adjustment for income, education and occupation, residents in lower SES areas had higher risks of CHD incidence than those in higher SES areas. Descriptive analyses do not indicate any cross-level interactions.
Occupational Class, Education or Income (Lowest SES: Service workers or below for men, below service workers for women, others continuous)	Occupation, Education & Income	Mutilevel models. (Significance of coefficients of interaction terms were used to determine the significance of cross-level interaction effects)	CHD Prevalence and risk factors were generally associated with different measures of low area SES. Cross-level interaction effects were not significant, with one exception: for men living in Jackson, increased serum cholesterol significantly associated with areas of higher education and higher median household income.

Ref	*Outcome*	*Sample*	*Areas (avg size)*	*Area SES*
Lindstrom et al 2004	Self-rated health	3602 aged 20-80, from the 1994 public health survey in Malmo, Malmo, Sweden	75 Administrative Areass (4500)	None tested because there was no between-neighbourhood variation in SRH after adjustment for individual-level variables.
Wight et al 2008	Self-rated health, CVD (self-reported), functional status	3442 aged 70+, from the 1993 Asset and Health Dynamics Among the Oldest Old (AHEAD) Study, Nationwide, US	1217 Census Tracts (4000)	PCA of %: Low education (≥25 without high school degree); On benefits (receiving public assistance outcome); Below poverty level; Unemployed (≥16)
Studies Supporting Relative Status (Attenuated/Zero Benefit)				
Collins et al 2009	Low Birthweight	267303 Mothers, from the Illinois Transgenerational Dataset, Chicago, US	Census tracts (4000)	Median Income into tertiles. Lifelong residence based on early and adult-life. Middle tertile not used.
Malmstrom et al 1999	Self-rated health	9240 aged 25-74, from the Swedish Annual Level of Living Survey, Malmo, Sweden	837 Small-area market statistics (SAMS) Areas (2000)	Care Need Index (CNI). Similar to the British Underprivileged Area Score and Townsend Score
Rundle et al 2008	BMI	13102 aged >30 yrs, from the Survey by New York City Government, New York City, US	176 Zip Codes (30000)	Poverty rate: proportion of households < poverty line. Poorer zip codes were those with poverty rates above the median.

Individual SES	*Cofactors*	*Type of Model (Interaction test)*	*Cross-level effects and interactions*
Educational Achievement (Lowest SES: Elementary school [≤ 9 years])	None	Multilevel logistic regression (No cross-level interaction test)	Between-neighbourhood variance accounted for only 2.8% of total variance in SRH. No variance remained after taking into account individual factors (country of origin, SES, and social participation). Because of this no area-level factors were tested for associations with SRH, and so no cross-level interaction effects were found.
Education, Wealth or Income (Lowest SES: All continuous wealth, education or income)	Two of Education, Wealth and Income	Multilevel logistic regression (Type of significance test for cross-level interaction not stated)	After adjusting for individual-level variables, only SRH remains significantly associated with low area SES. However, <5% of between-area variation is explained by area SES after including individual-level variables. Individual-level variables attenuate associations between area SES and CVD or functional status. No cross-level interaction terms were significant.
Education (Lowest SES: < 12 years education)	None	Descriptive tables of prevalence only.	1.6% of White and 23.6% of Black low birthweight births are attributable to lifelong residence in low-income neighbourhoods, compared to high-income neighbourhoods. For both White and Black mothers, the risk of low birthweight of the most educated is more strongly associated with area income, than that of the least educated.
Educational Achievement (Lowest SES: Elementary school [≤ 9 years])	None	Descriptive tables only.	Potential cross-level interaction effects could only be inferred through inspection of prevalence tables of SRH by area deprivation category stratified by individual educational categories. There is an indication of steeper SRH gradients in less deprived areas, and a stronger health-protective effect of less deprived areas for people educated beyond 2 years of high school, compared to people not educated beyond elementary school.
Household income (Lowest SES: < $15K)	None	Mutlilevel Analysis with interaction terms. Model fit not compared formally between models with and without interaction terms.	For women, income was more strongly associated with BMI in richer zip codes. For both sexes combined, education was more strongly associated with BMI in richer zip codes. These cross-level interaction terms were significant, although whether their inclusion explained significantly more variation was not formally tested.

