The social determinants of health: an empirical analysis of ethnic and spatial inequalities in health

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Declarations

No part of this thesis has been submitted for another degree. I am the sole author of all chapters in this thesis.

I confirm that appropriate credit has been given within the thesis where reference has been made to the work of others.

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Summary

This thesis consists of three self-contained research articles that empirically examine the ethnic and spatial patterning of health outcomes in England today. Health is defined here as a multidimensional concept encompassing physical and mental health and wellbeing, in line with the Public Health White Paper 'Healthy Lives, Healthy People' (HM Government, 2010). Each chapter utilises data from Understanding Society, a nationally representative panel study, which provides detailed information about the social and economic situations of people living in the UK.

Chapter one of this thesis examines whether the association between unemployment and subjective wellbeing varies as a function of ethnicity and how this intersects with gender, and socioeconomic and generational status. Chapter two revisits the ethnic density hypothesis to explore whether residing in an area with a higher concentration of co-ethnics is protective for mental health and models the mediating role of an alternative formulation of social capital. Finally, chapter three investigates the interaction between person and place, specifically the association between neighbourhood socioeconomic context and allostatic load and the moderating role of individual level education.

Chapter one finds clear ethnic differences in the association between unemployment and subjective wellbeing, although the precise nature of ethnic patterning differs according to the domain studied. Chapter two finds that the ethnic density effect does not operate at a more refined geographical level than previously examined in the empirical literature. Finally,

chapter three finds neighbourhood differences in allostatic load. While the effect of individual level education varies across neighbourhoods, cross level interactions were statistically insignificant, therefore suggesting that these differences are not explained by the educational composition of the neighbourhood.

This thesis is dedicated to Pat Neave, whose intervention and support led me to this path

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Glossary of terms

AL Allostatic load

BHPS British Household Panel Survey

BME Black and Minority Ethnic

BMI body mass index

CRP C-reactive protein

DHEAs Dihydroepiandrosterone suphate

ELSA English Longitudinal Study of Ageing

EMPIRIC Ethnic Minorities Psychiatric Illness Rates in Community Survey

ESRC Economic and Social Research Council

FNS Fourth National Survey of Ethnic Minorities

GCSE General Certificate for Secondary Education

GHQ General Health Questionnaire

GPS General Population Sample

HbA1c Glycated Hemoglobin

HSA Health Survey for England

ICC Intraclass Correlation Coefficient

ICE Index of Concentration at the Extremes

IG1-F Insulin-like growth factor-1

IMD Index of Multiple Deprivation

LFS Labour Force Survey

LSOA Lower Super Output Area

MLM Multi Level Model

MSOA Middle Super Output Area

MTO Moving to Opportunity programme

NHANES III Third National Health and Nutrition Examination Survey

NHS National Health Service

ONS Office of National Statistics

SES Socioeconomic Status

SWB Subjective wellbeing

UK United Kingdom

UKHLS United Kingdom Household Longitudinal Survey

WHO World Health Organisation

Introduction

In 2010, the average life expectancy for a new born in the UK was 79 years for a man and 83 years for a woman, increasing from 69 and 75 years in 1970. Despite this overall improvement, certain groups have experienced greater health gains than others. Significant health inequalities thus persist, with the gap in both life and healthy life expectancy between the richest and poorest in society now wider than it was in the 1970s (Jagger, 2015). Such inequalities in health arise as a consequence of the circumstances in which people are 'born, grow, live, work, and age' (WHO, 2011) and are collectively defined as the social determinants of health. There is a clear social gradient in health; the lower an individual's position in society, the worse his or hers health (Marmot & Wilkinson, 2008). The unequal distribution of resources in society means that some groups are disproportionately concentrated in lower social positions and therefore have poorer health outcomes than others (Marmot & Wilkinson, 2008).

Health is, however, more than just the presence of disease or illness (HM Government, 2010). It is, rather, a multidimensional concept encompassing both physical and mental health and also wellbeing. The UK Government, in 2010, published the Public Health White Paper 'Healthy Lives, Healthy People', which set out the Government's commitment to reducing the pattern of ill health by socioeconomic and other characteristics. Delivering on the commitment to improve the health of the poorest, fastest, however, necessitates a comprehensive understanding of the structural drivers of health inequalities. It is here that this thesis contributes.

Health and wellbeing are not fixed throughout the lifecourse; they are sensitive to social, economic, psychological and environmental factors (HM Government, 2010). The Marmot Review, published in 2010, identified six key policy areas that, with targeted action, could reduce inequalities in health (Marmot Review, Institute of Health Equity, 2010). These included creating fair employment for all and developing healthy and sustainable communities. Concentrating on these two policy objectives, this thesis utilises *Understanding Society*, a nationally representative panel study, to empirically examine how health inequalities are ethnically and spatially arranged in England today.

At the 2011 Census, the non-white ethnic population comprised 14 percent of the total UK population, increasing from 7 percent in 1991 (Jivraj, 2012). Projections suggest this number may increase to as much as 43 percent by 2056 (Coleman, 2010). Increasingly, evidence documents ethnic inequalities in health across physical and mental health and wellbeing. Yet the drivers of these ethnic inequalities in health remain poorly understood and, as has been articulated elsewhere in the empirical literature, remains a "significant gap in current evidence and policy" (Nazroo, 2014: 90).

Chapter one of this thesis therefore examines the public health threat of unemployment among the five largest ethnic minority groups in the UK today. Unemployment is a stressful life event and a primary determinant of health inequalities (Schuring et al, 2009; Marmot Review, Institute of Health Equity, 2010). The burden of unemployment is not, however, equally distributed across the population (Nazroo & Kapadia, 2013). Individuals from ethnic minority groups continue to experience higher unemployment rates than the majority white British population (Nazroo & Kapadia, 2013). Despite this ethnic penalty in employment, the public health threat of unemployment is not well understood among ethnic minority groups.

Unemployment has most consistently been shown to strongly negatively impact wellbeing (Artazcoz et al, 2004; Paul & Mosser, 2009). Research has shown that it is possible to collect ‘meaningful and reliable data’ via subjective measures of wellbeing (Stiglitz et al., 2009). Chapter one therefore empirically examines whether the association between unemployment and subjective wellbeing varies as a function of ethnicity. In 2010, the UK government launched the *National Wellbeing Programme*, which includes both subjective and objective measures to understand societal and structural drivers of population level wellbeing. This research therefore represents a timely contribution to this research agenda.

In the UK, there is a seven year difference in life expectancy between the most and least deprived neighbourhoods and a seventeen year difference in disability-free healthy life expectancy (Marmot Review, 2010). Individuals living in disadvantaged areas are more likely to bear a greater burden of poor health (Marmot Review, Institute of Health Equity, 2010; HM Government, 2010). There has been a renewed academic interest in the role of neighbourhood context in structuring and contributing to inequalities in health, with neighbourhood context now considered an important risk factor, independent of individual level characteristics (Aneshensel & Sucoff, 1996; Elliot, 2000; Diez-Roux, 2001; Browning et al, 2003; Cummins et al, 2007). While such studies evidence only a modest contribution of neighbourhoods in explaining inequalities in health, all individuals are exposed to this driver of health. As such, the spatial distribution of health outcomes remains an important research and policy question. The role of environment and place in health is, however, multidimensional and can contribute to health inequalities in a myriad ways (Shaw, 2004). Chapters two and three of this thesis therefore consider two discrete hypothesised pathways by which neighbourhood context structures health outcomes.

Chapter two of this thesis empirically explores the association between neighbourhood ethnic composition and mental health for different ethnic minority groups. While ethnic minority groups in the UK are disproportionately concentrated in deprived neighbourhoods (Jivrai & Khan, 2013), a known stressor for mental health (Stafford & Marmot, 2003), a growing literature suggests that residing in an area with a higher concentration of co-ethnics may be protective for mental health: the ethnic density hypothesis. This ethnic density effect is complex however, operating differently across ethnic groups, at different spatial levels and socio-political contexts (Pickett & Wilkinson, 2008). Fewer studies have considered the mechanisms by which ethnic density buffers mental health, with reduced exposure to racism and discrimination and increased social capital the only pathways presently tested in the literature (Becares et al, 2009; Becares & Nazroo, 2013). Using a multilevel modelling approach, this chapter re-examines the ethnic density hypothesis at a more refined geography than earlier studies, and models the mediating role of an alternative formulation of social capital than previously tested.

While a growing number of studies report a clear correlation between neighbourhood socioeconomic disadvantage and poor health (Diez-Roux, 2001; Cummins et al, 2007), it is plausible that neighbourhood context may differentially affect the health of advantaged and disadvantaged individuals (Stafford & Marmot, 2003). Chapter three of this thesis therefore empirically examines the interaction between person and place.

According to the relative deprivation thesis, individuals who are disadvantaged, relative to others in a neighbourhood, will enter into stress inducing social comparisons which can have adverse consequences for individual health (Wilkinson, 2002). Implicit to this theoretical model, therefore, is the assumption that the association between neighbourhood context and health is mediated by the psychosocial effects of environmental stress (Ewart & Suchday, 2002). Allostatic load, a composite measure of the cumulative biological 'wear and tear' on the body, and measure of the body's physiological response to stress exposures (McEwen & Seeman, 1999) is therefore particularly suited to empirically examining this association.

In contrast, residing in an area characterised by concentrated advantage may be protective for health since individuals, irrespective of personal resource and circumstance will be positioned to draw upon the collective resources of the neighbourhood made available by concentrated affluence, as theoretically hypothesised under the collective resources model (Stafford & Marmot, 2003). Using an Educational Index of Concentration at the Extremes (ICE), a measure that captures the full distribution of neighbourhood advantage and disadvantage (Massey, 2001), this study examines the association between neighbourhood socioeconomic context and allostatic load and the moderating role of individual level education to test these opposing hypotheses.

With the collection of biomarkers, *Understanding Society* represents a unique opportunity to explore the complex processes by which individual pathways interact with neighbourhood context to contribute to social and spatial inequalities in health in the UK (Hobcraft, 2009). In 2014, *The Economic and Social Research Council (ESRC)* announced biosocial research as a strategic priority, setting out its intent to commit to enabling research "concerned with the dynamic interplays between biology, experiences and behaviours over the course of a person's life" (ESRC Framework, December 2014). This study therefore represents a timely contribution to a growing, interdisciplinary, research agenda by identifying one pathway by which 'the social gets under the skin' (Hobcraft, 2009; Hertzman & Boyce, 2010).

This thesis is organised as three self-contained empirical research articles, ready for submission for publication. As such, there is some necessary overlap between the literature reviews presented in each chapter. Chapters one and two both discuss ethnic inequalities in psychological wellbeing while chapters two and three both consider the contributory role of neighbourhoods to health inequalities. Each literature review is, however, tailored to the specific research questions set out in the corresponding chapter. Variation in chapter length reflects both the substantive research questions examined and the discipline(s) style underpinning each study.

Chapter 1

Unemployment and subjective wellbeing: the role of ethnicity

1.1 Introduction

Unemployment represents a stressful life event and a primary determinant of health inequalities (Schuring et al, 2009; Marmot Review, Institute of Health Equity, 2010). The association between unemployment and specific domains of subjective wellbeing in particular has received much attention in the empirical literature and has been the focus of several systematic reviews (see Murphy & Athanasou, 1999; Paul & Mosser, 2009). Subjective wellbeing (SWB) is defined as 'people's cognitive and affective evaluations of their lives' and is composed of three distinct domains: (1) overall life satisfaction, (2) domain specific satisfaction and (3) emotional responses including both positive and negative affect (Diener, Suh, Lucas, & Smith, 1999). While the association between unemployment and SWB varies as a function of both individual and macro level characteristics and the SWB domain under investigation, studies consistently find unemployment to be correlated with poorer SWB.

The burden of unemployment is not, however, equally distributed across the population (Nazroo & Kapadia, 2013). Individuals from ethnic minority groups continue to experience higher unemployment rates than the majority white British population (Nazroo & Kapadia, 2013) and greater long term unemployment (Guardian, 2015). Ethnic minority status is also associated with poorer SWB, independent of employment status. Despite the ethnic patterning of both unemployment and SWB, the health consequence of unemployment for ethnic minority groups is poorly understood and represents a gap in the empirical literature (Nazroo, 2014).

It is plausible that the association between unemployment and SWB may vary both between and within ethnic groups, with the role of ethnicity hypothesised to be partly contingent on generational status (Knies et al, 2014), socioeconomic status (Darlington et al., 2015) and gender (Artazcoz et al, 2004; Paul & Mosser, 2009). This study therefore contributes to the empirical literature by empirically examining whether (1) the association between unemployment and SWB varies as a function of ethnicity, (2) the ethnic patterning is consistent across each distinct domain of subjective wellbeing and (3) whether this association varies within ethnic groups, notably by gender, socioeconomic and generational status.

1.2 Background

1.2.1 Unemployment and subjective wellbeing

Unemployment is a stressful life event that often leads to a loss of both financial resources and psychosocial assets including social contact, status and purpose (Jahoda, 1982; Warr 1987; Janlert & Hammarstrom, 2009). It is therefore unsurprising that a negative association between unemployment and subjective wellbeing is well documented in the empirical literature (see Murphy & Athanasou, 1999; Thomas et al., 2005; McKee-Ryan et al., 2005; Janlert & Hammarstrom, 2009; Paul & Moser, 2009). The consequence of unemployment, however, varies as a function of the SWB domain studied, and has been shown to be positively associated with certain domains. The association between unemployment and SWB is also moderated by individual, unemployment and other macro characteristics, thereby introducing further heterogeneity.

Psychological wellbeing

Of the three domains of SWB, the impact of unemployment on psychological wellbeing has been most widely studied (see Murphy & Athanasou, 1999; Paul & Moser, 2009 & Binder & Coad, 2015). Psychological wellbeing is conceptualised as feelings of positive affect and ‘functioning with optimal effectiveness’ (Winefield et al, 2012). Several meta-analyses report a clear negative association between unemployment and psychological wellbeing, with the strongest association among men, the middle aged and non-married. Gender differences have been explained by theories of role loss, financial insecurity and stigmatization (see Paul & Moser, 2009 for discussion). Men have traditionally been the breadwinner of the household, thus becoming unemployed not only represents a loss of income and financial security, but also a threat to male identity (McFayden, 1995; Artazcoz et al., 2004). The negative association between unemployment and psychological wellbeing is greatest for middle aged persons (Jackson & Warr, 1984; Broomhall & Winefield, 1990). It is hypothesised that because younger and older groups typically have fewer financial responsibilities and less career attachment compared to middle aged groups, the negative effect of unemployment is comparatively less for these groups (Jackson & Warr, 1984; Lahelma, 1989). Little is known, however, about how the association between unemployment and psychological varies as a function of ethnicity and how this intersects with gender.

Life satisfaction

Life satisfaction is defined as a measure of how people evaluate their life overall and is distinct from a measure of current feelings (OECD, Better Life Index, n.d.). Studies find a negative association between unemployment and life satisfaction, again with significant heterogeneity across different demographic and socioeconomic groups. A similar pattern emerges as set out above, with men reporting lower life satisfaction than women when unemployed. As before, lower attachment to the labour market among women is hypothesised to explain why the association between unemployment and life satisfaction is not as pronounced for women (Kassenboehmer & Haisken-DeNew, 2009). Studies also find that repeated unemployment spells is associated with a downward trend in life satisfaction compared to those who have never experienced unemployment (Luhmann & Eid, 2009). Again, little is known of how ethnicity intersects with gender in the association between unemployment and life satisfaction.

Domain satisfactions

Studies suggest that individuals consider a number of key aspects of their life when reporting their life satisfaction (Layard, 2005). Since life satisfaction is influenced by a broad range of factors, it may be less sensitive to change than certain domain specific satisfactions in times of unemployment, thereby underestimating the effect of unemployment on SWB. Unemployment most often represents a large income shock for a household. While the non-pecuniary effect of unemployment on SWB is larger than the effect arising from a loss of income, studies have nevertheless found that unemployment is negatively associated with income satisfaction. Unemployment has also been shown to be negatively associated with health satisfaction. While short term unemployment is negatively associated with health satisfaction for men only, long term unemployment is for both men and women (Gordo, 2006). In contrast, the opposite may be true for satisfaction with leisure time. By virtue of being unemployed, individuals will have more leisure time. As such, some studies find individuals report greater satisfaction during unemployment. Since domestic and childrearing duties are disproportionately undertaken by women, unemployed men often have more leisure time than unemployed women, and therefore often report greater satisfaction with leisure time.

Studies have found the association between unemployment and domain satisfactions to vary as a function of the specific domain under investigation. As such, it is important each domain satisfaction is analysed as a separate dependent variable in any empirical analysis, as opposed to creating a single scale, which may conceal such differences.

1.2.2 The role of ethnicity

As set out above, there is much heterogeneity in the association between unemployment and SWB. Less academic attention has, however, been given to the potential moderating role of ethnicity. Studies have shown that both SWB and the likelihood of unemployment are ethnically patterned. It is therefore possible that the association between unemployment and SWB may vary as a function of ethnicity. The following section sets out (1) how unemployment and SWB are ethnically patterned and (2) how we might expect the association between unemployment and SWB to vary across ethnic groups.

Ethnic differences in subjective wellbeing

In the UK, non-white ethnic minority groups have, on average, lower SWB than the majority white British population. Ethnic minority groups are more likely to live in lower socioeconomic groups, areas of deprivation and experience discrimination; factors known to be negatively associated with SWB (Knies et al., 2014). Ethnic differences, however, persist even when these known correlates of SWB are controlled for, suggesting a residual 'ethnic effect' not wholly explained by these factors (NEF, 2012; Knies et al., 2014). While all minority groups experience poorer SWB overall, the specific patterning varies according to the domain of SWB and ethnic groups considered.

Psychological wellbeing

Early studies consistently reported significantly higher rates of schizophrenia and common mental disorder among the black Caribbean group with psychotic illness particularly common among young men (Bagley, 1971; Cochrane & Bal, 1989; Bhugra & Bhui, 2001). Results were, however, less consistent among South Asian groups. Some studies reported that the rate of first diagnosis was as elevated as for the black Caribbean group (King et al., 1994) while other studies suggest a lower incidence, comparable to the white British group (Bhugra et al, 1997). These differences may, however, be attributed to the differing composition of ethnic groups within each study since the former was comprised largely of those of Indian origin while the latter included a significant proportion of individuals who were Pakistani.

Such studies, however, relied upon contact with treatment services data which is problematic since such data may reflect illness behaviour rather than actual prevalence of mental illness and discrimination in the health services. Consequently, the reported increased incidence rate of psychosis among the Black Caribbean group has been contested and the validity of such findings questioned. In contrast, data from nationally representative social surveys, notably the FNS and EMPIRIC, find that while psychotic illness is more prevalent among the Black Caribbean group than the white majority population, this difference is inflated in studies relying on contact with treatment services data, and largely holds for women only (Sproston & Nazroo, 2002).