Chapter 3 Appendix

Note that in these tables, significant factors are indicated by stars (* = $p < 0.05$, ** = $p < 0.01$), and interaction terms which are of borderline significance are indicated by a cross († = $p < 0.1$).

Results of Health Behaviours

Table A3.1 Fully adjusted multilevel logistic regression models to predict odds of smoking by neighbourhood status score

	Full regression
	All Data
Demographic Controls	
Age (continuous)	0.98*
Not Married vs Married	2.28**
Household Equivalised Income	
Income Quintile 5	1
Income Quintile 4	1.33**
Income Quintile 3	1.36**
Income Quintile 2	1.59**
Income Quintile 1	1.49**
Missing Income	1.45*
Housing Tenure	
Owner Occupier	1
Private Renter	2.02**
Social Housing Renter	2.26**
Other	1.05
Status Group of Mothers	
Highest Status	1
High Status	2.02**
Mid Status	2.12**
Low Status	2.43**
Lowest Status	2.58**
Neighbourhood Status	
Status Score (continuous, increasing w/ status)	1.13
Interaction Terms	
Highest Status Mothers x Neigh. Status Score	1
High Status Mothers x Neigh. Status Score	0.96
Mid Status Mothers x Neigh. Status Score	0.81†
Low Status Mothers x Neigh. Status Score	0.70**
Lowest Status Mothers x Neigh. Status Score	0.81†

Table A3.2 Fully adjusted multilevel logistic regression models to predict odds of obesity by neighbourhood status score

Demographic Controls	
Age (continuous)	1.01
Not Married vs Married	0.67**
Household Equivalised Income	
Income Quintile 5	1
Income Quintile 4	0.89
Income Quintile 3	1.18
Income Quintile 2	1.09
Income Quintile 1	0.75
Missing Income	0.68
Housing Tenure	
Owner Occupier	1
Private Renter	1.55**
Social Housing Renter	1.21
Other	0.93
Status Group of Mothers	
Highest Status	1
High Status	1.15
Mid Status	1.39*
Low Status	1.78**
Lowest Status	1.57*
Neighbourhood Status	
Status Score (continuous, increasing w/ status)	0.55**
Interaction Terms	
Highest Status Mothers x Neigh. Status Score	1
High Status Mothers x Neigh. Status Score	1.23
Mid Status Mothers x Neigh. Status Score	1.62**
Low Status Mothers x Neigh. Status Score	1.55**
Lowest Status Mothers x Neigh. Status Score	1.67**

Results for General Health

Table A3.3 Fully adjusted multilevel logistic regression models to predict odds of low self-rated health by neighbourhood status score

Demographic Controls	
Age (continuous)	1.02**
Not Married vs Married	1.27**
Household Equivalised Income	
Income Quintile 5	1
Income Quintile 4	1.02
Income Quintile 3	1.42**
Income Quintile 2	1.63**
Income Quintile 1	1.35
Missing Income	1.17
Housing Tenure	
Owner Occupier	1
Private Renter	1.48**
Social Housing Renter	1.39**
Other	1.02
Status Group of Mothers	
Highest Status	1
High Status	1.07
Mid Status	1.16
Low Status	1.34*
Lowest Status	1.86**
Neighbourhood Status	
Status Score (continuous, increasing w/ status)	0.77**
Interaction Terms	
Highest Status Mothers x Neigh. Status Score	1
High Status Mothers x Neigh. Status Score	1.03
Mid Status Mothers x Neigh. Status Score	1.27†
Low Status Mothers x Neigh. Status Score	1.09
Lowest Status Mothers x Neigh. Status Score	1.32*

Table A3.4 Fully adjusted multilevel logistic regression models to predict odds of limiting longterm illness by neighbourhood status score