There is notable heterogeneity within ethnic groups, specifically by generational status. Second generation groups, on average, have lower psychological wellbeing than migrant groups. This may be partially explained by the accepted ‘healthy migrant effect’ whereby first generation immigrants are frequently healthier across a range of health measures compared to non-migrants (Fennelly, 2007). Interestingly, this finding is not replicated among younger age groups in the ‘Determinants of Adolescent Social wellbeing and Health’ (DASH) survey where ethnic minority groups reported better mental health than the white

British group. This may indicate greater resilience among younger age groups and protective cultural factors (Harding et al., 2015).

Life satisfaction

Data from the 2012 Annual Population Survey found that people from black ethnic groups[1] reported the lowest life satisfaction, followed by the Bangladeshi group. In fact, among the five largest non-white ethnic minority groups in the UK today, only the Indian group reported a higher score than the white British (7.4 vs 7.5 on a 10-point scale). Again, there is however important heterogeneity within ethnic groups, notably by generational status and sex. A recent study has shown that second generation groups report lower life satisfaction than first generation groups (Knies et al., 2014). While the former do not face the stresses associated with migration, they do continue to face discrimination in most domains of life in the UK (Knies et al., 2014). These groups may also be more likely to compare themselves to the majority, UK born, population. It is therefore hypothesised that the greater mismatch between second generation and UK born majority groups lead second generation minority groups to experience greater frustration and alienation, known stressors for poorer SWB. Consistent with the white British majority, women from ethnic minority groups report higher life satisfaction than men, with the largest gaps reported for Pakistani and Bangladeshi groups. Due to small sample sizes, however, results did not reach a level of statistical significance for all groups (ONS, 2013).

Domain satisfaction

While domain satisfactions can be distinguished from overall life satisfaction, they are certainly interrelated (Diener et al., 2000). There is evidence of both a bottom-up association,

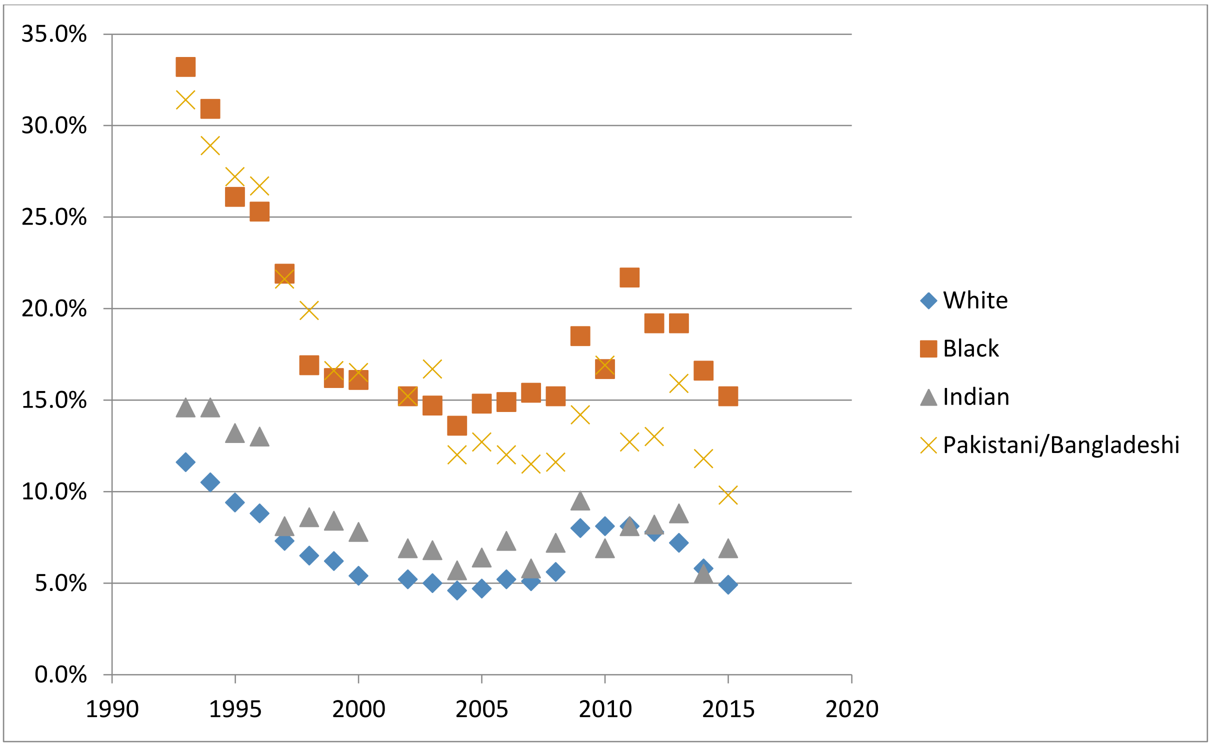
[1] In this study, the black group is comprised of those who identify as black African, black Caribbean and black British.

with life satisfaction understood as the sum of domain satisfactions (Argyle, 1987), and a top-down association, where life satisfaction induces positive evaluations of domain satisfactions. The lower life satisfaction scores reported by ethnic minority groups may, therefore, influence domain satisfaction also. The disproportionate concentration of ethnic minority groups in low socioeconomic groups may lead to lower income satisfaction, while potential challenges associated with language and culture may influence satisfaction with leisure.

Ethnic employment penalty

Since 1971 the UK unemployment rate has fluctuated between 3.4 percent in late 1973 and 11.9 percent in 1984 (ONS, 2016). The burden of unemployment is not, however, equally distributed in the UK. Despite a number of targeted government initiatives aimed at increasing employment, ethnic minority groups continue to experience higher unemployment rates than the majority white British population (Nazroo & Kapadia, 2013). Of the five largest ethnic minority groups in the UK today, only the Indian group has comparable labour market prospects to the majority white British population. In contrast, Pakistani, Bangladeshi, black Caribbean and black African groups, on average, experience greater labour market disadvantage, as shown in figure one below. These groups are more likely to become unemployed and experience longer unemployment spells. These findings remain after adjusting for education and local labour markets, known correlates of labour market status (Berthoud and Blekesaune, 2006; Bell and Casebourne, 2008; Nazroo and Kapadia, 2013).

Figure 1.1: Ethnic specific unemployment rates 1991 – 2015, ONS



1.2.3 Theorising the association between unemployment and subjective wellbeing for ethnic minority groups

A number of theories have been proposed to explain the association between unemployment and SWB and these may be key to understanding how this association may vary as a function of ethnicity. The negative association between unemployment and SWB has been hypothesised to be greater for ethnic minority groups as a consequence of bleaker labour market opportunities (Broman et al., 1995; Paul & Maser, 2009). Ethnic minority groups may interpret a high unemployment rate as indicative of increased labour market competition which may induce greater stress than when reemployment probabilities are greater (Broman et al., 1995). This may also have a longer term consequence of weakening resistance to the negative effects of unemployment.

Economic deprivation models suggest that the association between unemployment and poor health is driven by having less financial resources available (Rantakeisu et al, 1999; Nordenmark & Strandh, 1999; Janlert& Hammarstrom, 2009). Approximately two fifths of people from ethnic minority groups live in low income households, twice the rate of the majority white British group (The Poverty Site, 2013). The experience of unemployment may therefore represent a greater financial challenge to ethnic minority groups, again suggesting that the negative association between unemployment and SWB may be greater for ethnic minority groups. Not only are ethnic minority groups more likely to live in low income households they are also disproportionately exposed to other stressors including area deprivation and discrimination. This accumulation of stressors may therefore exacerbate the negative consequence of unemployment for ethnic minority groups.

Conversely, it could be hypothesised that although ethnic minority groups are more likely to experience unemployment, these groups may develop a greater resilience or tolerance, which may be protective against subsequent unemployment spells. A growing empirical literature suggests aggregate unemployment rates may influence individual's response to unemployment. Studies have found individuals are less negatively affected by unemployment where regional unemployment is high, compared with areas where regional unemployment is lower. This has been explained by a social norm to work and associated stigma effects. When unemployment is high, more individuals experience this phenomenon, thereby reducing a social norm to work and also associated stigma effects. This may be particularly relevant for ethnic minority groups, who are characterised by higher unemployment rates. If ethnic minority groups typically compare themselves to other minority groups they may be more likely to perceive unemployment as a normal experience and thus feel less stigmatized when they themselves are unemployed (Leach & Smith, 2006).

Factors known to buffer the negative consequence of unemployment are not equally distributed across ethnic groups. For example, religiosity, which is greater among ethnic minority groups, may replace some of the non-pecuniary benefits of unemployment including sense of purpose and social networks (Jahoda, 1982; Harding et al., 2015). The negative association between unemployment and SWB may therefore be mediated by religious attachment. A similar pattern may also emerge for ethnic groups characterised by greater social capital. These groups may, for example, perceive local networks as offering employment opportunities not otherwise available.

It is plausible that the association between unemployment and SWB may vary both between and within ethnic groups, with the role of ethnicity hypothesised to be partly contingent on both generational (Knies et al., 2014) and socioeconomic status (Darlington et al., 2015). The burden of unemployment is not equally distributed different socioeconomic groups with unemployment higher, on average, among manual occupation groups. Individuals from these groups may therefore find it more difficult to find reemployment which may have negative consequences for SWB, as per the employment competition thesis (Broman et al., 1995). In contrast, individuals from higher socioeconomic groups often have access to social and financial resources that may mitigate the financial pressures of unemployment and thus act as a buffer against the adverse psychological consequence of unemployment (Artazcoz et al., 2004).

As set out elsewhere, a recent study has shown that second generation groups report lower SWB than first generation groups (Knies et al., 2014). It has been hypothesised that these groups may be more likely to compare themselves to the majority, white British, population, where unemployment is, on average, lower (Knies et al., 2014). As such, second generation groups may experience greater frustration and alienation, known stressors for poorer SWB, when unemployed.

A recent study has shown that second generation groups report lower life satisfaction than first generation groups (Knies et al., 2014). While the former do not face the stresses associated with migration, they do continue to face discrimination in most domains of life in the UK. These groups may also be more likely to compare themselves to the majority, UK born, population. It is therefore hypothesised that the greater mismatch between second generation and UK born majority groups lead second generation minority groups to experience greater frustration and alienation, known stressors for poorer SWB, when unemployed.

Alongside ethnic differences in labour market participation, there are also distinct gender patterns (Leana & Feldman, 1991; Kulik, 2000; Artazcoz et al., 2004). Gender role attitudes and expectations also differ by both ethnicity and gender (Kane, 2000). It is, therefore, plausible that ethnicity intersects with gender, thereby introducing further complexity into the association between unemployment and SWB.

Only one study has, however, empirically examined whether the association between unemployment and SWB varies as a function of ethnicity, focusing on psychological wellbeing only. Using data from a 2003 health survey in Rotterdam, Schuring et al looked at whether health inequalities associated with unemployment were comparable across ethnic groups. Despite a higher prevalence of unemployment, the association between unemployment and psychological wellbeing was less profound for the ethnic minority groups analysed (Schuring et al, 2009). While informative, any conclusions drawn from this study are indicative only. Results were drawn from a sample of approximately 2000 individuals only, almost 70 percent of who were from the native Dutch reference group. Additionally, psychological wellbeing was only one component of an overall measure of health (SF-36) and thus the results may be driven by physical, rather than mental health outcomes.

Nevertheless, these findings suggest that despite higher unemployment rates, the association between unemployment and psychological wellbeing may be less pronounced for ethnic minority groups, contrary to the economic resource driven hypotheses set out above.

1.3 Inferring causality

Whether the observed negative association between unemployment and subjective wellbeing is causal or the consequence of a health driven selection into unemployment remains contested. While the causation hypothesis assumes unemployment is the cause of poor mental health and lower life satisfaction, the selection hypothesis assumes individuals with poorer SWB are more likely to become unemployed and, once unemployed, take longer to secure new employment (Mastekaasa, 1996; Bartley et al., 2004; Schuring et al, 2009; Paul & Moser, 2009; GarcÌa-Gomez et al. 2011; Schmitz, 2011). Pathways by which this may occur include reduced performance at work and an increased incidence of absence at work, both factors which may lead to dismissal (Mastekaasa, 1996) and, once unemployed, lower SWB may inhibit job search efforts (see Paul & Moser, 2009 for summary).

While meta-analyses in the field largely support the causation thesis, several recent econometric studies suggest a health selection effect into unemployment may contribute to the observed association between unemployment and poor mental health in particular (Schmitz, 2011). As such, it may be difficult to think of causation and selection as mutually exclusive processes.

1.4 This study

1.4.1 Research question(s)

With little empirical evidence, it is difficult to hypothesise how ethnic minority groups respond to unemployment and whether the association between unemployment and SWB differs by ethnicity. While a number of theoretical models have been posited to explain the association between unemployment and SWB in general, once applied to ethnic minority groups, it is difficult to derive clear hypotheses. Three key exploratory research questions are therefore addressed in this paper:

1. Does the association between unemployment and subjective wellbeing vary as a function of ethnicity?
2. Is this ethnic patterning consistent across each distinct domain of subjective wellbeing?
3. Does the association between unemployment and SWB vary within ethnic groups, specifically by generational and socioeconomic status?

1.4.2 Study contribution(s)

In 2011, non-white ethnic minority groups represented 14 percent of the total UK population (Jivraj, 2012). Research interested in ethnic variation across health and labour market outcomes has, however, been historically impeded by a dearth of data. Where data has been collected for ethnic minority groups, sample sizes are often small or collected for broader ethnic groups only, despite distinct migration experiences. This has often meant that ethnic differences in health and labour market outcomes have not been well explored, and has potentially concealed heterogeneity between those ethnic groups collapsed into a single group for the purpose of empirical investigation.

Overall, ethnic minority groups continue to experience both poorer SWB and labour market outcomes than the majority white British population. Little is known, however, of whether the association between unemployment and SWB varies as a function of ethnicity. As such, the public health threat of unemployment remains unknown for a significant proportion of the population.

SWB is composed of three distinct domains which often have different antecedents and consequences (Diener et al., 2000). Diener et al. therefore suggest studies utilise a battery of instruments to measure all domains of SWB. Despite this, studies seldom focus simultaneously on all three. Consequently, little is known about whether ethnic differences in SWB vary as a function of the domain studied within a given sample. Focusing on only one domain may mask important differences in SWB which could have important policy implications. This study, therefore, represents a contribution to the growing literature of ethnicity and SWB in two clear ways:

1. This is the first empirical investigation of whether the association between unemployment and SWB varies as a function of ethnicity for the five largest ethnic minority groups in the UK.
2. This is the first empirical study to estimate whether the ethnic patterning of the association between unemployment and SWB is consistent across each domain of SWB.

1.5 Data and methods

1.5.1 Data

This study utilises the first five waves of Understanding Society: the UK Household Longitudinal Study (UKHLS). The UKHLS started in 2009 and provides detailed information about the social and economic situations of people living in the UK. Approximately 40,000 households within the United Kingdom were selected into the survey at wave one and are re-interviewed annually. The sample is comprised of five components including a general population sample (GPS) and an ethnic minority boost sample (Lynn, 2009). The ethnic minority boost sample was designed to recruit 1,000 participants from five targeted non-white ethnic minority groups: Indian, Pakistani, Bangladeshi, Caribbean and African, the largest non-white groups in the UK at the study's inception (Lynn, 2009). Eligibility into the boost sample was determined via a screening question. This analysis includes individuals recruited via both the general population and ethnic minority boost sample.

Understanding Society represents the first longitudinal survey to annually interview large numbers of individuals from the largest non-white ethnic minority groups in the UK today (Understanding Society, 2014), and therefore offers a unique opportunity to understand how the association between unemployment and SWB varies as a function of ethnicity.

1.5.2 Sample characteristics

This analysis is restricted to individuals aged between 16 and 65 and active in the labour force. All analyses include individuals from the five largest ethnic minority groups and the reference 'White British' category only. All other ethnic groups are excluded from the analysis rather than being retained in an 'other' ethnic category. The heterogeneity across these groups would render any estimates substantively meaningless. Individuals who report a clinical diagnosis of depression are also excluded from this analysis (3,118 observations).

Estimates are presented separately for men and women, since women more frequently exit the labour market voluntarily, which is expected to be differentially associated with SWB. The analytical strategy taken in this thesis was complete case analysis, meaning that individuals with missing data on any of the variables included in this study were excluded. Statistical tests (results detailed in appendix 1) indicate that those excluded from the final analytical sample are, on average, younger, more likely to be male, less likely to be single, less likely to have a degree, and more likely to be unemployed. Income profiles, however, did not differ.

This results in a final sample size of 36,443 person-year observations. Descriptive statistics are presented separately for ethnic group at wave two[2]. Fixed effects estimates are gender and ethnic specific.

1.5.3 Measures

Ethnicity

Understanding Society utilises the standard ONS classification of ethnicity, as used in the 2011 Census, Labour Force Survey and Annual Population Survey: a self-reported question with 18 response categories (Berthoud et al, 2009). Ethnicity is operationalised as a series of dummy variables indicating membership of the five largest non-white ethnic minority groups (Indian, Pakistani, Bangladeshi, Caribbean and African) and the reference category of White British. A value of one represents membership of the named ethnic group and a zero otherwise. As set out above, all analysis is restricted to these groups only; all other ethnic groups are excluded from this study.

[2] The British Household Panel Survey (BHPS) sample was incorporated into the Understanding Society sample at wave two. The decision was taken, therefore, to present descriptive statistics at this time.

Employment status

The key independent variable in this study is employment status. Unemployed individuals are defined as those who, for a given reference period, are:

* *without work, that is, were not in paid employment or self-employment during the reference period;*
* *currently available for work, that is, were available for paid employment or self-employment during the reference period; and*
* *seeking work, that is, had taken specific steps in a specified recent period to seek paid employment or self-employment* (ILO, 2000).

Unemployment is operationalised as a binary variable with a value of one for those who are unemployed and a zero for those employed or self-employed. The inactive, i.e. those not in the labour force, are excluded from the analysis.

Subjective wellbeing

Subjective wellbeing is operationalised with 5 separate self-report measures. Each captures a distinct domain of SWB: overall life satisfaction, domain specific satisfactions and psychological wellbeing (affect) (Diener et al., 1999).

Life satisfaction

Life satisfaction is measured with a single item in Understanding Society: *(please choose the number which you feel best describes how dissatisfied or satisfied you are with the following aspects of your current situation.) Your life overall.*

Responses sit on a 7-point response scale ranging from 'completely dissatisfied' to 'completely satisfied'. A higher score therefore indicates a greater level of life satisfaction.[3] Life satisfaction is retained as a linear outcome in this analysis.

Domain satisfaction

Satisfaction across three distinct domains, hypothesised to be associated with unemployment, are modelled in this study: income, leisure and health. Each domain is measured with a single item on a 7-point response scale, as above. The association between unemployment and domain satisfactions has been found to vary as a function of the specific domain under investigation. As such, each domain satisfaction is retained as a separate dependent variable in this study, rather than creating a single scale, which may mask this heterogeneity. Each domain satisfaction item is retained as a linear outcome in this study.

Psychological wellbeing

The 12-item version of the General Health Questionnaire, a common psychological well-being instrument, is employed as a measure of affect. It is a validated multidimensional screening instrument for detecting non-psychotic and minor psychiatric morbidity, focusing on two chief areas: 'the inability to carry out normal functions' and 'the appearance of new and distressing phenomena' (Goldberg & Williams, 1988). Responses are scored from 0-3 (ONS, 2013) with total score values ranging from 0 to 36; higher scores are indicative of poorer mental health. Due to its skewed distribution, the GHQ is often dichotomised, with a cut-off point of above 11 indicating risk for minor psychiatric morbidity (Goldberg,

[3] 11 and 5 point scales have been used elsewhere and recent ONS analysis demonstrates that the distribution of the data varies according to the response scale used. On average, the 7 point scale differs from the 5 and 11 point scales. A larger proportion of people score below the midpoint (score of 4) compared to the 5 and 11 point response scales and the 7 point scale has a sharper increase in the cumulative number of people reporting greater life satisfaction. Further information on how the skew of the data compares across response scales can be found elsewhere (ONS, 2015).

Oldehinkel & Ormel, 1998). For the purpose of this analysis, however, the GHQ will be retained as a continuous measure. The aim of this study is to measure whether unemployment is associated with a worsening in subjective wellbeing. As such, we are interested in any increase in mental distress and not simply whether becoming unemployed pushes an individual over a certain threshold into being at risk of minor psychiatric morbidity. Put simply, dichotomising the GHQ may mask subtle changes in mental health, which may have important implications for policy recommendations drawn from this study.

The role of education and generational status

The association between unemployment and SWB is hypothesised to vary both between and within ethnic groups, with the role of ethnicity hypothesised to be partially contingent on both generational (Knies et al, 2014) and socioeconomic status (Darlington et al., 2015). Binary indicators of highest educational qualification and generational status (defined as born in the UK or otherwise) are therefore included in this study. A value of one represents those with a degree and first generation, for each indicator respectively.

Covariates

Individual demographic characteristics associated with unemployment propensity and SWB are included in this study: age (centred), marital status, number of children in the household and presence of a long term health condition. Binary indicators for tenure status and whether a respondent resides in an ‘urban’ area, defined as an area with a population of more than 10,000, are also included in this study. Equivalised net household income is also included in all models.

1.5.4 Analytical method

This study exploits the longitudinal design of Understanding Society to estimate an individual fixed effects model. A fixed effects specification assumes that unobserved characteristics may bias the predictor or dependent variables in some way, and that this must be controlled for, with individuals serving as their own control. Fixed effects estimates therefore use only within-individual differences. As such, standard errors in a fixed effects specification are inflated compared to a random effects model, where both between and within individual variation is utilised. A fixed effects specification thus sacrifices efficiency to reduce bias introduced from omitted variables. By controlling for all time-invariant differences between individuals, estimates cannot be biased because of omitted time-invariant characteristics (Kohler & Kreuter, 2005). Simply put, if the unobserved characteristics are stable across time, then any changes in the dependent variable must be caused by factors other than these stable characteristics (Stock & Watson, 2003).

A fixed effects specification does not, however, control for all potential confounding variables associated with unemployment and mental health, specifically:

a) Unobserved time varying characteristics,

b) Fixed confounding factors that combine interactively with unemployment to influence mental health,

c) Time invariant characteristics whose effects on the key variables of interest vary across time (Allison, 2009).

To minimise the potential bias introduced by each of these confounding processes, key time varying factors known to be associated with unemployment and SWB are included in all models, i.e. equivalised household income. Nevertheless, a fixed effects specification represents an appropriate and robust analytical approach for this study. Unweighted individual level fixed effects models are estimated using STATA 14 and the *xtreg, fe* command (StataCorp, 2014). All results are presented as marginal effects. This study utilises a sample comprising of between 111 and 207 employment transitions across each ethnic group.

1.5.5 Model specifications

A total of four models are estimated for each of the five dependent variables in this study: (1) SWB is regressed on ethnicity*unemployment interaction controlling for individual level characteristics, (2) introduction of three way interaction between ethnicity*unemployment*educational level and (3) introduction of second three way interaction between ethnicity*unemployment*generational status.[4] The three way interactions introduced in models three and four test for heterogeneity within ethnic groups in the association between unemployment and SWB.

[4] Three way interactions are not entered sequentially. In model 3, where highest educational level is interacted with ethnicity*unemployment interaction, generational status is entered as a covariate and vice-versa.

1.6 Results

Table 1.1: sample characteristics at wave two, by ethnicity

	British	Indian	Pakistani	Bangladeshi	Caribbean	African
	N=19,532	N=699	N=370	N=234	N=376	N=410
Proportion not UK born (%)	0.0	64.2	52.7	67.5	37.8	88.5
Proportion male (%)	48.1	55.7	61.1	66.7	36.4	45.4
Age	42.1	38.8	35.1	34.6	42.4	37.8
Married (%)	54.1	72.5	67.8	71.8	30.6	54.4
Single (%)	32.2	22.5	25.1	25.2	52.9	33.2
Widowed (%)	1.3	1.0	0.5	0.0	0.5	2.0
Separated (%)	12.4	4.0	6.5	3.0	16.0	10.5
Children in household	0.6	1.0	1.3	1.2	0.6	1.0
Proportion with degree (%)	38.0	60.0	48.7	36.8	42.6	65.6
Equivalised household income	1746.6	1620.6	1121.5	1139.4	1457.1	1383.0
Home owner (%)	75.8	73.8	72.7	45.3	53.7	30.2
Social renter (%)	12.1	4.4	10.0	37.6	35.9	43.9
Private renter (%)	12.1	21.8	17.3	17.1	10.4	25.9
Proportion living in urban area (%)	72.6	97.9	99.7	99.1	99.2	98.3
Proportion unemployed (%)	8.2	9.3	15.7	23.5	21.5	18.3
Proportion with longstanding illness	26.3	16.5	14.3	18.4	26.6	14.6
Average GHQ	10.9	10.5	11.1	11.8	11.4	10.2
Life satisfaction	5.2	5.1	5.0	4.8	4.7	5.0
Health satisfaction	5.1	5.2	5.0	4.7	4.9	5.5
Income satisfaction	4.6	4.5	4.3	4.1	3.7	4.0
Leisure satisfaction	4.5	4.4	4.1	4.2	4.1	4.2

Source: Understanding Society, wave 2

1.6.1 Descriptive statistics

Table 1.1 presents key sample statistics for each ethnic group. All ethnic minority groups, excluding the Caribbean group, have younger age profiles than the White British majority group with the Pakistani and Bangladeshi groups the youngest overall. The Caribbean group have the lowest proportion not born in the UK while the African group the highest, reflecting the later migration pattern of this group. All South Asian groups are more likely to be married or cohabitating than the White British majority while, among the Caribbean and African groups, the percentage is much lower at 30.6 and 54.4 percent respectively. Excluding the Bangladeshi group, the proportion of individuals with a degree is higher across ethnic minority groups than the white British and largely reflects patterns in the wider population. As expected, Pakistani and Bangladeshi groups report the lowest equivalised household income in the sample. Home ownership is the lowest among the Bangladeshi, Caribbean and African groups while home ownership among other groups is comparable to the white British majority group, at above 70 percent. As expected, all ethnic minority groups are concentrated in urban areas, reflecting both the sampling strategy of Understanding Society and wider residential patterns in the population. Consistent with Labour Force Survey (LFS) data presented elsewhere (ONS, 2015), all ethnic minority groups in the sample have higher unemployment rates than the white British majority group, ranging from 9.3 percent among Indians to 23.5 percent for the Bangladeshi group. Excluding the Caribbean group, all ethnic minority groups in the sample are less likely to report a longstanding illness, likely reflecting the lower age profiles of these groups (DWP, 2014). Focusing on each domain of subjective wellbeing, simple cross-tabulations show that overall life satisfaction, satisfaction with leisure and satisfaction with income is lower among all ethnic minority groups compared to the white British group. In contrast, Indian and African groups report, on average, the greatest satisfaction with health, while all other groups report lower satisfaction, as compared to the white British group. Finally, results show that average GHQ scores range between 10.2 and 11.8 across ethnic groups, with the Indian and African groups reporting lower average scores than the white British majority group.

Table 1.2: M**arginal effects estimates for each domain of subjective wellbeing, as compared to the white British group**[+]

		Men (S.E)	Women (S.E)
Psychological wellbeing	White British	2.11 (0.12)	2.09 (0.15)
	Indian	3.03 (0.53)	2.64 (0.70)
	Pakistani	2.20 (0.66)	0.56 (0.76)**
	Bangladeshi	3.60 (0.76)*	0.03 (1.01)**
	Caribbean	2.68 (0.67)	1.64 (0.66)
	African	1.86 (0.59)	0.44 (0.72)**
Life satisfaction	White British	-0.37 (0.04)	-0.23 (0.04)
	Indian	-0.35 (0.17)	-0.08 (0.20)
	Pakistani	-0.28 (0.21)	-0.04 (0.22)
	Bangladeshi	-0.47 (0.24)	-0.18 (0.29)
	Caribbean	0.07 (0.21)**	-0.23 (0.19)
	African	0.01 (0.19)**	-0.26 (0.21)
Income satisfaction	White British	-0.90 (0.04)	-0.57 (0.49)
	Indian	-0.57 (0.19)*	-0.49 (0.22)
	Pakistani	0.09 (0.23)***	-0.37 (0.24)
	Bangladeshi	-0.42 (0.27)*	-0.89 (0.32)
	Caribbean	-0.08 (0.23)**	-1.16 (0.21)*
	African	-0.21 (0.21)**	-0.33 (0.23)
Health satisfaction	White British	-0.05 (0.05)	-0.06 (0.06)
	Indian	-0.17 (0.21)	0.01 (0.26)
	Pakistani	0.47 (0.26)**	0.39 (0.28)
	Bangladeshi	0.21 (0.30)	-0.08 (0.37)
	Caribbean	0.03 (0.26)	0.04 (0.24)
	African	0.35 (0.23)*	0.26 (0.26)
Leisure satisfaction	White British	0.54 (0.04)	0.47 (0.05)
	Indian	0.11 (0.19)**	0.10 (0.22)
	Pakistani	0.54 (0.24)	0.49 (0.24)
	Bangladeshi	-0.22 (0.27)**	0.02 (0.32)
	Caribbean	0.45 (0.24)	0.12 (0.21)
	African	0.07 (0.21)**	0.50 (0.23)

[+] Post estimation marginal effects derived from fixed effects specification. Reference categories of married, highest educational qualification: degree, owner occupier, residing in a rural area and born in the UK. ***p=0.00, **p<0.05, *p<0.10 Denotes significance in comparison to the reference category of white British. Source: Understanding Society, waves 1 - 5

1.6.2 Ethnic differences in association between unemployment and subjective wellbeing

Table 1.2 presents ethnic and gender specific fixed effects estimates for each domain of subjective wellbeing, controlling for individual level characteristics.

Psychological wellbeing

Among men, results are statistically significant for the Bangladeshi group only, with the negative effect of unemployment statistically significantly larger than it is for white British men. Unemployed Bangladeshi men score, on average, 3.60 (0.76) higher on the GHQ-12 36 point scale compared to employed Bangladeshi group. While results operate in the same direction for Caribbean and Pakistani groups, results are not statistically significant, meaning that we cannot say that this association differs for these groups as compared to the white British. Interestingly, results suggest that for this group the negative association between unemployment and psychological wellbeing is greater, although again results do not reach a level of statistical significance.

For women, the negative association between unemployment and psychological wellbeing is greater for the Indian group only, although results do not reach a level of statistical significance. For all other groups, while being unemployed is negatively associated with unemployment, this effect is smaller than it is for white British women. Results do, however, reach a level of statistical significance for Pakistani, Bangladeshi and African groups only, at 0.56 (0.76), 0.03 (1.01) and 0.44 (0.72) respectively.

Life satisfaction

Among men, results are statistically significant for Caribbean and African groups only. Unemployed Caribbean and African men score, on average, 0.07 (0.21) and 0.01 (0.19) points higher on a 7 point response scale compared to employed individuals within their own ethnic group, meaning life satisfaction is greater for unemployed men in these groups. While results for Indian, Pakistani and Bangladeshi groups operate in the expected direction, as they do for the white British, results are not statistically significant. It is therefore not possible to say that the association between unemployment and life satisfaction differs for these groups, as compared to the white British group.

For women, being unemployed is associated with lower life satisfaction for all ethnic groups, with the greatest effect among African and Caribbean groups, at -0.26 (021) and -0.23 (0.19) respectively. While the direction of association is consistent across all ethnic groups, point estimates are smaller for Indian, Pakistani and Bangladeshi groups, thereby suggesting they are less negatively affected by unemployed, as compared to the white British group. Results do not, however, reach a level of statistical significance for any ethnic group. As such, it is not possible to say that the association between unemployment and life satisfaction statistically differs across ethnic groups for women.

Domain satisfaction

For men, being unemployed is associated with lower satisfaction with income for most ethnic groups. Point estimates suggest this negative association is, however, less pronounced for these groups, as compared to the white British. Put simply, while these groups report lower satisfaction with income when unemployed, the difference is smaller than it is for the white British group. In contrast, Pakistani men report greater satisfaction with income when unemployed compared to the white British group, at 0.09 (0.23). Results are statistically significant for all ethnic groups meaning that there is significant heterogeneity by ethnicity in the association between unemployment and income satisfaction.

For women, again point estimates suggest that being unemployed is associated with lower income satisfaction for all groups although results are statistically significant for Caribbean women only. The association between unemployment and satisfaction with income is greater for Caribbean women as compared to white British women, at -1.16 (0.21) and -0.57 (0.49) respectively, meaning that unemployed Caribbean women report lower satisfaction with income than white British women do when unemployed. In contrast, Indian, Pakistani and African groups are less negatively affected by unemployment than the white British group, at -0.49 (0.22), -0.37 (0.24) and -0.33 (0.23) respectively.

A less consistent picture emerges for satisfaction with health among men. Unemployment is negatively associated with health satisfaction for the white British group at -0.05 (0.05). While this association operates in the same direction for the Indian group, with a point estimate of -0.17 (0.21), results are not statistically significant. In contrast, all other ethnic groups report a greater satisfaction with health when unemployed, although results are statistically significant for Pakistani and African groups only, at 0.47 (0.26) and 0.35 (0.23) respectively.

For women, again results are not consistent. While white British and Bangladeshi women report lower satisfaction with health when unemployed, point estimates for Indian, Pakistani, Caribbean and African groups are reversed at 0.01 (0.26), 0.39 (0.28), 0.04 (0.24) and 0.26 (0.26) respectively. Results do not however reach a level of statistical significance for any group. As such, it is not possible to say that the association between unemployment and health satisfaction statistically differs across ethnic groups for women.

Again ethnic differences are evident for the final domain satisfaction of this study, satisfaction with leisure. For men, all ethnic groups, excluding the Bangladeshi group, report greater satisfaction with leisure time when unemployed. Results are not, however, statistically significant for Caribbean and Pakistani groups. As such, it is not possible to say that the association between unemployment and satisfaction with health differs for these groups compared to the white British group. In contrast, satisfaction with leisure is lower when unemployed for the Bangladeshi group, and is statistically significant at -0.22 (0.27).

Among women, being unemployed is associated with a greater satisfaction with leisure time for all ethnic groups, although results do not reach a level of statistical significance for any group. It is, therefore, not possible to say that the association between unemployment and satisfaction with leisure time varies as a function of ethnicity among women.

Table 1.3: marginal effects estimates for psychological wellbeing, as compared to the white British group: (I) the moderating role of education and (II) the moderating role of generational status+

	Model I: Men		Model I: Women		Model II: Men		Model II: Women	
	Degree	Non degree	Degree	Non degree	Non UK born	UK born	Non UK born	UK born
White British	2.05 (0.23)	2.10 (0.14)	2.40 (0.27)	1.98 (0.19)***	1.28 (0.87)	2.08 (0.12)***	2.09 (0.15)***	3.93 (1.06)***
Indian	2.99 (0.83)	2.98 (0.70)	2.19 (0.89)	3.38 (1.14)**	2.45 (0.73)**	3.60 (0.78)***	3.40 (0.94)***	1.69 (1.05)
Pakistani	1.84 (1.01)	2.42 (0.88)	0.72 (1.07)	0.39 (1.07)	2.75 (1.02)*	1.76 (0.87)**	0.59 (0.95)	0.50 (1.26)
Bangladeshi	4.52 (1.42)	3.21 (0.91)	6.74 (2.12)**	-1.51 (1.10)	3.07 (0.88)**	5.08 (1.51)**	1.23 (1.13)	-4.89 (2.29)**
Caribbean	2.44 (1.38)	2.70 (0.76)	0.12 (0.93)	3.26 (0.95)**	2.05 (1.23)	2.88 (0.79)***	1.41 (0.81)	2.09 (1.15)
African	2.06 (0.71)	1.33 (1.04)	0.12 (0.91)	0.92 (1.11)	2.23 (0.63)***	-1.19 (1.72)	0.68 (1.60)	0.38 (0.80)

+ Post estimation marginal effects derived from fixed effects specification. Reference categories of married, highest educational qualification: degree, owner occupier, residing in a rural area and born in the UK. ***p=0.00, **p<0.05, *p<0.10 Denotes significance in comparison to the reference category of white British. Source: Understanding Society, waves 1 – 5

1.6.3 Within ethnic group heterogeneity: the moderating role of education and generational status

Table 1.3 presents marginal effects for the moderating role of education (as a marker of SES) (model I) and generational status (model II) within ethnic groups. Results are presented for one domain of subjective wellbeing only, psychological wellbeing, to demonstrate how the association between unemployment and subjective wellbeing differs both between and within ethnic groups. Psychological wellbeing was chosen since this is where the greatest variation by ethnicity was identified (taking men and women together).

The moderating role of education was operationalised as having a degree or otherwise. Joint significance tests of the interaction terms were not statistically significant, indicating that the model fit was not improved by estimating these additional parameters. Individual differences within ethnic groups did not reach a level of statistical significance meaning that there is no heterogeneity within ethnic groups by education for men. Put simply, the association between unemployment and psychological wellbeing therefore does not differ according to level of education within ethnic groups among men.

For women, some statistically significant findings emerge by education. Marginal effects, as presented in table 1.3, demonstrate the effect of being unemployed for each ethnic group. Results indicate that white British women without a degree score 1.98 (0.18) points higher on psychological wellbeing compared to an employed white British woman without a degree. Results operate in the same direction for Indian women, although the magnitude of the effect is greater at 3.38 (1.14). Results are not, however, statistically significant for Pakistani, Bangladeshi and African women without a degree, meaning that we cannot say that there is a difference between the employed and unemployed in psychological wellbeing. For Bangladeshi graduates, there is a large and statistically significant positive effect at 6.74

(2.12). This therefore indicates that unemployment is strongly negatively associated with psychological wellbeing among female Bangladeshi graduates.