	Full regression	Additional Analysis referred to in Discussion
	All Data	**Including Mothers who have lived in neighbourhood for less than 18 months**
Demographic Controls		
Age (continuous)	1.02	1.03**
Not Married vs Married	1.01	0.96
Household Equivalised Income		
Income Quintile 5	1	1
Income Quintile 4	1.11	1.04
Income Quintile 3	1.48*	1.33*
Income Quintile 2	1.68**	1.55**
Income Quintile 1	1.55*	1.58**
Missing Income	0.90	0.87
Housing Tenure		
Owner Occupier	1	1
Private Renter	1.18	1.23
Social Housing Renter	1.37*	1.56**
Other	1.32	1.44
Status Group of Mothers		
Highest Status	1	1
High Status	1.00	0.99
Mid Status	1.26	1.19
Low Status	1.72**	1.51**
Lowest Status	1.35	1.32
Neighbourhood Status		
Status Score (continuous, increasing w/ status)	0.97	0.86
Interaction Terms		
Highest Status Mothers x Neigh. Status Score	1	1
High Status Mothers x Neigh. Status Score	0.88	1.02
Mid Status Mothers x Neigh. Status Score	0.98	1.12
Low Status Mothers x Neigh. Status Score	1.07	1.26†
Lowest Status Mothers x Neigh. Status Score	1.18	1.36*

Table A3.5 Fully adjusted multilevel logistic regression models to predict odds of limiting longterm illness for lowest status mothers by neighbourhood status deciles

	Additional Analysis referred to in Discussion
	Including Mothers who have lived in neighbourhood for less than 18 months
Demographic Controls	
Age (continuous)	1.02
Not Married vs Married	1.01
Household Equivalised Income	
Income Quintile 5	1
Income Quintile 4	1.33
Income Quintile 3	1.46
Income Quintile 2	1.82
Income Quintile 1	1.87
Missing Income	1.18
Housing Tenure	
Owner Occupier	1
Private Renter	0.90
Social Housing Renter	1.14
Other	0.66
Neighbourhood Status Decile	
Status Decile 1 (Lowest Status - baseline)	1
Status Decile 2	1.11
Status Decile 3	0.84
Status Decile 4	0.88
Status Decile 5	0.85
Status Decile 6	1.86*
Status Decile 7	1.83
Status Decile 8	0.43
Status Decile 9	1.91
Status Decile 10	1.53

Chapter 4 Appendix

Results for Analyses of Neighbourhood Friendships

Table A4.1 Fully adjusted multilevel logistic regression models to predict odds of no neighbourhood friends by neighbourhood status score

Demographic Controls	
Age (continuous)	1.01
Not Married vs Married	1.00
Household Equivalised Income	
Income Quintile 5	1
Income Quintile 4	1.02
Income Quintile 3	0.85
Income Quintile 2	0.87
Income Quintile 1	1.43
Missing Income	0.53
Housing Tenure	
Owner Occupier	1
Private Renter	1.09
Social Housing Renter	1.05
Other	1.19
Status Group of Mothers	
Highest Status	1
High Status	0.71
Mid Status	1.11
Low Status	1.33
Lowest Status	1.74*
Neighbourhood Status	
Status Score (continuous, increasing w/ status)	0.64**
Interaction Terms	
Highest Status Mothers x Neigh. Status Score	1
High Status Mothers x Neigh. Status Score	0.79
Mid Status Mothers x Neigh. Status Score	0.98
Low Status Mothers x Neigh. Status Score	1.29
Lowest Status Mothers x Neigh. Status Score	1.54†

Figure A4.1 Regional differences in patterns for percentage of low/lowest status mothers with no friends in the neighbourhood