Model II in table 1.3 presents marginal effects for the moderating role of generational status. Among men, results indicate clear differences for both first generation and those born in the UK. For all ethnic groups born in the UK, excluding African, unemployment is associated with poorer psychological wellbeing, with the greatest effects for Indian and Bangladeshi groups. A similar pattern is evident across non UK born groups also, with the exception of the Caribbean group where results are not statistically significant.

Among women, statistically significant results emerge by generational status. For Indian women not born in the UK (column 5 of table 1.3) there is a large and statistically significant negative association with unemployment. Indian women born outside of the UK score 3.40 (0.94) points higher on the GHQ-12 compared to an employed Indian woman not born in the UK. Results operate in the same direction for Bangladeshi women born in the UK; being unemployed is associated with -4.89 points lower on the GHQ-12 for Bangladeshi women born in the UK. Simply put, Bangladeshi women born in the UK report better psychological wellbeing when unemployed.

1.7 Discussion

Using a fixed effects specification, this study sought to address three key research questions:

1. Does the association between unemployment and subjective wellbeing vary as a function of ethnicity?
2. Is this ethnic patterning consistent across each distinct domain of subjective wellbeing?
3. Does the association between unemployment and SWB vary within ethnic groups, specifically by generational and socioeconomic status?

Several key findings emerged from this study. Results indicate that the association between unemployment and SWB does indeed differ by ethnicity with the precise nature of ethnic patterning specific to the domain of SWB examined. Ethnicity intersected with gender, indicating clear ethnic differences across all domains of SWB for men. Among women, ethnic differences were most pronounced in the association between unemployment and psychological wellbeing. This section focuses primarily on statistical significant findings.

1.7.1 Psychological wellbeing

The negative association between unemployment and psychological wellbeing was statistically significantly smaller for Pakistani, Bangladeshi and African women in comparison to the white British. A growing literature suggests that, for ethnic minority groups, residing in an area with a higher concentration of co-ethnics may be protective for psychological wellbeing, over and above any deprivation stressor effects (Halpern, 1993; Becares et al, 2009; Das-Munshi et al, 2010; Becares, 2011; Becares & Nazroo, 2013). Data from the 2011 Census shows that co-ethnic concentration is greatest among Indian, Pakistani and African groups. It is therefore possible that Pakistani and African women are, on average, able to draw upon institutional group-specific resources which may be protective for psychological wellbeing, notably places of worship and community programmes (Knies et al,. 2014). Additionally, these groups may feel they are well positioned to draw upon local ethnic specific networks for local or informal employment opportunities. This may attenuate the concern for competition for jobs, thereby buffering against the negative effect of unemployment (Broman et al,. 1995). While Understanding Society represents a unique opportunity to empirically examine ethnic inequalities in health and labour market outcomes, the number of transitions to unemployment did limit opportunities to examine how the role of the neighbourhood may moderate these associations. As such, this is a hypothesised pathway only.

Pakistani and African women also have the highest unemployment rates (in this study). As such, the social norm to work may be lower and these groups may have less attachment to the labour market. The experience of unemployment may, therefore, not induce the stigma characteristic for other ethnic groups, where unemployment occurs less frequently (Clarke, 2003). The only other empirical study in this field also reported a similar finding, as those found here, although with the caveat that the dependent variable employed in the study was a composite of both physical and psychological health (Schuring et al., 2009).

The findings from this study indicate that, among men, the association between psychological wellbeing and unemployment differs for the Bangladeshi group only. Bangladeshi men are more negatively affected by unemployment than the white British group. Unemployment is highest among the Bangladeshi group in this study. This may suggest that the Bangladeshi group interprets lower employment probabilities as indicative of increased labour market competition which may induce greater stress as compared to other ethnic groups (Broman et al., 1995).

Like many studies in this field, unemployment was operationalized as individuals *without, currently available for, and seeking work,* as per the International Labour Office definition (ILO, 2000). As a multidimensional construct, both the experience of being non-employed (without work) and the motivational dimension of 'seeking work' are captured. By this definition, individuals who are without work and available but not actively seeking employment are not counted as unemployed but are instead considered 'out of the labour force'. This has been termed the discouraged worker effect and is increasingly the subject of academic investigation. The discouraged worker effect is defined as the decision to refrain from job search as a consequence of poor labour market opportunities (Ham et al, 2001). Discouragement may occur where there is high regional or national unemployment, discrimination in the labour market, or where individuals have few qualifications.

A small number of studies suggest the negative association between non-employment and psychological wellbeing, one domain of SWB, is stronger among discouraged workers than those who identify as unemployed. Ethnic minority groups are more likely to experience unemployment throughout the lifecourse. Over time, these groups may, therefore, be more likely to select themselves out of the labour force rather than report being unemployed, i.e. they may on average be more discouraged workers. As such, the results presented in this study may underestimate ethnic differences in the association between unemployment and psychological wellbeing.

Identifying this group is, however, difficult and requires careful consideration. Individual selection out of the labour force can occur for a number of reasons which often differ for men and women. Women are more likely than men, for example, to exit the labour market to start a family. As such, discouraged workers represent only a proportion of those out of the labour force. Despite these considerations, studies estimate that up to one third of those out of the labour market are discouraged (Dagsvik et al., 2010) and thus represents an important area for further study. As more waves of Understanding Society become available, it may be possible to exploit the study's panel design to capture this group. Taking into account expected gender differences, individuals who report being unemployed across a number of consecutive waves before reporting as being out of the labour force may indicate a discouraged worker effect. Unfortunately, with only five waves of data available at this time, and a number of unemployment transitions occurring in the latter part of the study's timeframe, it was not possible to employ this approach here.

1.7.2 Life satisfaction

Life satisfaction is defined as a measure of how people evaluate their life overall and is distinct from a measure of current emotion and functioning. Caribbean and African men report greater life satisfaction when unemployed. Again, this may be indicative of a social norm effect; Caribbean and African men have significantly higher unemployment rates than the white British. The experience of unemployment may, therefore, not induce the stigma characteristic for other ethnic groups, where unemployment occurs less frequently, thereby mitigating the adverse effects of unemployment (Clarke, 2003). Gender role expectations are more egalitarian among Caribbean men and women (Kane, 2000). Male identity may, therefore, not be as centrally defined by male breadwinner status as other ethnic groups. As such, unemployment may not negatively impact their life satisfaction.

Results did not reach a level of statistical significance for any ethnic group among women. It is therefore not possible to say that, among women, the association between unemployment and life satisfaction varies as a function of ethnicity.

1.7.3 Domain satisfaction

The results from this study indicate that there are ethnic differences in the association between unemployment and satisfaction with income for men. While all ethnic groups report lower satisfaction with income, for Indian, Bangladeshi, Caribbean and African groups, the effect is statistically significantly smaller than it is for the white British group. With the exception of the Indian group, these ethnic groups are disproportionately concentrated in low socioeconomic groups (JRF, 2015). Unemployment may, therefore, represent a smaller income shock than for the white British; thereby mitigating the negative effect of unemployment on satisfaction with income.

In contrast, there appears to be little ethnic variation in the association between unemployment and income satisfaction among women. While all groups report lower satisfaction with income when unemployed, results are statistically significant for Caribbean women only. As set out above, gender role expectations are more egalitarian among Caribbean men and women (Kane, 2000). As such, Caribbean women may be contributing more financially to the household than women from other ethnic groups.

Pakistani and African men report greater satisfaction with health when unemployed, operating in the opposite direction than for the white British. Studies elsewhere find that long term unemployment has a significant and negative effect on health satisfaction for both men and women (Gordo, 2006). As such, it is surprising that we find results operate in the opposite direction for Pakistani and African men. Pakistani men are more likely to be in semi-skilled manual occupations than white British men (Green et al., 2005). It may, therefore, be that manual occupations take a greater toll on one's health and thus lead these groups to report greater satisfaction with health when not employed in such positions. Owing to small sample sizes, however, it was not possible to explore this further. Nevertheless this represents an interesting finding and should be considered further in future research.

The association between unemployment and satisfaction with leisure did not vary as a function of ethnicity among women. Among men, all groups, except for the Bangladeshi group, report greater satisfaction with leisure when unemployed. This positive association is however statistically significantly smaller for Indian and African groups. Thus, while unemployed men in these groups report greater satisfaction with leisure when unemployed, the effect size is not as large as it for white British men. In contrast, satisfaction with leisure is lower when unemployed for the Bangladeshi group, and is statistically significant at -0.22 (0.27). Both Bangladeshi and African groups, in this study, report lower household income. It may, therefore, be that these groups are constrained by having less financial resources available when unemployed to undertake meaningful or enjoyable activities, thereby impacting evaluations of satisfaction with leisure.

1.7.4 The moderating role of generational status and education

Three way interactions were introduced to test for heterogeneity within ethnic groups in the association between unemployment and psychological wellbeing. Clear differences were identified by generational status, suggesting that unemployment is negatively associated with psychological wellbeing for both those born in the UK and those who migrate, a pattern that held across both men and women. Interestingly, fewer differences were identified by level of education. This represents a novel finding and should be examined more closely in future research as sample sizes continue to grow within Understanding Society.

1.8 Strengths and limitations of study

This study represents the first empirical analysis of ethnic differences in the association between unemployment and SWB in the UK. Historically, research interested in the health and labour market outcomes of ethnic minority groups has been limited by small sample sizes. Understanding Society represents a unique opportunity to undertake detailed analysis to understand the economic and social situation of ethnic minority groups in the UK today and how this intersects with gender. This study therefore makes a clear contribution to the empirical literature of ethnic inequalities in health.

By exploiting the panel design of Understanding Society, this study has demonstrated the consequence of unemployment for SWB for the five largest ethnic minority groups in the UK. The identification strategy employed in this paper does not, however, address the potential for reverse causation or selection into unemployment. As set out earlier in this study, the selection hypothesis into unemployment cannot be discounted (Mastekaasa, 1996; Schmitz, 2011). A growing econometric literature has sought to address this potential endogeneity by estimating this association among plant closures, which represents an exogenous entry into unemployment (Browning et al, 2006; Salm, 2009; Schmitz, 2011). Such studies find evidence of a health driven selection effect into unemployment, which is likely to contribute to the observed association between unemployment and poor psychological wellbeing (Schmitz, 2011). Quantitative research interested in ethnic specific labour market and health outcomes is, however, frequently hampered by small sample sizes and this study was no exception. It was therefore not possible to replicate such an econometric approach here. By using a fixed effects approach, this study does, however, get closer to estimating a causal effect than purely cross-sectional studies, and therefore represents an important contribution to the empirical literature.

SWB is composed of three distinct domains which often have different antecedents and consequences (Diener et al., 2000). Studies therefore suggest operationalising SWB via a battery of instruments, rather than a single measure. Despite this, studies seldom focus simultaneously on all three. By examining the association between unemployment and each domain of SWB separately, this study has identified domain specific associations among different ethnic groups, which may have important policy implications.

Psychological wellbeing was measured in this study with the GHQ12, a measure of psychiatric morbidity. While the GHQ12 has established reliability and validity claims

(Goldberg & Williams, 1988), it is based upon western psychiatric practice and may therefore be less effective at identifying poor psychological wellbeing among some ethnic minority groups where there are important cultural differences (Kleinman, 1987; Sproston and Nazroo, 2002). It is not known from this study whether the GHQ12 is differentially interpreted by some ethnic minority groups and consequently it is unclear whether any of the null findings reported here are in fact an artefact of the instrument utilised.

The wording of GHQ response categories may have also influenced individual response patterns. Respondents are asked to compare their psychological wellbeing to how they have felt recently, i.e. 'better than usual' vs. 'less than usual'. Individuals with longstanding poor psychological wellbeing may therefore feel no worse than usual despite having poor wellbeing. As such, the response given may not accurately reflect the experience of poor psychological wellbeing. Despite these caveats, the GHQ remains a commonly used measure in the literature where such studies frequently report a significant negative association between unemployment and psychological wellbeing (Paul & Moser, 2009). Alternative measures designed to capture psychological wellbeing are not available in consecutive ways of Understanding Society and could therefore not be utilised in this study.

Descriptive statistics and fixed effects estimates were unweighted in this study. The findings of this study are therefore specific to this sample only and not generalizable to the wider population. Despite these limitations, this study represents an important contribution to the empirical literature and offers a foundation for future research interested in how the association between labour market outcomes and SWB varies as a function of ethnicity.

1.9 Future research

The findings presented in this study are specific to the UK, which is characterised by specific ethnic minority profiles, labour market conditions and unemployment provisions. As such, future research should consider whether the findings of this study are replicated in different countries, where these characteristics and contexts may vary.

As set out at the beginning of this study, a number of theoretical models have been proposed to explain the association between unemployment and SWB. Few have, however, been applied to understand how this association varies by ethnicity. The disproportionate concentration of ethnic minority groups in deprived neighbourhoods and low socioeconomic positions, for example, may have important implications for the explanatory power of economic deprivation models (Nordenmark & Strandh, 1999; Rantakeisu et al., 1999; Dooley, 2003; Janlet & Hammarstrom, 2009). Future research should build on the findings of this study to operationalize and empirically examine the explanatory power of these theoretical models. Examples could include operationalizing a social norm to work with ethnic specific unemployment data, which could serve as a proxy in the absence of information asked directly of participants.

The reason for exiting unemployment has been shown to determine individual improvement in SWB. Transitioning from unemployment to parenthood may, for example, be associated with a different gain in SWB compared to a transition from unemployment to employment (Thomas et al, 2005). Little is known, however, about how the health gains associated with each of these pathways vary as a function of ethnicity and gender together. The importance and value ascribed to each employment status may not be consistent across ethnic groups, which are characterised by specific cultural norms and behaviour. One study, for example, found that older Pakistani and Bangladeshi women concentrated in home making roles often saw no need to increase their already heavy burden of work. A transition to employment may therefore be met with negative feelings for this group. As such, it is plausible to assume that the health gains associated with different employment pathways may indeed differ by ethnicity.

This study was interested in whether the association between unemployment and SWB varies as a function of ethnicity. Now that ethnic differences have been identified, the next step is to understand whether factors known to be correlated with SWB and unemployment mediate or moderate this association. For example, religiosity, which is greater among ethnic minority groups, may replace some of the non-pecuniary benefits of unemployment including sense of purpose and social networks. Across the five waves of Understanding Society, reported transitions from employment to unemployment ranged between 111 and 207 for each ethnic group. It was, therefore, not possible to empirically examine how the role of potential mediating factors may vary as a function of ethnicity. As more waves of Understanding Society become available, the number of employment transitions in the dataset will increase, thereby permitting further analysis with a larger sample.

1.10 Conclusion

Academic and policy interest in subjective wellbeing has increased significantly in recent years, with, in 2009, the Commission on the Measurement of Economic Performance and Social Progress recommending that national statistical agencies collect and monitor measures of SWB (Stiglitz et al., 2009). The first World Happiness Repot, published in 2012, identified broad societal and structural drivers of wellbeing, including unemployment (Helliwell, J. Layard, R. & Sachs, J. 2012). While there is much heterogeneity in the association between unemployment and SWB, on average, becoming unemployed is associated with a significant fall in wellbeing (see Paul & Mosser, 2009 and Helliwell, J. Layard, R. & Sachs, J. 2012 for discussion).

While ethnic minority groups continue to experience both poorer SWB and labour market outcomes than the majority white British population, this represents the first study to empirically examine ethnic differences in the association between unemployment and each domain of SWB in the UK. As such, this study offers the first insight into the public health threat of unemployment for the five largest ethnic minority groups in the UK and represents an important contribution to the empirical literature.

The analytical strategy taken in this study was complete case analysis, meaning that individuals with missing data on any of the variables included in this study were excluded. It is plausible, therefore, that the characteristics of the final sample utilised in each study, differ from the larger population, and given the non-random nature of item non-response, may be correlated with the variables selected in this study. Statistical tests do support this hypothesis for the main independent variables, indicating that those retained in the final analytical sample are, on average, more likely to be unemployed and white British. It is therefore plausible that the results presented in this study are not representative of the wider population, again demonstrating the need for further research in this area.

Identification of those groups most negatively affected by unemployment is key. This information will allow policymakers to target interventions to mediate the negative health consequences of unemployment for those most affected. The reverse of this, however, is that by identifying those groups less negatively affected by unemployment, we can begin to understand key protective factors among these groups which may have wider implications for interventions associated with health and employment (Karsten & Klaus, 2009). This study has demonstrated that although for Pakistani, Bangladeshi and African women unemployment is negatively associated with unemployment, the magnitude of the effect is statistically significantly smaller than it is for white British women. In contrast, the negative association between unemployment and satisfaction with income is greatest for Caribbean women and is statistically different from white British women. Among men, there is a clear ethnic patterning across all domains of SWB. The strongest ethnic patterning is evident for satisfaction with income, where all ethnic minority groups are less negatively affected by unemployment than the white British. Collectively, these results provide the first evidence of how the association between unemployment and SWB is ethnically patterned and should be of interest to policymakers.

Chapter 2

Revisiting the ethnic density hypothesis and the mediating role of social capital in mental health

2.1 Introduction

2.1.1 Ethnicity in the UK today

A question on ethnicity was first introduced in the 1991 Census, where approximately 7 percent of the population identified themselves as belonging to a non-white ethnic group. This had increased to 9 percent in the 2001 Census and 14 percent by 2011 (Jivraj, 2012). Indian, Pakistani, Bangladeshi, Caribbean and African groups represent the largest non-white ethnic minority groups in the UK today (Jivraj, 2012), although the spatial distribution and growth patterns of these groups varies as a function of their differing migratory and settlement patterns in the UK.

While ethnic residential segregation decreased between 2001 and 2011 (Catney, 2013), overall ethnic density increased as a consequence of increasing populations among BME groups. Additionally, despite an overall decrease in the proportion of ethnic minority groups residing in the most deprived neighbourhoods during the same period, all ethnic minority groups in the UK remain more likely to reside in deprived areas compared to the majority white British population in 2011. This is highest among the Pakistani and Bangladeshi groups (Jivraj & Khan, 2013).

2.1.2 Ethnic differences in mental health

Given the disproportionate concentration of ethnic minority groups in more deprived neighbourhoods, where local infrastructures and opportunities are often deficient, it is unsurprising that these groups also experience poorer health outcomes, on average. While specific patterns vary across health conditions, Pakistani, Bangladeshi and Caribbean groups experience the poorest health in the UK (Nazroo, 2001) on average. Ethnic inequalities have additionally been identified in mental health and have, as a consequence, been the focus of targeted interventions to address this. Studies utilising treatment data, for example, report significantly elevated rates of psychosis and common mental disorder among the Caribbean group, specifically young men. Such findings have, however, been contested since patterns may reflect biases in service use and discrimination in the health services rather than actual incidence. In contrast, data from nationally representative social surveys, notably the FNS and EMPIRIC, find that while psychotic illness is more prevalent among the Black Caribbean group than the white majority population, this difference is inflated in studies relying on contact with treatment services data.

Explaining ethnic inequalities in mental health

A range of hypothesised causal pathways between ethnicity and mental health have been empirically tested in both the UK and US, notably exposure to racism and discrimination as well as the role of socioeconomic status (SES) and unemployment. As a consequence of BME peoples' disproportionate concentration in low SES groups and higher unemployment probabilities than the majority white British population, the potential mediating role of both SES and unemployment, known stressors to mental health, has been tested (Williams et al, 1997). While ethnic inequalities attenuate when controlling for SES, indicative of a mediating effect, a residual 'ethnic effect' remains, therefore suggesting other explanatory mechanisms.

A number of studies have examined whether exposure to racism and discrimination, both within and outside of work, explain ethnic inequalities in mental health. Studies find that perceived discrimination is associated with poorer mental health outcomes, with the risk of common mental disorders highest among those who report experiencing racism or discrimination across most ethnic groups (Bhui et al, 2003). While exposure to racism and discrimination are clearly stressors for poor mental health (Williams & Mohammed, 2009), the changing nature of the UK's socio-political context, anti-discrimination laws and assimilation discourse may have changed the nature and strength of this association.

2.1.3 The ethnic density hypothesis

The spatial distribution of BME groups in the UK, and the potential impact of this upon mental health has received renewed interest in recent years. While ethnic minority groups are disproportionately concentrated in deprived neighbourhoods (Jivrai & Khan, 2013), a known stressor for mental health (Stafford & Marmot, 2003; Kim, 2008), a growing literature suggests that residing in an area with a higher concentration of co-ethnics may be protective for mental health among BME groups, over and above any deprivation stressor effects (Halpern, 1993; Becares et al, 2009; Das-Munshi et al., 2010; Becares, 2011; Becares & Nazroo, 2013). In fact, despite country specific migratory and settlement patterns among ethnic minority groups, studies from a range of national contexts support this ethnic density hypothesis.

The ethnic density hypothesis was first empirically tested in the UK by Cochrane & Bal in 1988. Utilising English mental health admission data from 1981, correlations between (1) ethnic group size and admission rates within a specific geographical area and (2) rates of admission and the size of an ethnic group across areas were tested to examine the ethnic density hypothesis. This study found no evidence to support the hypothesis of ethnic density being protective for mental health among the nine immigrant groups examined, with results for some groups operating in the opposite direction to that which was hypothesised (Cochrane & Bal, 1989. Subsequent studies have suggested that their failure to identify a between-group effect may be partly attributed to the fact that the geographical unit of analysis, Regional Health Authority, was too large a geographical distance to detect an ethnic density effect (Halpern, 1993; Halpern & Nazroo, 2000). In contrast, in studies where ethnic density was modelled at a more localised level (specifically electoral wards within London), an ethnic density effect was identified for some groups. Specifically, a higher incidence of schizophrenia was found among Caribbean and African groups in areas of lower co-ethnic concentration (Boydell et al, 2001) while a second study found that rates of self-harm were higher in areas of low co-ethnic concentration for African-Caribbean and Asian groups (Neeleman et al, 2001). While these studies suggest that ethnic density is protective for some ethnic groups, these findings may reflect service use bias and racial discrimination in the health services as set out above. They may also be specific to London given the spatial concentration and distribution of BME groups in the capital, which is markedly higher than in many other parts of the UK. These findings must therefore be considered accordingly (Pickett & Wilkinson, 2008).

With the collection of data on BME groups in sufficient numbers to permit robust statistical analysis, a growing number of studies have re-examined the ethnic density hypothesis in community-based samples. Utilising geocoded data from the Fourth National Survey of Ethnic Minorities (FNS) and the 1991 Census, Halpern and Nazroo re-examined the ethnic density hypothesis among Indian, Bangladeshi, Pakistani, Caribbean, African-Asian and Chinese groups. While some results support the ethnic density hypothesis, they were not consistent across ethnic groups and mental health measures considered. Specifically, while a higher co-ethnic concentration was significantly protective for PSQ symptoms among Indian, Caribbean and Bangladeshi groups, it was protective for neurotic symptoms among the Indian and Caribbean groups only. Results remained statistically significant upon adjustment for potential confounding variables (Halpern & Nazroo, 2000). Interestingly, for the Pakistani group the inverse was true; residing in areas with a higher co-ethnic concentration was associated with poorer mental health, although results were not statistically significant. Pakistani individuals are among the most likely to reside in the most deprived neighbourhoods in the UK and thus this association may be partially explained by the fact that any protective effects of ethnic density may not be enough to offset the negative effects associated with living in areas of high deprivation, a known stressor. By utilising a community based sample, this study sought to overcome the aforementioned issues of service use bias and discrimination associated with admissions data. This study did not, however, utilise a multilevel modelling approach and consequently failed to account for the correlated errors between individuals within a neighbourhood.

Building on this, subsequent studies have sought to overcome this issue by utilising a multilevel modelling approach. Utilising the Ethnic Minorities Psychiatric Illness Rates in Community Survey (EMPIRIC), Das-Munshi et al. have re-examined the ethnic density hypothesis at the Middle Layer Super Output Area level (MSOA – mean population 7200 people) and its association with both common mental disorders and psychotic symptoms. The first study found that, upon adjustment for individual level characteristics including marital status and highest educational qualifications, ethnic density was protective for common mental disorders among the Irish (odds ratio 0.21) and Bangladeshi (odds ratio 0.75) groups only (Das-Munshi et al, 2010). While the association operated in the hypothesised direction for all other minority groups examined, results did not reach a level of statistical significance. Since effect sizes were not available at the time of publication, the study's authors suggest that the lack of statistically significant effects for some groups may be explained by insufficient power rather than the absence of a 'true' effect (Das-Munshi et al, 2010). Results from the second study support the ethnic density hypothesis in relation to psychotic symptoms for some ethnic groups. Specifically, statistically significant associations between reporting psychotic experiences per ten percentage point reduction in own-group density were identified among Irish, Bangladeshi and Indian groups in the expected direction.

Findings from a recent study further support the ethnic density hypothesis, although results do not reach a level of statistical significance for any ethnic minority group (Becares & Nazroo, 2013). Utilising geocoded data from the 2004 Health Survey for England linked to the 2001 Census at the MSOA level, this study finds that while the association between ethnic density and mental health operates in the expected direction for Indian, Pakistani, Black Caribbean and Black African groups, results are not statistically significant for any group. Interestingly, among the Bangladeshi group, results are the inverse of the hypothesised association. Again, like Pakistani individuals, Bangladeshi people are most likely to reside in the most deprived neighbourhoods in the UK which may explain the unexpected association (as discussed above).

A recent narrative review seeks to synthesise the evidence base relating to the ethnic density hypothesis (Shaw et al, 2012). A review of 34 papers from 29 data-sets found that the most consistent associations between ethnic density and mental health were found for psychoses. As a consequence of limited statistical power owing to small sample sizes, evidence for the protective effects of ethnic density for other mental disorders is tentative only (Shaw et al, 2012).

2.1.4 Potential pathways

In sum, while the evidence base suggests that the association between ethnic density and mental health is complex, with heterogeneity across ethnic groups, results overall are indicative of an ethnic density effect for particular ethnic minority groups in particular contexts. Less is known, however, about the pathways by which ethnic density is protective of mental health. To date, the potential mediating role of only three psychosocial pathways between ethnic density and mental health have been empirically tested: (1) exposure to racism and discrimination, (2) increased social support and (3) social capital.

Exposure to racism and discrimination and social support

Only two studies have empirically tested the role of exposure to racism and discrimination in explaining the association between ethnic density and mental health. It is hypothesised that in areas with a higher concentration of co-ethnics, individuals will be both less exposed to racism and discrimination. Furthermore, where racism is experienced, they will have greater supportive communities to process such experiences (Becares et al, 2009; Das Munshi et al, 2010). Using data from the FNS linked to the 1991 Census at the MSOA level, the earlier study tested whether exposure to racism and discrimination moderated the association between ethnic density and mental health. While the experience of racism was lower in areas with a higher concentration of co-ethnics as hypothesised, interactions between ethnic density and exposure to racism were not at a level of statistical significance for any ethnic group despite operating in the expected direction. The authors suggest that this may, however, be a consequence of a lack of statistical power due to small sample sizes.

A second study interested in the role of exposure to racism and discrimination and increased social support utilised data from the EMPIRIC survey linked to the 2001 Census. As with the study above, results indicated that exposure to racism and discrimination was inversely associated with ethnic density although the picture was less clear for increased social support. While the Bangladeshi group reported increased social support (as measured by specific sub-domains) in areas with higher co-ethnic density, results were not statistically significant for most groups. Upon adjustment for the proposed mediators, associations between ethnic density and mental health did not attenuate for any ethnic group. Evidence therefore indicates that exposure to racism and discrimination and increased social support are not causal mechanisms in the pathway between ethnic density and mental health (Das Munshi et al 2010).

Social capital

A growing literature, spanning the social sciences, supports an association between social capital and mental health, with increased levels of social capital being positively associated with better mental health for some groups (Stafford et al, 2008; Ivory et al, 2011). This association is complex, however. Some findings suggest that the effect only applies to specific forms of social capital, notably bridging social capital that is protective for mental health (Stafford et al, 2008). At the same time, there has been a renewed interest in the role of social capital as a neighbourhood characteristic and its explanatory power as a psychosocial pathway between place and health (Pickett & Wilkinson, 2008).

Relatedly, studies in the field of psychology have focused on the association between specific dimensions of social capital, most frequently sense of belonging and perceived social support, and health outcomes. Results show that, for some groups, a greater sense of belonging (Sargent et al, 2002) and perceived social support (Choenarom et al, 2005) can buffer against the development of depressive symptoms. While not concentrated on neighbourhood social capital specifically, these findings may be relevant for understanding the mechanisms by which ethnic density is protective of mental health. This is especially true given their focus on specific domains of what is generally understood and operationalised as social capital in the aforementioned studies.

Shared ethnic membership is often considered an important contributory factor to, if not a form of, social capital (Portes & Zhou, 1993; Bankston & Zhou, 2002) and thus increased social capital is the third empirically tested pathway by which ethnic density may be protective for mental health. Utilising geocoded data from the 2004 Health Survey for England linked to the 2001 Census at the MSOA level (average population 7200 individuals), only one study has presently empirically tested the mediating role of social capital (Becares & Nazroo, 2013). Results suggest a heterogeneous effect in the association between ethnic density and social capital according to ethnicity, with increased ethnic density associated with lower social capital among black Caribbean, black African and Bangladeshi groups, contrary to the hypothesised direction. Results were not, however, statistically significant for all groups and upon adjustment for area level social capital, calculated as the mean social capital score within a neighbourhood, all significant associations between ethnic density and individual level social capital dropped out. Importantly, social capital was not found to mediate the association between ethnic density and mental health for any ethnic group.

This may be partly attributed to the measure of social capital employed in the study. Both individual and area level social capital were measured by a factor score, operationalised from 4 individual level variables, relating to neighbourhood level processes, that asked respondents: (1) *whether this area is a place they enjoy living in*, (2) *whether this area is a place where neighbours look after each other,* (3) *how much of a problem in their local area are teenagers hanging around on the streets,* and (4) *how much of a problem in their local area are vandalism, graffiti or deliberate damage to property*. While the authors assert that these four items captured cognitive social capital, defined as shared beliefs and values and social support (Forsman et al, 2012), the latter two items arguably capture physical dimensions of the neighbourhood, and may therefore not be related to the psychosocial pathway by which social capital may be associated with ethnic density and mental health.

2.2 Methodological challenges

It may simply be that the mechanisms by which ethnic density is protective for mental health are heterogeneous, operating differentially according to ethnicity (Das-Munshi et al, 2010), or rather, that a number of methodological issues explain the inconsistencies reported between studies (Stafford et al, 2009; Shaw et al, 2012). Such issues relate specifically to (1) sample size, (2) differing geographical levels of analysis, (3) operationalisation of ethnicity and ethnic density, (4) measures of mental health employed, (5) insufficient sample specific between neighbourhood variation in ethnic density, (6) identification strategy utilised and (7) appropriate adjustment for potential confounders.

(1) In practice, studies in the area of ethnicity have suffered from small sample sizes. Even where studies have ethnic minority boost samples, numbers can quickly become very small

upon stratification or exclusion of those with item non-response. This may be particularly pertinent for the ethnic density hypothesis, where statistical power may be of particular importance, ‘possibly because of the subtlety of such associations’ (p.12: Shaw et al, 2012). A recent narrative review highlights the fact that in small studies (n<500) findings are, on average, neutral while large studies (n>4000) find, on average, a protective effect of ethnic density upon mental health (Shaw et al, 2012).

(2) Recent studies have recognised that the geographical level at which ethnic density is protective for mental health may be ethnic group specific (Das Munshi et al, 2012) and, in fact, remains a central issue within the literature (Pickett & Wilkinson, 2008). Most studies in this area have operationalised ethnic density at the MSOA level, where there is an average population of approximately 7000 individuals, right through to the level of Regional Health Authority. In practice, the geographical level of analysis is often constrained by data linkage issues and a reliance upon arbitrary neighbourhood boundaries, often constructed for government statistics. This presents two related issues: (1) the arbitrary neighbourhood boundaries imposed by government statistics may not be perfectly correlated with an individual’s perception of their neighbourhood and (2) ethnic density may be protective for mental health at a more localised spatial level than that operationalised with government statistics (see Schofield et al, 2011 for an examination of the ethnic density hypothesis at a more refined spatial level among the black Caribbean group). While attaining consent to link data with Census statistics at the LSOA level, a smaller geographical level of between 1000 and 3000 individuals, allows us to consider whether ethnic density operates at a more localised geography, it is much more challenging to address the first issue raised. It is important to recognise this as a caveat of research in this area, but one should not abandon research in this area given that statistically significant associations between ethnic density and mental health have been found in a number of studies and contexts.

(3) As discussed above, studies interested in ethnicity have often faced the challenge of limited sample size. In addition to the problem of a lack of statistical power, this has presented an issue for the classification of ethnic groups. As a consequence of limited sample sizes, a number of earlier studies were compelled to either rely on broader ethnic classifications or simply dichotomise their analysis according to white vs non-white. Despite markedly different migratory patterns and experiences upon settlement, black African and black Caribbeans have often been modelled as a single category (Smaje, 1995). Additionally, earlier studies have collapsed Indian, Pakistani and Bangladeshi groups into a single category 'South Asian', thereby failing to account for the heterogeneity among these groups. While both Pakistani and Bangladeshi groups, on average, have similar demographic profiles, it is well documented that the Indian group outperform even the majority White British population on a range of indicators, including home ownership and employment probabilities.

(4) As with most research areas, secondary data analysis is constrained by the variables included in the original study. Thus, the association between ethnic density and mental health has been empirically examined with (1) a range of instruments measuring mental health and (2) at various cut-off points. While some studies have utilised indicators of common mental disorder, such as the General Health Questionnaire (GHQ) (Ecob & Williams, 1991; Becares & Nazroo, 2013), others have relied on treatment data for psychoses (Cochrane & Bal, 1989). This may partially explain why findings are not consistent across studies.

(5) A recent narrative review suggests that the lack of consistent findings across studies may be partially attributed to insufficient variation in ethnic density between neighbourhoods or within neighbourhood levels. It has been hypothesised that the threshold at which ethnic density exhibits a protective effect upon mental health is not reached in a number of studies (Shaw et al, 2012). In fact, this may explain why an ethnic density effect is more often found

within the US context, where average ethnic density levels among the African American group is much higher than it is for black ethnic groups in the UK.

(6) A number of earlier studies in this area utilised a single level regression estimation method, thus failing to account for the non-independence of observations within a neighbourhood. It is only with a multilevel modelling approach that the within and between neighbourhood variation can be partitioned, that is to say that it is only with a multilevel approach that we can know the explanatory power of neighbourhood context in mental health outcomes.

(7) Earlier studies interested in the ethnic density hypothesis and its association with mental health often failed to adjust for area level deprivation. Given ethnic minority groups' concentration in deprived neighbourhoods, a known stressor for mental health, failing to appropriately adjust for this in any analysis may have masked any potential protective effect of increased ethnic density on mental health. A number of later studies have found that, upon adjustment for area level deprivation, a protective effect of ethnic density remains statistically significant (Bosqui et al, 2014). As expected, due to selective sorting across neighbourhoods, identified associations between ethnic density and mental health attenuate upon adjustment for a range of individual level characteristics, with this pattern evident across most studies in this area (Pickett & Wilkinson, 2008).

2.4 This study

2.4.1 Academic contributions

As demonstrated above, the ethnic density hypothesis is complex, operating differentially across specific ethnic groups (Halpern & Nazroo, 2002; Becares & Nazroo, 2013), at varying spatial levels (Das-Munshi, 2012) and may be specific to certain socio-political contexts

(Pickett & Wilkinson, 2008; Das-Munshi et al, 2010). Most studies in this area have relied on data from the 1991 and 2001 Censuses, where both ethnic density and diversity were very different, as was the socio-political context[5]. It is, therefore, possible that recent governmental discourse centred on assimilation and anti-discrimination and concentrated policy efforts at addressing ethnic inequalities in mental health may have moderated an ethnic density effect and the mechanisms by which it operates. In light of this, a re-examination of the ethnic density hypothesis is recommended. Building upon a recent study exploring the mediating role of social capital in explaining the association between ethnic density and mental health (Becares & Nazroo, 2013), this study will contribute to the literature in three distinct ways:

(1) Utilising Understanding Society, a contemporaneous, nationally representative, data set linked with Census 2011 data, to examine whether the ethnic density hypothesis still contributes to explaining ethnic inequalities in health today or is specific to certain socio-political contexts and spatial distributions.
(2) Utilising Census 2011 Small Area Statistics at the Lower Super Output Area level (LSOA) to estimate the ethnic density hypothesis at a more refined geographical level. This is used because a more localised spatial level may better reflect community level social interaction and sense of neighbourhood belonging.
(3) Utilising Buckner's Social Cohesion scale (Buckner, 1988) to test the mediating role of an alternative formulation of social capital, one that is explicitly focused on the psychosocial processes of social capital and, as asserted in this paper, may be more

[5] As acknowledged elsewhere, BME group migratory and settlement patterns in England have changed over time, and consequently effects identified in previous literature may no longer be relevant to either the groups included in such studies or to more recent migrant groups (Das-Munshi et al, 2010)

strongly associated with ethnic density and mental health than measures used elsewhere.