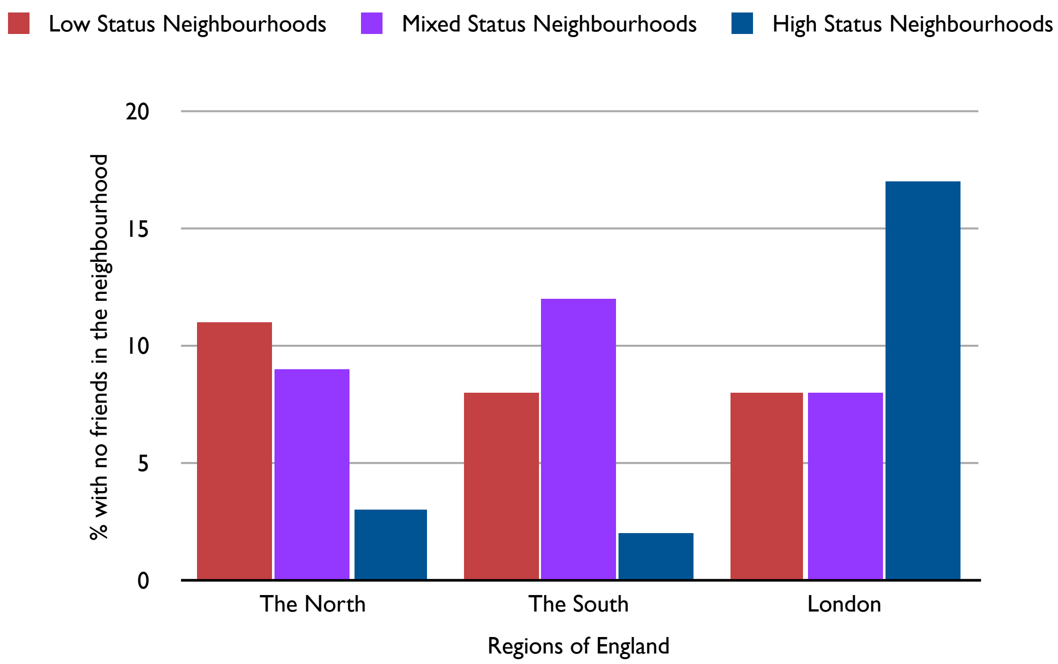
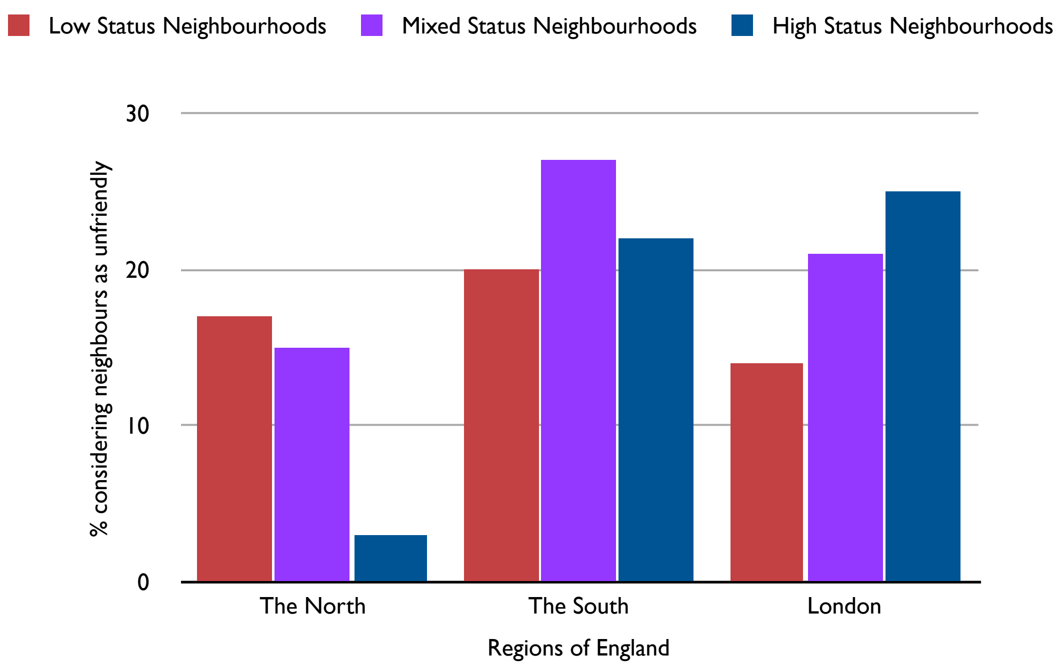


Figure A4.2 Regional differences in patterns for percentage of low/lowest status mothers who consider neighbours unfriendly



NB: Mothers are coded as considering neighbours unfriendly if they classed their neighbourhood as 'very unfriendly', 'unfriendly', or 'neither unfriendly or friendly'; as opposed to 'friendly' or 'very friendly'.