2.4.2 Hypotheses

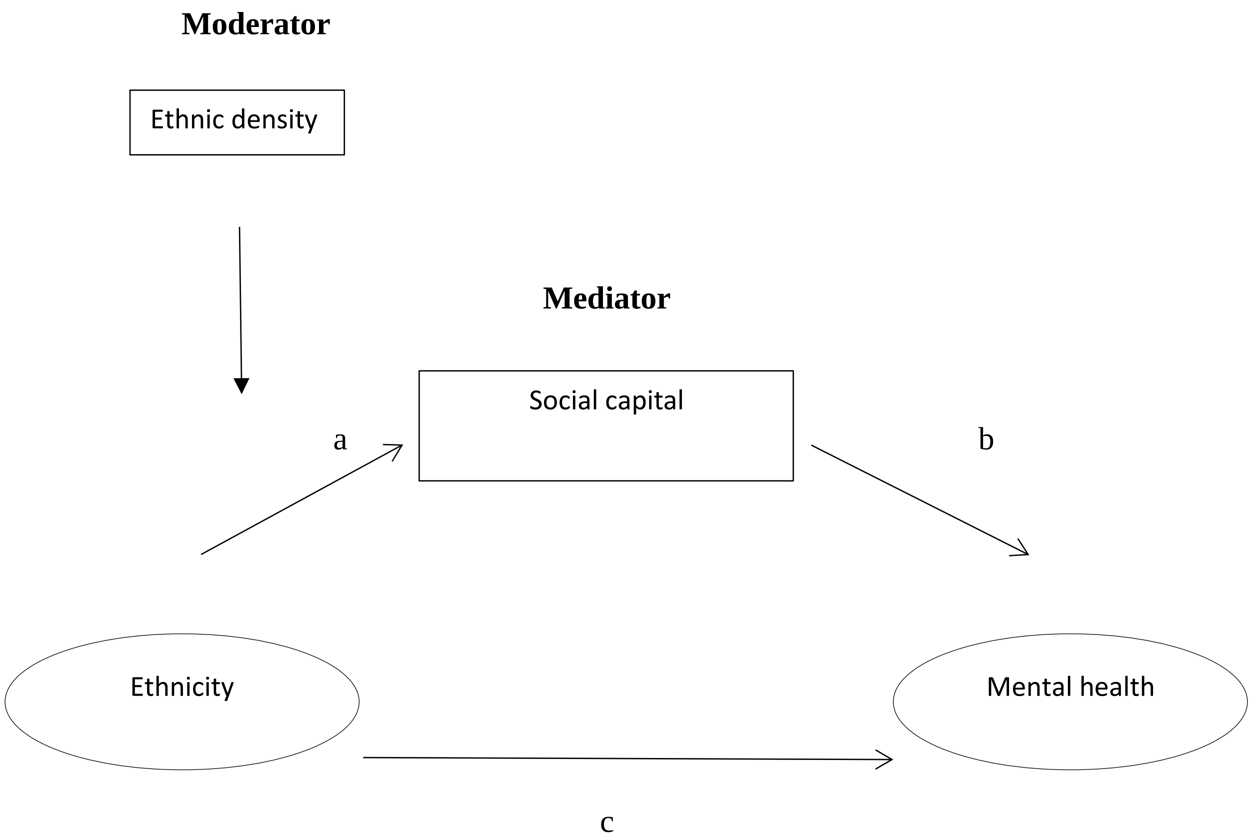
Hypothesis 1: Ethnic minority individuals residing in neighbourhoods with a higher concentration of co-ethnics (same ethnic density) will report better mental health outcomes than those residing in areas with a lower concentration of individuals from their own ethnic group (path c: direct effect).

Hypothesis 2: Ethnic minority individuals residing in neighbourhoods of higher co-ethnic concentration will report higher levels of social capital compared to individuals residing in areas with a lower concentration (path a).

Hypothesis 3: The association between ethnic density and mental health will be partially mediated by individual level social capital (full mediation model).

It is expected that with the inclusion of the individual level social capital measure the association between ethnic density and mental health will partially attenuate for all ethnic minority groups.

Figure 2.1: graphical representation of causal pathway of moderated mediation



Independent Variable **Dependent**

Variable

2.5 Data and methods

2.5.1 Data

This study utilises, wave three, a cross-section of Understanding Society: the UK Household Longitudinal Survey (UKHLS). The UKHLS started in 2009 and provides detailed information about the social and economic situations of people living in the UK. Approximately 40,000 households within the United Kingdom were selected into the survey and are interviewed annually. The sample is comprised of five components including a general population sample (GPS) and an ethnic minority boost sample (Lynn, 2009). The GPS is based upon a multistage, proportionately stratified, equal probability (clustered) design (Lynn, 2009) and the ethnic minority boost sample is designed to recruit 1,000 participants from five targeted non-white ethnic minority groups. These groups are Indian, Pakistani, Bangladeshi, Caribbean and African (Lynn, 2009). These ethnic minority groups were targeted because they were the largest in the UK at the study's inception. The decision was taken to exclude white minority groups from the boost (Berthoud et al, 2009).

Eligibility into the boost sample was determined via a screening question. This analysis includes individuals recruited via both the general population and the ethnic minority boost sample. Consequently, all descriptive statistics are weighted to adjust for Understanding Society's complex survey design (Lynn & Kaminska, 2010). Given Understanding Society's sampling strategy of recruiting for the ethnic minority boost sample in areas of mid to high ethnic density, we expect to attain both sufficient (1) variation in ethnic density across neighbourhoods and (2) within neighbourhood ethnic density levels above the minimum threshold at which ethnic density is hypothesised to be protective of health (Shaw et al, 2012).

Geographical identifiers

Information on ethnicity is collected at each Census and is aggregated to various spatial levels as part of the Census statistical geographies. Since data collection for wave three of UKHLS took place between 2011 and 2012, this study utilises information from the 2011 Census, thereby providing a contemporaneous measure of ethnic density. Specifically, this study models ethnic density at the Lower Super Output Area level; a refined homogenous spatial level comprising of 1,000 to 1,500 individuals on average. In 2011, there were 34,753 LSOA's in England and Wales. LSOA level Information is not available for both Northern Ireland and Scotland due to geographical statistics being aggregated at different spatial levels. In this study, all analyses are restricted to England only so that potential country level effects are not conflated with any neighbourhood level effects identified (Knies et al, 2014).

While geographical identifiers are not available as part of UKHLS public release data, a look-up file between household identifiers and select local area statistics was obtained upon application for a UKHLS special licence. Using these identifiers, all individual and household level information in the UKHLS sample can be linked to Census area statistics.

2.5.2 Sample characteristics

Analyses include individuals from the study's five targeted ethnic minority groups and the reference 'White British' category only. The decision was taken not to construct an 'other' category since the ethnic groups it would comprise are too heterogeneous to be collapsed into a single category. Given the substantive topic of this study, respondents identifying themselves as White British but who were born outside of the UK are excluded from all analyses (52 observations). Finally, all analyses are restricted to England only so that potential country level effects are not conflated with any neighbourhood level effects identified (Knies et al, 2014).

The analytical strategy taken in this thesis was complete case analysis, meaning that individuals with missing data on any of the variables included in this study were excluded. Statistical tests (results detailed in appendix 2) indicate that those excluded from the final analytical sample are, on average, less likely to be White British, male, and have a degree. Income, and co-ethnic density profiles do not differ however.

This results in a final sample size of 20,984 individuals across 9,627 LSOA's. All descriptive statistics are stratified by ethnicity.

2.5.3 Measures

GHQ

The UKHLS utilises the 12-item version of the General Health Questionnaire, a common psychological well-being instrument, as a measure of current mental health. It is a validated screening instrument for detecting non-psychotic and minor psychiatric morbidity, focusing on two chief areas: ‘the inability to carry out normal functions’ and ‘the appearance of new and distressing phenomena’ (Goldberg & Williams, 1988). Responses are scored from 0-3 (ONS, 2013) with total score values ranging from 0 to 36. Higher scores are indicative of poorer mental health. Due to the variables’ skewed distribution among each ethnic group in this analysis, the GHQ is dichotomised, with a cut-off point of above 11 indicating risk of minor psychiatric morbidity (Goldberg, Oldehinkel & Ormel, 1998).

Ethnicity

The UKHLS employs the standard ONS classification of ethnicity, as utilised in the 2011 Census, the Labour Force Survey and the Annual Population Survey (Berthoud et al, 2009): a self-reported question with 18 response categories. Ethnicity is operationalised via a series of dummy variables indicating membership of the five targeted non-white ethnic minority groups (Indian, Pakistani, Bangladeshi, Caribbean and African) and the reference category of White British. A value of one represents membership of the ethnic group and a zero otherwise. The category White British is employed as the reference category in all analyses.

Individual level characteristics

Individual level characteristics associated with selection into neighbourhoods and mental health are included in this study: age, sex, marital status, number of children in the household, equivalised household income, employment status, highest educational qualification, generational status (defined as born in the UK or otherwise), a binary indicator of whether a respondent resides in an ‘urban’ area, defined as an area with a population of more than 10,000 and a variable indicating whether a respondent has a preference to move home.

Ethnic density

Ethnic density is calculated using Census 2011 data at the Lower Super Output Area (LSOA) level and is operationalised in accordance with other ethnic density studies, as the number of residents in each ethnic group divided by the total population of a given LSOA (Halpern & Nazroo, 2000; Neeleman et al, 2003; Stafford et al, 2009). Since this study is interested in the effect of ethnic density, it is important to consider the complete ethnic composition of the neighbourhood and thus the decision was taken not to exclude residents of mixed ethnicity from the denominators. Ethnic density is retained as a continuous measure and is centred for the purpose of meaningful interpretation, thus all models are interpreted in relation to a neighbourhood of 'average ethnic density' rather than when density is at zero.

Neighbourhood deprivation

Since all ethnic minority groups in England are more likely than the majority White British population to reside in deprived neighbourhoods, a known stressor for mental health, it is important that a measure of neighbourhood deprivation is included in this analysis to ensure unbiased estimates. This study utilises the Index of Multiple Deprivation 2010 (IMD 2010), a composite measure of neighbourhood deprivation at the LSOA level in England. Since deprivation refers to more than the absence of financial resources, the IMD encompasses seven domains to provide an overall relative deprivation score: income, employment, health, education, crime, barriers to housing and services, and the living environment, with income and employment being the most heavily weighted. The majority of the IMD 2010 indicators are derived from 2008 population estimates. IMD data is a continuous measure where each LSOA is ranked according to its IMD score, with 1 being the most deprived (Department for Communities and Local Government, 2011). This variable is transformed into quintiles. While the IMD is not comparable over time given its ranked nature, it is suitable for this analysis, which utilises a cross-section of data only.

Social capital

At wave three, respondents were asked a battery of questions relating to their sense of attachment to and perception of the local neighbourhood, adapted from Buckner's *Neighbourhood Cohesion Instrument* (Buckner, 1988). Respondents were asked to rate, on a 5 point Likert scale, 8 specific statements as listed in figure two below (UKHLS Documentation, 2013):

Figure 2.2: Neighbourhood Cohesion Instrument

I feel like I belong to this neighbourhood

The friendships and associations I have with other people in my neighbourhood mean a lot to me

If I needed advice about something I could go to someone in my neighbourhood

I borrow things and exchange favours with my neighbours

I am willing to work together with others on something to improve my neighbourhood

I plan to remain a resident of this neighbourhood for a number of years

I think of myself as similar to the people that live in this neighbourhood

I regularly stop and talk with people in my neighbourhood

In accordance with previous studies in this area, each item is reverse coded, so that a higher score indicates greater agreement with the statement, and then all items are summed, creating an indicator of social capital. A higher score on this indicator therefore represents greater social capital.

2.5.4 Analytical method

Multilevel modelling

Unweighted multilevel models are estimated using STATA 14 and the *xtmelogit* command (StataCorp, 2014) with LSOA specified as the grouping variable.

Multilevel modelling allows for the analysis of clustered data where observations are nested within groups, thereby accounting for the non-independence of observations (Rabe-Hesketh & Skrondal, 2012). Multilevel modelling allows variation to be analysed at all specified levels, specifically the variation both between individuals and between neighbourhoods (higher level of data structure). In this analysis, level one relates to individual level predictors, including ethnicity and a range of sociodemographic characteristics. Level two predictors relate to the neighbourhood (operationalised at the LSOA level), specifically ethnic density (concentration of co-ethnics) and neighbourhood deprivation. Multilevel modelling additionally allows us to relax the assumption of homoscedasticity and instead assume that the variances depend on explanatory variables (heteroscedasticity).

Likelihood ratio tests will be conducted to compare the goodness of fit between ethnic specific random intercept (null) and random coefficients (alternative) models, thereby identifying the most parsimonious model. Specifically, while a random intercept model assumes that the effect of the explanatory variable is consistent across neighbourhoods, a random coefficients model relaxes this assumption thereby allowing the slopes to differ for each group. The null model, that is the random intercept only model, is rejected where

$p<0.05$, thereby indicating that the slope for each ethnic group modelled differs across neighbourhoods.

Cross-level interactions

Cross-level interactions allow us to formally test the ethnic density hypothesis of whether the effect of ethnicity (level 1) upon mental health varies as a function of the ethnic composition of the neighbourhood (level 2), thereby formally accounting for the expected heterogeneity in associations (Shaw et al, 2012; Becares & Nazroo, 2013). Additionally, it is only with ethnic specific interactions that we can account for potentially different intercepts across ethnic groups. Specifically, simply stratifying our models by ethnicity does not allow for comparability across ethnic groups, and therefore the decision was taken to model cross-level interactions between ethnicity (level 1) and ethnic density (level 2).

2.5.5 Model specifications

In accordance with Baron and Kenny (Baron & Kenny, 1986), mediation is tested for with the following steps and each successive step is tested only if estimates from previous steps are significant:

(1) Regressing the mediator (social capital) on the independent variables of interest (ethnicity*ethnic density)
(2) Regressing the dependent variable (mental health) on the independent variables of interest (ethnicity*ethnic density)
(3) Regressing the dependent variable (mental health) on both the independent variables of interest (ethnicity*ethnic density) and the mediator (social capital)

Attenuation in the association between ethnic density and mental health upon adjustment for social capital will therefore demonstrate a mediating effect, as hypothesised above.

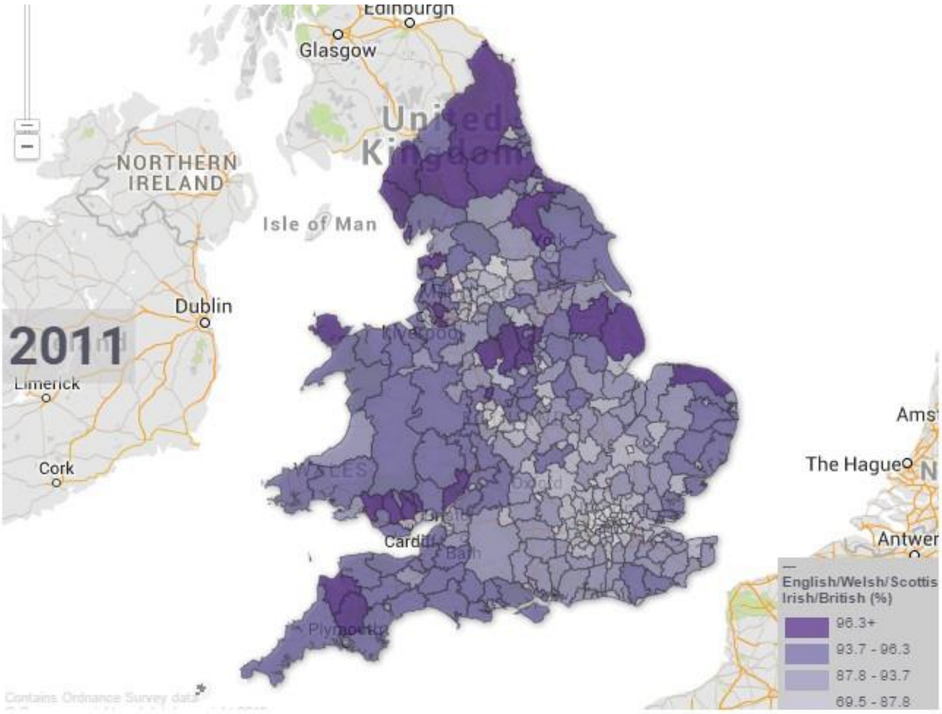
Upon testing the association between social capital and ethnic density, variables of interest are introduced in a stepwise manner with a total of five models estimated: (1) a null, random intercept only, model to identify the contribution of between neighbourhood variation in mental health outcomes, (2) adjustment for individual level sociodemographic characteristics, (3) adjustment for neighbourhood level deprivation to account for potential selective sorting into neighbourhoods and neighbourhood level confounders and (4) adjustment for individual level social capital, our mediator of interest.

The binary nature of the outcome variable necessitates a logistic multilevel model and thus it must be noted that the estimated odds ratios in such models are more extreme, that is more different from 1, than those attained in a single level logistic regression model. This is explained by the fact that a single level logistic regression model fits overall population averaged or marginal probabilities while multilevel models fit subject-specific probabilities at the neighbourhood level, i.e. at level 2 (Rabe-Hesketh & Skrondal, 2012). Additionally, no level one random parameter is given since a random intercept logistic regression model assumes the distribution of the error in the latent response variable. The variance at level one is, therefore, fixed at 3.29, unlike in MLM models with a continuous outcome. Since the intraclass correlation (ICC) is a function of the values of the right hand side variables in a logistic MLM, comparing ICC's across models is not informative.

Due to the data structure, specifically the small cluster sizes present in the dataset, the Laplace approximation of numerical integration is inappropriate since it can produce biased estimates in such circumstances. Thus, the default of 8 integration points is employed in all models (Rabe-Hesketh & Skrondal, 2012).

2.6 Results

Figure 2.3: The spatial distribution of the white British majority population in England and Wales at the Lower Super Output Area level, Census 2011



Source: ONS UK Census 2011. Ethnic concentration for the majority white British population are presented at the Lower Super Output Area (LSOA) level. There were 34,753 Lower Super Output Areas at the 2011 Census in England and Wales. LSOA's are designed to be consistently sized with the average population in a given LSOA of 1500 (range 1000 – 3000). Darker areas indicate a higher concentration of white British, therefore highlighting the unequal distribution of ethnic minority groups in England and Wales in 2011 (BME groups are more concentrated in the lighter shaded areas).

Table 2.1: Average co-ethnic density of ethnic minority groups in England and Wales at the Lower Super Output Area level, Census 2011

	Mean (S.D)	Range
White British	81.43 (21.88)	0.63 - 99.72
Indian	2.39 (5.83)	0.00 - 85.54
Pakistani	1.84 (6.16)	0.00 - 84.97
Bangladeshi	0.74 (3.20)	0.00 - 90.35
Caribbean	1.01 (2.29)	0.00 - 27.80
African	1.66 (3.62)	0.00 - 48.38

Source: ONS UK Census 2011. Statistics are presented at the Lower Super Output Area (LSOA) level. There were 34,753 Lower Super Output Areas at the 2011 Census in England and Wales. LSOA's are designed to be consistently sized with the average population in a given LSOA of 1500 (range 1000 – 3000). All ethnic groups are retained in the denominators. Table 2.1 refers to population characteristics and not this sample.

2.6.1 The spatial distribution and average density levels of ethnic minority groups

Table one presents the mean level of ethnic density at the neighbourhood level. As expected, neighbourhoods are dominated by the White British majority population with an average neighbourhood level co-ethnic concentration of approximately 81 percent. Among the ethnic minority groups studied here, the Indian group have the highest mean score, indicating, on average, the greatest concentration of co-ethnics within a neighbourhood across BME groups. In contrast, the Bangladeshi population are the least ethnically concentrated group at 0.74 percent, on average. Of the ethnic groups specified, the Caribbean group has the smallest upper bound of ethnic density at less than 28 percent, followed by the African group at 48 percent.