Table A4.2 Fully adjusted multilevel logistic regression models to predict odds of 'no one to share feelings with' by neighbourhood status score

Demographic Controls	
Age (continuous)	1.00
Not Married vs Married	0.91
Household Equivalised Income	
Income Quintile 5	1
Income Quintile 4	1.78*
Income Quintile 3	1.29
Income Quintile 2	2.09**
Income Quintile 1	2.74**
Missing Income	2.16*
Housing Tenure	
Owner Occupier	1
Private Renter	0.83
Social Housing Renter	1.50*
Other	1.28
Status Group of Mothers	
Highest Status	1
High Status	1.98**
Mid Status	1.76*
Low Status	2.05*
Lowest Status	3.15**
Neighbourhood Status	
Status Score (continuous, increasing w/ status)	1.27
Interaction Terms	
Highest Status Mothers x Neigh. Status Score	1
High Status Mothers x Neigh. Status Score	0.88
Mid Status Mothers x Neigh. Status Score	0.77
Low Status Mothers x Neigh. Status Score	0.76
Lowest Status Mothers x Neigh. Status Score	0.93

Results for Analyses of Mental Wellbeing

Table A4.3 Fully adjusted multilevel logistic regression models to predict odds of low self-esteem by neighbourhood status score

	Full regression	Additional Analysis referred to in Discussion
	All Data	**In the North**
Demographic Controls		
Age (continuous)	1.01	0.99
Not Married vs Married	1.05	1.02
Household Equivalised Income		
Income Quintile 5	1	1
Income Quintile 4	1.38*	1.19
Income Quintile 3	1.44*	1.42
Income Quintile 2	1.40	1.18
Income Quintile 1	1.79**	1.36
Missing Income	1.47	1.19
Housing Tenure		
Owner Occupier	1	1
Private Renter	1.17	1.12
Social Housing Renter	1.20	1.46*
Other	1.25	1.36
Status Group of Mothers		
Highest Status	1	1
High Status	0.96	0.89
Mid Status	1.19	1.23
Low Status	1.15	1.27
Lowest Status	1.18	1.08
Neighbourhood Status		
Status Score (continuous, increasing w/ status)	1.06	0.91
Interaction Terms		
Highest Status Mothers x Neigh. Status Score	1	1
High Status Mothers x Neigh. Status Score	0.93	0.96
Mid Status Mothers x Neigh. Status Score	1.08	1.51†
Low Status Mothers x Neigh. Status Score	1.03	1.52†
Lowest Status Mothers x Neigh. Status Score	0.84	0.94

Table A4.4 Fully adjusted multilevel logistic regression models to predict odds of depression or anxiety by neighbourhood status score