Figure two presents a map highlighting the spatial distribution of ethnic minority groups in England and Wales. Darker shaded areas correspond to those areas where the majority white British population is most concentrated (>96.3%) while lighter areas, therefore, correspond to those areas where all other ethnic groups are most heavily concentrated. As expected ethnic minority groups are heavily concentrated in London (as indicated by the lighter shading) while pockets of high ethnic concentration in the Midlands can be explained by the high concentration of South Asian groups in this area. Overall, this map highlights the unequal distribution of ethnic minority groups in England and Wales, with certain areas having a higher concentration of BME groups than others.

Table 2.2: Demographic and socioeconomic sample statistics, stratified by ethnicity

	White British	Indian	Pakistani	Bangladeshi	Caribbean	African
UK born	1.00	0.38	0.49	0.47	0.54	0.15
Mean age	49.2	39.5	34.3	34.3	45.3	37.3
Marital status						
Single	0.29	0.26	0.32	0.35	0.53	0.46
Married or cohabitating	0.53	0.69	0.61	0.60	0.27	0.41
Divorced or separated	0.11	0.03	0.05	0.04	0.17	0.09
Widowed	0.07	0.02	0.02	0.01	0.03	0.04
No of children in household	0.44	0.73	1.06	0.96	0.51	0.94
Proportion with a degree	0.34	0.54	0.41	0.35	0.37	0.52
Proportion unemployed	0.05	0.06	0.10	0.10	0.15	0.11
Equivalised household income (log transformed)	7.31	7.28	6.99	7.14	7.17	7.11
Tenure						
Owner occupier	0.73	0.75	0.71	0.41	0.44	0.25
Private renter	0.11	0.18	0.16	0.20	0.16	0.27
Social renter	0.16	0.07	0.12	0.39	0.40	0.48
Lives in urban area	0.77	0.98	0.99	0.98	1.00	0.99
Proportion of households living in most deprived IMD quintile	0.15	0.24	0.58	0.58	0.42	0.47
Proportion who would prefer to move	0.36	0.33	0.35	0.38	0.52	0.55
Mean score on social capital (32 point scale)	20.3	20.2	20.6	21.1	18.6	18.6
Proportion at risk of minor psychiatric morbidity (GHQ)	0.35	0.36	0.48	0.47	0.41	0.33
Number of observations	17850	812	623	358	539	542

Source: Understanding Society, Wave 3, linked with 2011 Census geographical data at the Lower Super Output Area level. All descriptive statistics are weighted and adjusted for the complex survey design. Statistics are presented as proportions unless otherwise specified.

2.6.2 Descriptive statistics

Table two presents key sample sociodemographic characteristics for each ethnic group. All ethnic minority groups have younger age profiles than the White British majority group with the African group reporting the highest proportion of non UK born, reflecting the later migration pattern of this group. All South Asian groups are more likely to be married or cohabitating than the White British majority while, among the Caribbean and African groups, the proportion is much lower at 0.27 and 0.41 respectively. All ethnic minority groups have higher unemployment rates and report a lower household income (log transformed) despite a greater proportion having a degree among each ethnic minority group compared to the White British majority population.

Home ownership is lowest among the Bangladeshi, Caribbean and African groups, at 41, 44 and 25 percent respectively. Home ownership among both the Indian and Pakistani groups is comparable to the White British group at around 70 percent. All ethnic minority groups are more likely to reside in urban areas compared to the White British majority group, in keeping with other data sources (JRF, 2007; Jivraj & Khan, 2013) and are more likely to reside in deprived neighbourhoods. The Bangladeshi and Pakistani groups are the most likely to reside in the most deprived quintile of neighbourhoods according to the 2010 Index of Multiple Deprivation (an overall deprivation score encompassing seven dimensions, including income, employment and health). Despite other groups being more highly concentrated in the most deprived neighbourhoods, more than half of the Caribbean and African respondents in the sample reported that they would prefer to move home, at 52 and 55 percent respectively and reported the lowest mean scores on the social capital scale (where a greater score indicates greater social capital).

Table 2.3: Association between ethnic density and social capital: path A of mediation model in figure 2.1

	Coefficient (S.E)	Ethnic specific differences between reference category
Indian	0.66 (0.24)**	0.02 (0.01)*
Pakistani	1.15 (0.26)***	0.04 (0.01)***
Bangladeshi	2.24 (0.34)***	0.03 (0.01)**
Caribbean	-0.12 (0.25)	-0.05 (0.04)
African	0.14 (0.29)	-0.02 (0.03)

* Reference categories of male, married, employed, highest educational qualification: degree, owner occupier, residing in a rural area and born outside of the UK. ***p=0.00, **p<0.05, *p<0.10
Source: Understanding Society, wave 3

2.6.3 Ethnicity and social capital

Table three presents the coefficients for path A of the mediation model: (1) the association between ethnicity and social capital and (2) the difference in the effect of ethnic density upon social capital for each ethnic group in relation to the reference category of white British. As hypothesised, there is a positive association between ethnicity and social capital among the Indian, Pakistani and Bangladeshi groups. Specifically, the Indian group have, on average, a higher social capital score than the white British by 0.66 points, while the effect size is even larger for the Pakistani and Bangladeshi groups at 1.15 and 2.24 respectively. While the association operates in the expected direction for the African group also, results are not statistically significant. In contrast, the association operates in the opposite direction to that hypothesised for the Caribbean group, with this group, on average, having a lower social capital score than the white British group.

Interactions between co-ethnic density and ethnicity were included in the model to account for the expected heterogeneity in the association between ethnic density and social capital according to ethnicity. The results presented indicate the difference in the effect of co-ethnic density for each ethnic group in relation to the reference category of white British.

Table 2.4: Multilevel models on GHQ: (1) adjusted for individual level characteristics, (2) adjusted for neighbourhood level characteristics and (3) adjusted for social capital: full mediation model

	Model One		Model Two		Model Three	
	O.R (SE)		O.R (SE)		O.R (SE)	
	Main effect	Interaction	Main effect	Interaction	Main effect	Interaction
Indian	0.76 (0.13) *	1.007 *	1.02 (0.10)	1.007*	1.05 (0.11)	1.009 **
Pakistani	1.15 (0.21)	1.002	1.33 (0.14) *	1.001	1.43 (0.15) **	1.003
Bangladeshi	1.04 (0.24)	1.000	1.15 (0.16)	0.999	1.31 (0.18) *	1.002
Caribbean	0.82 (0.16)	0.987	0.84 (0.09)	0.983	0.84 (0.09) *	0.981
African	0.56 (0.11) **	1.004	0.66 (0.08) **	1.002	0.66 (0.08) **	1.001

* Reference categories of male, married, employed, highest educational qualification: degree, owner occupier, residing in a rural area and born outside of the UK. ***p=0.00, **p<0.05, *p<0.10

Source: Understanding Society, wave 3

2.6.4 Co-ethnic density and mental health

Models one and two of table four present results for (1) the association between ethnicity and mental health and (2) the direct effect of ethnic density on mental health for each ethnic group, adjusting for individual level characteristics (model one) and then additionally area deprivation (model two). The main effect of ethnicity, controlling for individual level characteristics and co-ethnic density, is presented in the first column of model one. An odds ratio of above one for each ethnic group indicates a higher likelihood of poor mental health in comparison to the reference category of white British, at an average level of co-ethnic density (since this variable has been centred). Results are statistically significant for the Indian and African groups only, at 0.76 and 0.56 respectively, but operate in the opposite direction to that which was hypothesised; both of these groups have lower odds of poor mental health than the white British group. Both the Pakistani and Bangladeshi groups have a higher likelihood of poor mental health than the white British reference category, as hypothesised, at 1.15 and 1.04 respectively, although results do not reach a level of statistical significance. Finally, the Caribbean group have lower odds of poor mental health than the white British group, again contrary to the study hypothesis. Adjustment for area level deprivation (model two) is associated with an increased likelihood of poor mental health for all ethnic groups in comparison to the previous model, although odds remain below one for both the Caribbean and African groups, indicating a lower likelihood of poor mental health compared to the white British group, at 0.84 and 0.66 respectively. This is, however, statistically significant for the African group only. Interestingly, adjusting for area level deprivation reverses the lower odds of poor mental health for the Indian group seen in model one, from 0.76 to 1.02, although results are no longer statistically significant. It is only here, in model two, that the association between ethnicity and mental health becomes significant for the Pakistani group, with an increased likelihood of poor mental health of approximately 33 percent in comparison to the white British group.

Column two of models one and two present odds ratios for the interactions between ethnicity and co-ethnic density, thereby indicating the ethnic specific effect of residing in an area of average co-ethnic density, compared to the reference category of white British. Odds ratios of below one support the ethnic density hypothesis of increased co-ethnic density being protective for mental health among ethnic minority groups. Given the measurement level of each variable in the interaction term (binary*continuous), results are interpreted as the effect of a one percent (one unit) increase in ethnic density upon the likelihood of having poor mental health for each ethnic group. Results are statistically significant for the Indian group only, thereby indicating that the effect of increasing co-ethnic density does not differ between each of the other ethnic groups and the reference category of white British. Further, adjusting for area level deprivation (model two) marginally changes the odds ratios for all ethnic groups, excluding the Indian group. Among the Indian group, a one percent increase in co-ethnic density is associated with 0.7 percent increase in the likelihood of poor mental health and is statistically significant.

2.6.5 Co-ethnic density and mental health: the mediating role of social capital

Model three of table four presents results from the full mediation model. Upon adjustment for individual level social capital, the odds of poor mental health increase for all our South Asian groups. Specifically, odds ratios increase to 1.05, 1.43 and 1.31 for the Indian, Pakistani and Bangladeshi groups respectively, although results do not reach a level of statistical significance for the Indian group. In contrast, the likelihood of poor mental health does not change for either the Caribbean or African group, although it does become statistically significant for the former at the 10 percent level. As with the previous models of table four, the second column refers to the odds ratios for the interactions between ethnicity and co-ethnic density, thereby indicating the ethnic specific effect of residing in an area of average co-ethnic density, adjusting additionally for individual level social capital. Attenuation of results between the interaction terms of models two and three will support the hypothesis of social capital being one causal pathway by which ethnic density is protective of mental health. Again, there is little change between models two and three, thus indicating that social capital is not on the casual pathway between ethnic density and mental health. Specifically, odds ratios are statistically significant for the Indian group only, where a one percent increase in co-ethnic density is associated with 0.9 percent increase in the likelihood of poor mental health, contrary to the study hypothesis. The odds ratios increase also for both the Pakistani and Bangladeshi groups, by 0.2 and 0.3 percent, but do not reach a level of statistical significance. In contrast, results do attenuate marginally for the Caribbean and African groups by 0.2 and 0.1 percent respectively, thereby supporting the study hypothesis. Overall, there is little evidence of social capital mediating the association between ethnic density and mental health, while adjusting for social capital actually increases the odds of poor mental health for all the South Asian groups examined here.

Table 2.5: Predicted probabilities for the association between a 10% increase in ethnic density and mental health

	10% increase in co-ethnic density
White British	-0.008
Indian	0.069
Pakistani	0.006
Bangladeshi	-0.007
Caribbean	-0.17
African	0.019

* Reference categories of male, married, employed, highest educational qualification: degree, owner occupier, residing in a rural area and born outside of the UK. ***p=0.00, **p<0.05, *p<0.10
Source: Understanding Society, wave 3

2.6.6 Predicted probabilities of co-ethnic density and mental health

To further unpack the association between co-ethnic density and mental health, table five presents the predicted probabilities of psychiatric morbidity for each ethnic group residing in a neighbourhood with a 10 percent increase above the ethnic specific average in co-ethnic density. While results do not reach a level of statistical significance for any ethnic group, they do operate in the expected direction for several groups. Specifically, a 10 percent increase in co-ethnic density is associated with a reduced probability of psychiatric morbidity of 0.7 and 17 percent among the Bangladeshi and Caribbean groups respectively. In contrast, results indicate the reverse for the Indian, Pakistani and African groups, indicating that a 10 percent increase in co-ethnic concentration is associated with an increased probability of psychiatric morbidity by 6.9, 0.6 and 1.9 percent respectively.

2.7 Discussion

This study sought to determine whether the protective effect of residing in an area with a higher co-ethnic concentration operates at a more localised geography than previously tested and whether an alternative formulation of social capital mediated this association. Several key results emerged from this analysis. Interestingly, both the Caribbean and African groups report the lowest mean scores on the social capital indicator. This may be attributed to the fact that these groups are among the least co-ethnically concentrated of those considered in this study. Since ethnicity is often considered a shared characteristic through which bonding social capital is established (Portes & Zhou, 1993; Bankston & Zhou, 2002) residing in neighbourhoods with a lower concentration of co-ethnics in comparison to other ethnic groups may partially explain why these groups report lower neighbourhood attachment. Again, both the Caribbean and African groups are more likely to report a preference for moving home than all other ethnic groups. This may, however, not only reflect a lower psychosocial attachment to the neighbourhood, as demonstrated above, but may also reflect the physical dimensions of their home. These groups are more highly concentrated in deprived neighbourhoods, where housing is often poorer quality, than both the Indian and white British majority groups and thus may explain the greater preference to move. While this hypothesised association does not explain why a lower proportion of Bangladeshi and Pakistani individuals report a preference to move despite being more likely to live in a deprived neighbourhood than all other ethnic groups, it may be that the nature of the association is ethnic specific or that the higher average co-ethnic concentration of these groups means they have greater access to shared resources which may mitigate any negative effects associated with poor quality housing.

The lower home ownership rates among the Bangladeshi, Caribbean and African groups may be partially attributed to their geographic concentration in London, where house prices are significantly higher than average. While all ethnic minority groups are well represented in London, South Asian groups are additionally geographically concentrated in the Midlands, where house prices are significantly lower, thereby increasing the opportunity for home ownership (ONS, 2015).

2.7.1 Ethnicity and social capital: path A of mediation model

In accordance with the framework set out by Baron & Kenny (Baron & Kenny, 1986), this study began by empirically testing path A of the mediation model: the association between ethnic density and social capital for each ethnic group. Results operated in the hypothesised direction for some ethnic groups and thus this study proceeded to empirically model whether social capital is one causal pathway by which ethnic density is protective for mental health. Results did not, however, support the study hypothesis for the Caribbean group. Specifically, upon controlling for co-ethnic density and a range of individual level characteristics, being Caribbean was associated with a lower social capital score than the white British group, by 0.12 points. Additionally, the interaction term between ethnicity and ethnic density was negative for this group, suggesting that a higher concentration of co-ethnic density is associated with lower social capital scores. This finding is surprising given that a recent study found a consistent positive effect of co-ethnic concentration on social cohesion for this group, although results did not reach a level of statistical significance (Becares et al, 2011). While social capital and social cohesion are often operationalised to capture distinct processes, there is frequently an overlap in the measures utilised, as with the measures employed here in this study and the aforementioned. Specifically, the social cohesion scale utilised in the above study was a summary scale constructed from four items including *'people in this neighbourhood pull together to improve the neighbourhood'* which is close to the items used here in this study (refer to methodology for detailed discussion of items used and question wording). It is, therefore, surprising that we find lower social capital scores among this group in this study. As highlighted in the descriptive statistics however, this group are among the most likely to express a desire to move home, which may indicate a lower sense of attachment to the neighbourhood and thus partially explain the lower social capital scores.

Additionally, a recent narrative review has suggested that the inconsistent ethnic density findings documented in the UK for black ethnic groups may be partially explained by the lower levels of co-ethnic concentration in comparison to the African American group in the US, where the evidence base is more robust. The data utilised here supports this, where the average level of co-ethnic concentration at the LSOA level is lower for the Caribbean group in comparison to most other ethnic minority groups, at 1.01 percent. This may also partially explain why the Caribbean group have a lower social capital score than the white British group. Specifically, since shared ethnic membership is often considered an important contributory factor to, if not a form of, social capital (Portes & Zhou, 1993; Bankston & Zhou, 2002), residing in areas with a lower co-ethnic concentration may constrain individual level social capital, thereby explaining the unexpected finding here.

2.7.2 Co-ethnic density and mental health

In accordance with the wider literature, this study found that the association between (1) ethnicity and mental health and (2) ethnic density and mental health is complex, operating differentially across ethnic groups (Pickett & Wilkinson, 2008; Becares & Nazroo, 2013). While results did not reach a level of statistical significance for many groups, this may be explained by a lack of statistical power rather than an absence of a true effect, as suggested by other studies in this area (Becares & Nazroo, 2013).

Despite previous studies indicating a markedly increased likelihood of poor mental health among the Caribbean group, this study found the reverse, thereby reinforcing the suggestion that the elevated rates identified in studies relying on treatment data may reflect discrimination within the health services. Interestingly, upon adjustment for area level deprivation, for the Indian group, the odds of poor mental health were reversed from a lower likelihood of poor mental to a higher likelihood in comparison to the white British group, thereby indicating a suppressant effect. Of the ethnic minority groups included in this study, the Indian group are the least likely to reside in a deprived neighbourhood. Despite this, this finding is surprising and has not been found in other studies in this area.

Focusing on the association between ethnic density and mental health we see that interactions between ethnicity and co-ethnic density did not operate in the expected direction for all ethnic groups, although results were statistically significant for the Indian group only, indicating that, contrary to the hypothesised association, residing in an area with a high concentration of co-ethnics is actually worse for the mental health of this group. It may be that any protective effect of ethnic density does not operate at the more refined geographical level captured here or that ethnic density is more important for some ethnic minority groups than others. As posited in a recent study, the different processes associated with the formation of ethnic identities and racialisation of ethnic enclaves determine, in part, the resources and opportunities available to specific ethnic minority groups, which may be differentially associated with ethnic density (Halpern & Nazroo, 2000; Becares et al, 2009; Becares & Nazroo, 2013). Specifically, where ethnic groups have a range of cultural and social resources available to them, ethnic density and the benefits it may ascribe may be of less relevance compared to those groups who cannot access such resources and opportunities and are consequently more reliant upon any benefit of residing in an area of a higher concentration of co-ethnics. The Indian group, in comparison to the other ethnic minority groups examined here, are less likely to be unemployed, more likely to have a degree and have a higher household income, which may suggest a greater resource and opportunity structure compared to other groups. Consequently, this group may be less reliant upon the resources and benefits accrued by residing in an area with a higher concentration of co-ethnics.

Finally, it may be that area level deprivation, a known stressor for mental health, is masking any protective effect of ethnic density. Since ethnic minority groups are, on average, more likely to reside in deprived neighbourhoods than the white British majority population it may be that any 'true' protective effect of ethnic density is masked by the negative effect of area level deprivation.