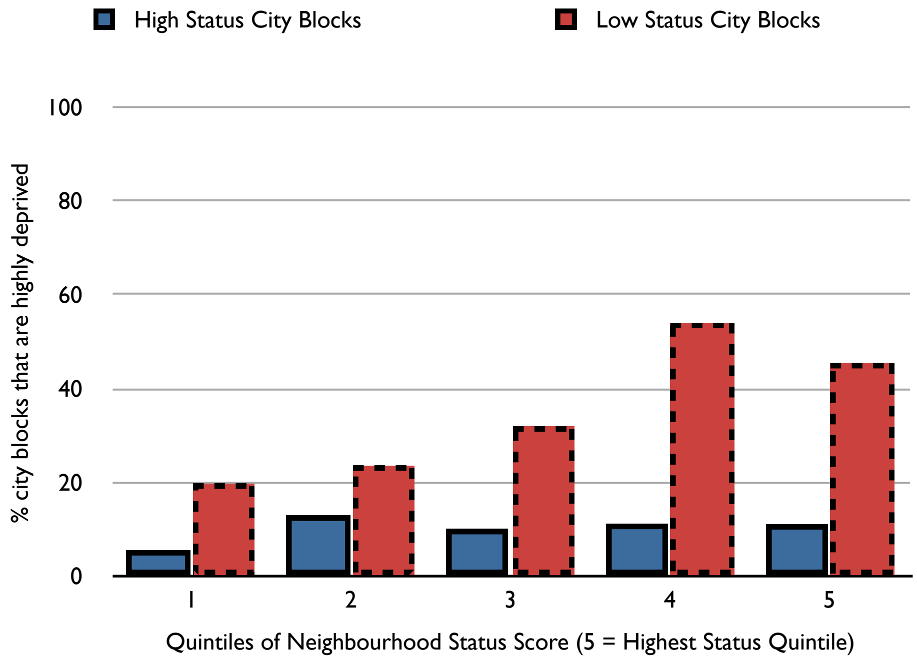
	Full regression	Additional Analyses referred to in Discussion	
	All Data	**In London**	**In the South**
Demographic Controls			
Age (continuous)	1.00	0.99	1.01
Not Married vs Married	1.24	1.65*	1.36*
Household Equivalised Income			
Income Quintile 5	1	1	1
Income Quintile 4	1.40**	1.52	1.44*
Income Quintile 3	1.86**	1.00	2.27**
Income Quintile 2	1.47**	1.16	1.41
Income Quintile 1	1.42*	0.77	1.22
Missing Income	1.57**	3.75**	0.95
Housing Tenure			
Owner Occupier	1	1	1
Private Renter	1.65**	4.67*	1.45
Social Housing Renter	1.55**	1.80	1.57**
Other	0.77	3.26×10^{-14}	0.80
Status Group of Mothers			
Highest Status	1	1	1
High Status	1.22	1.00	1.07
Mid Status	1.32*	1.50	1.13
Low Status	1.35*	0.54	1.47
Lowest Status	1.55**	0.83	1.42
Neighbourhood Status			
Status Score (continuous, increasing w/ status)	0.87	0.77	0.72*
Interaction Terms			
Highest Status Mothers x Neigh. Status Score	1	1	1
High Status Mothers x Neigh. Status Score	1.05	1.28	1.36†
Mid Status Mothers x Neigh. Status Score	1.19	1.09	1.26
Low Status Mothers x Neigh. Status Score	1.12	0.83	1.44†
Lowest Status Mothers x Neigh. Status Score	1.22	2.11†	1.06

Table A4.5 Fully adjusted multilevel logistic regression to predict odds of depression or anxiety by categorical neighbourhood status type.

Demographic Controls	
Age (continuous)	1.01
Not Married vs Married	1.24**
Household Equivalised Income	
Income Quintile 5	1
Income Quintile 4	1.40**
Income Quintile 3	1.85**
Income Quintile 2	1.47**
Income Quintile 1	1.42*
Missing Income	1.58**
Housing Tenure	
Owner Occupier	1
Private Renter	1.64**
Social Housing Renter	1.54**
Other	0.77
Status Group of Mothers	
Highest Status	1
High Status	1.08
Mid Status	1.03
Low Status	1.05
Lowest Status	1.16
Neighbourhood Type	
Low Status	1
Mixed Status	0.78
High Status	0.65*
Interaction Terms (baselines omitted)	
High Status Mothers x Mixed Status Neighs.	1.07
High Status Mothers x High Status Neighs.	1.37
Mid Status Mothers x Mixed Status Neighs.	1.27
Mid Status Mothers x High Status Neighs.	1.58†
Low Status Mothers x Mixed Status Neighs.	1.41
Low Status Mothers x High Status Neighs.	1.82†
Lowest Status Mothers x Mixed Status Neighs.	1.21
Lowest Status Mothers x High Status Neighs.	2.34*

Chapter 5 Appendix

Figure A5.1 Percentage of low status city blocks that are highly deprived* increasing with neighbourhood status contrasted to that of high status city blocks



* City blocks that are deprived are those that are ranked within the most deprived quintile based on the index of multiple deprivation (IMD), which is equivalent to being in the bottom quintile based on IMD rank.

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