2.7.3 Co-ethnic density and mental health: predicted probabilities

To better understand whether residing in an area of increased co-ethnic concentration is protective for the mental health of ethnic minority groups, the predicted probabilities of poor mental health were calculated when residing in a neighbourhood with a 10 percent increase in co-ethnic concentration. A reduced probability indicates a protective effect of ethnic density, thereby supporting the ethnic density hypothesis. While results did not reach a level of statistical significance for any ethnic minority group, they did operate in the reverse direction to that which was hypothesised for some ethnic groups. The increased probability of poor mental health among the Pakistani group may be explained by their concentration in the most deprived neighbourhoods. Thus, it may be that that any protective effect of ethnic density is not enough to offset the negative effects associated with living in areas of high deprivation, a known stressor for mental health. Despite operating in the opposite direction to that hypothesised, there is a precedent for a reverse ethnic density effect in previous studies among this ethnic group, although no explanation was offered as to why this may be the case (Halpern & Nazroo, 2000).

Interestingly, the results presented here differ from those found in a recent study utilising geocoded data from the 2004 Health Survey for England (HSE) for all ethnic groups (Becares

& Nazroo, 2013). Specifically, while this study finds that residing in an area with a higher concentration of co-ethnics is associated with an increased probability of poor mental health for the Indian, Pakistani and African groups, results from the study utilising the 2004 HSE find that a 10 percent increase in co-ethnic density is associated with lower odds ratios for these ethnic groups, in comparison to the white British reference category. Since this is the first study to test the ethnic density hypothesis at a more refined spatial level, it is unclear whether the difference in findings between the two studies is explained by the protective effect of ethnic density operating at a more localised level or reflects the fact that the ethnic density hypothesis is specific to certain socio-political contexts.

2.7.4 Co-ethnic density and mental health: the mediating role of social capital

The mediating role of social capital has been empirically tested in only one other study (Becares & Nazroo, 2013). While the study found no evidence of social capital being one causal pathway by which ethnic density is protective of mental health, the study authors did suggest that this may be a consequence of the measure of social capital utilised, rather than the absence of a 'true' effect. This study, which utilised an alternative measure of social capital, sought to contribute to the literature by empirically testing the mediating properties of an alternative formulation of social capital. Again, there was no evidence of social capital mediating this association, thereby suggesting social capital is not a causal pathway by which ethnic density is protective of mental health. It may, however, be that social capital does not operate at such a localised geography, as captured here, or that other dimensions of social capital, those not related to the psychosocial processes measured here, explain the protective effect of ethnic density upon mental health.

Interestingly, results operate in the inverse direction to that hypothesised for all South Asian groups. Both Pakistani and Bangladeshi groups are the most concentrated ethnic groups in the most disadvantaged neighbourhoods and thus it may be that the role of social capital is dependent upon other macro factors such as area level deprivation. In this study, area level deprivation was simply controlled for, and thus any potential interactive effect between area deprivation and social capital were not captured.

2.8 Strengths and limitations

This study contributes to the literature in a number of clear ways. To our knowledge, this is the first study to empirically test the ethnic density hypothesis with contemporaneous data from a nationally representative survey, linked to the 2011 Census. Understanding Society represents the first longitudinal survey to annually interview large numbers of individuals from some of the UK's largest ethnic minority groups (UKHLS website), thereby providing the opportunity to revisit the ethnic density hypothesis for the five largest ethnic minority groups in the UK today. Previous studies suggest distinguishing between compositional and contextual neighbourhood effects necessitates a data source with a mix of individuals in deprived and affluent neighbourhoods (Pickett & Pearl, 2001; Pickett & Wilkinson, 2008) as captured here with Understanding Society.

This study also represents the first study to examine the ethnic density hypothesis at a more refined spatial level using nationally representative data. While previous studies have operationalised ethnic density at the LSOA level, as this study has, analyses were limited to one area of England and tested only for the black Caribbean and white majority groups, and are therefore not generalizable in the way that this study is (Schofield et al, 2011).

The cross-sectional nature of this analysis, however, means it is not possible to disentangle the social causation and health selection hypotheses. Specifically, the findings presented in this study cannot inform the debate on whether neighbourhood context leads to poor mental health or whether those with poor mental health are sorted into deprived neighbourhoods.

Relatedly, while social capital was not found to mediate the association between ethnic density and mental health, it may be that those with poor mental health are more likely to isolate themselves (reverse causation) and thus report lower social capital, given our conceptual focus on sense of belonging and attachment. Exploiting the longitudinal nature of the dataset will permit a closer examination of, and inform, the health selection vs social causation hypotheses.

Although this study utilised Understanding Society's ethnic minority boost, sample sizes within some ethnic minority groups were significantly reduced as a consequence of item non-response and thus models may have lacked statistical power, which is particularly important since power is driven by heterogeneity within areas (Pickett & Wilkinson, 2008). This may be of particular importance when empirically testing the ethnic density hypothesis, where associations may be subtle (Shaw et al, 2012).

The UKHLS utilises the GHQ12 as a measure of psychiatric morbidity. While the GHQ12 has established reliability and validity claims (Goldberg & Williams, 1988), it is based upon western psychiatric practice and may therefore be less effective at identifying poor mental health among some ethnic minority groups where there are important cultural differences (Kleinman, 1987; Sproston and Nazroo, 2002). Differences among some ethnic groups may not have been identified, therefore, due to potential differences in interpretation of the GHQ questionnaire rather than an absence of differences per se. Finally, the wording of response categories may influence answers; since respondents are asked to compare their mental health to how they have felt recently, i.e. 'better than usual/ less than usual', those with longstanding pre-existing conditions may have been feeling equally anxious or depressed recently and thus report 'same as usual'. Consequently, responses may not accurately reflect actual poor mental health.

2.9 Conclusion

The spatial distribution of ethnic minority groups in the UK has changed since 2001, with ethnic minority groups being less likely to live in ethnic residential segregation by 2011. The findings presented here may, therefore, reflect the consequence of this changing spatial distribution upon the association between ethnic density and mental health. In contrast, it may be that the positive effects associated with living in an area with a higher co-ethnic concentration does not operate at the more localised geographical level analysed here. Future analysis should therefore test whether the ethnic density hypothesis is 'psychologically salient' (Cochrane & Bal, 1988) at a larger geographical level, specifically at the MSOA level as modelled in previous studies, to disentangle potential explanatory factors for the statistically insignificant results reported here in this study. By re-specifying this analysis at a larger spatial level, future studies will be able to understand whether it is that ethnic density is no longer protective for mental health and is specific to certain socio-political contexts only or whether it simply does not operate at such a localised level, as tested in this study.

While previous research has found no evidence to suggest that social capital mediates the association between ethnic density and mental health (Whitley & Prince, 2005; Becares & Nazroo, 2013), this study asserted that this may be a consequence of the social capital measure utilised. An alternative measure of social capital was utilised in this study, one explicitly focused on the psychosocial processes of social capital, which was hypothesised to be more strongly associated with ethnic density and mental health than measures empirically tested elsewhere. While this study found no evidence of a mediating effect, in accordance with previous studies, which would suggest social capital is not a causal pathway between ethnic density and mental health, this remains an important finding in itself, particularly in light of the increasing prominence of 'localism' in political and health discourse.

The analytical strategy taken in this study was complete case analysis, meaning that individuals with missing data on any of the variables included in this study were excluded. It is plausible, therefore, that the characteristics of the final sample utilised in each study, differ from the larger population, and given the non-random nature of item non-response, may be correlated with the key variables of this study. Statistical tests find that those excluded from the final analytical sample are, on average, more likely to be male, not have a degree and not be single. While those retained in the final analytical sample were more likely to be white British, importantly for this study, co-ethnic density did not, on average, differ between those included in the final sample and those excluded. Thus, the findings reported in this study are robust to differences in co-ethnic density.

Of course, respondents with missing information on the variables included in this study may not be a random subset of population-based survey participants and may differ on other relevant characteristics not controlled for here. Nevertheless, the findings presented in this study support findings elsewhere in the empirical literature.

In sum, this study supports the conclusions of a recent narrative review, which asserts that the ethnic density hypothesis is complex, with ethnic specific pathways between ethnic density and mental health (Shaw et al, 2012), and echoes the recommendations of previous studies in the area, which call for further empirical analysis of hypothesised pathways between ethnic density and mental health (Becares et al, 2011; Becares & Nazroo, 2013) and theoretical developments of what it means to measure a neighbourhood (Daniel et al., 2008).

Chapter 3

Neighbourhood socioeconomic context and health: the interaction between person and place

3.1 Introduction

Low neighbourhood socioeconomic status (SES) is associated with poorer individual level health across a range of outcomes, including obesity (Dragano et al., 2007; Grafova et al., 2008; Stimpson et al., 2007), hypertension (Dragano et al., 2007; Matthews and Yang, 2010), and a number of other chronic conditions (Mustard et al., 1999; Clark et al., 2013). This association persists once individual level characteristics are adjusted for (Stafford & Marmot, 2003) and is robust across various indicators of socioeconomic status (Subramanian et al., 2006). Neighbourhood socioeconomic context is, therefore, increasingly considered an important risk factor for poor health (Ferraro & Farmer, 1996; Carpiano, 2008; Do, 2009).

Few studies have, however, examined how neighbourhood socioeconomic context is translated into biological risk (Bird et al., 2010; Theall et al., 2012). Empirical evidence suggests three pathways: via poor health behaviours (Gruenewald et al., 2012), the built environment (Diez-Roux & Mair, 2010) and psychosocial stress (Robinette et al., 2016). Stress pathways, however, remain underrepresented in empirical research linking place and health outcomes (Daniel et al., 2008). Yet fewer studies have considered the interaction between person and place, that is, does the neighbourhood affect all equally? It is here that this study contributes. Using Understanding Society, a nationally representative social survey, this study empirically examines the association between neighbourhood socioeconomic context and allostatic load and the moderating role of individual level education.

3.2 Background

3.2.1 Allostatic load

Allostatic load measures the cumulative biological 'wear and tear' on the body, representing a long term physiological response to chronic stressors (McEwen &Stellar, 1993; McEwen & Seeman, 1999), leading collectively to poor health (Clark et al., 2007). Allostatic load therefore presupposes a biopsychosocial model in the stress-health relationship (Engel, 1977). A model of the stress-health relationship was first theorised by Selye in 1956. According to Seyle's operationalisation, stress was a triadic biological model: alarm, resistance and exhaustion (Selye, 1956). Individuals are exposed to stressors, i.e. an exposure that is perceived as challenging or threatening (*alarm*). Stressors represent the stimulus that elicits a need for *adaptation* in the body, which is the change that takes place in the body as a consequence of exposure to a stressor. *Exhaustion* refers to the final stage, whereby, as a consequence of exposure to repeated or chronic stressors, there is an increased risk or morbidity and mortality (Selye, 1956).

Building on preceding stress-health models, allostatic load theories were first explicated by Sterling and Eyer (1988) and McEwen (1998, 2000). Like earlier stress-health models, allostatic load theories hypothesise that the body's response to stressors leads to adverse changes across a range of physiological systems (McEwen & Steller, 1993). Specifically, each time an individual is exposed to a stressor the body's primary stress mediators respond to support adaptation (Sterling & Eyer, 1988). While this is a necessary function, repeated activation of this kind may negatively impact these regulatory systems, leading to tertiary disease outcomes (McEwen & Steller, 1993; Clark et al., 2007). Allostatic load, therefore, represents the quantification of the cost of adaptation across a number of physiological systems in the body to prolonged stress (Szanton et al., 2005; Clark et al., 2007; Read & Grundy, 2012).

Allostatic load typically incorporates information across inflammatory, metabolic and cardiovascular systems, although specific biomarkers utilised varies across studies. Allostatic load scores are most frequently calculated as the sum total number of individual biomarkers for which an individual is identified as at risk, so that a higher score is indicative of poorer health. Despite the variation in specific biomarkers utilised, a growing empirical literature links allostatic load both to a number of antecedents and subsequent disease outcomes. Allostatic load is, thus, a composite index of biologic risk, and represents a key pathway by which stress is associated with longer term disease outcomes (McEwen & Seeman, 1999). Studies interested in allostatic load therefore represent an important contribution to the health disparities literature (Szanton et al., 2005).

3.2.2 Neighbourhood socioeconomic context and allostatic load

Increasingly, neighbourhood socioeconomic context is considered an important risk factor for poor health (Ferraro & Farmer, 1996; Carpiano, 2008; Do, 2009), independent of individual level characteristics (Stafford & Marmot, 2003). Despite a growing academic interest in the role of place in health, few empirical studies have examined how neighbourhood socioeconomic context is translated into biological risk (Bird et al., 2010; Theall et al., 2012). The small number of studies that have empirically examined the association between neighbourhood socioeconomic context and allostatic load suggest low socioeconomic status is associated with higher allostatic load, independent of individual level characteristics (Bird et al., 2010; Theall et al., 2012).

The empirical literature linking place and health has been critiqued for not clearly theorising a causal pathway between health and place (O'Campo, 2003). Studies interested in the association between neighbourhood context and allostatic load may, therefore, contribute to this theoretical and empirical gap in the research by evidencing how neighbourhood context 'gets under the skin', translating into biological risk for subsequent disease outcomes (Hobcraft, 2009).

3.2.3 The interaction between person and place

Neighbourhood socioeconomic context may not equally represent a chronic stressor for all residents. Instead, neighbourhood and individual level characteristics may interactively shape biological risk (Stafford & Marmot, 2003). Whether neighbourhood context differentially affects the health of advantaged and disadvantaged individuals is a key question and results may have important implications for area based interventions. Neighbourhood socioeconomic context may interact with individual circumstance in two distinct ways: via a collective resources model or via psychosocial stress pathways of relative deprivation.

Collective resources model

The collective resources model assumes that neighbourhoods characterised by concentrated advantage are correlated with greater public, material and social resources which all residents in the neighbourhood are able to draw on. Thus, disadvantaged individuals residing in an advantaged neighbourhood would benefit from living among more affluent neighbours (Stafford & Marmot, 2003).

Relative deprivation thesis

According to the relative deprivation thesis, individuals who are disadvantaged, relative to others in a neighbourhood, will enter into stress inducing social comparisons which can have adverse consequences for individual health (Wilkinson, 2002; Stafford & Marmot, 2003). This thesis therefore assumes that reference groups for status comparisons are spatially arranged (Wilkinson, 2002). Thus, it is not simply the experience of poverty, but poverty as related to others that it detrimental for health.

3.3 Methodological and theoretical considerations

Studies interested in the association between neighbourhood context and individual outcomes face two key theoretical and methodological challenges: (a) operationalising 'neighbourhoods' and (b) utilising an appropriate identification strategy. Further, empirical studies interested in allostatic load face a number of additional methodological considerations, specifically around (c) deciding which measures to utilise as part of an allostatic load index, (d) the identification of 'at risk' individuals, and (e) adjusting for medication use.

3.3.1 Operationalising neighbourhoods

Geographical unit of analysis

The association between neighbourhood context and health has been both hypothesised and empirically modelled at a number of spatial levels from the Lower Super Output Area (LSOA), where there is an average population of 1,500 individuals, through to the level of Regional Health Authority, where the median population is 221,000 (ONS, 2013). In practice, the geographical level of analysis is often constrained by data linkage issues and a reliance upon arbitrary neighbourhood boundaries, often constructed for the purpose of government statistics. As such, the arbitrary neighbourhood boundaries imposed by government statistics may not be perfectly correlated with an individual's perception of their neighbourhood (Basta et al., 2010). While it is important to recognise this as a caveat, research in this area should not be abandoned given that statistically significant associations between neighbourhood socioeconomic context and allostatic load have been identified across a growing number of studies (Finch et al., 2010; Bird et al., 2010).

Neighbourhood socioeconomic context

Neighbourhood socioeconomic context is frequently operationalised as concentrated deprivation in the empirical literature (Schulz et al., 2012; Robinette et al., 2016). The absence of deprivation does not, however, necessarily mean the concentration of advantage; the two are not always perfectly collinear. Neighbourhood socioeconomic context can instead be understood as a continuum, ranging from concentrated disadvantage through to concentrated advantage (Massey, 2001; Finch et al., 2010). While neighbourhood disadvantage can be deleterious for health, concentrated neighbourhood advantage has been shown to be protective for health, for example via the collective resources thesis (Morenoff et al., 2001). As such, it is important to consider the entire neighbourhood socioeconomic context when examining the association between place and individual level health outcomes.

Operationalising both concentrated advantage and disadvantage does, however, require methodological consideration. Where studies enter distinct variables measuring concentrated advantage and disadvantage into a single empirical model, they may encounter issues of multicollinearity which presents a problem for estimation (Massey, 2001). A small number of studies have sought to circumvent this by operationalising a single measure that captures both, thereby allowing the competing influences of concentrated advantage and disadvantage to be estimated. An Index of Concentration at the Extremes operationalises neighbourhood socioeconomic context as a continuum, with advantage and disadvantage representing each extreme (Massey, 2001) and represents an important contribution to the empirical literature of health and place.

3.3.2 Allostatic load

Despite a growing academic interest in allostatic load and an agreed understanding of the measure as a multi systems view of the body's response to stress exposures, a set of specific biomarkers to be included as part of an allostatic load index is not universally agreed (McEwen & Seeman, 1999). While it is important to incorporate individual biomarkers across inflammatory, metabolic and cardiovascular systems, studies are often constrained by the specific biomarkers available in what are often large, multipurpose studies. It is, therefore, not surprising that we find variation across studies in both the specific biomarkers included as part of an allostatic load index and patterns of association with a range of economic and sociodemographic factors.

Once an index of individual biomarkers has been agreed upon for inclusion, 'at risk' individuals must be identified. Empirical studies in the literature routinely apply one of two methods: operationalise individuals in the top or bottom quartile[6] of the study sample as those 'at risk' (see Robertson et al., 2015 for example) or utilise established clinical cut points whereby individuals above these clinical thresholds are identified as 'at risk' (see Mattei et al., 2010 & Finch et al., 2010 for examples). While the former is computationally simple, the consequence is that results may not be generalizable since they are specific to the sample distribution of the data utilised in a given study. In contrast, while the use of clinical cut points circumvents the problem of generalisability, thresholds are not established for all biomarkers.

Finally, consideration must be given to how medication use can affect individual biomarkers. By their very function, medications can alter natural biomarker levels, with the purpose often to bring biomarkers back into a clinically healthy range. As such, where no adjustment is made for medication use, individuals who, without medication, would potentially be

[6] Dependent on whether high or low scores represent unhealthy scores.

classified as ‘at risk’ may not be identified as such. Empirical studies in the literature routinely apply one of two methods to adjust for medication use: make specific value adjustments for medications associated with specific biomarkers (Robertson et al., 2014) or identify those who take medications as ‘at risk’ for each associated biomarker. While the former is perhaps considered more sensitive and refined, specific value adjustments are not established for all biomarkers, and studies must therefore often make a trade-off between the two.

Overall, it is clear that a number of methodological considerations must be given to the operationalisation of allostatic load. Given this, it is not surprising we find variation across studies in how allostatic load is operationalised and indeed how it is associated with neighbourhood context.

3.3.3 Identification strategy

A number of early empirical studies interested in the role of neighbourhood context in influencing individual health outcomes relied upon a single level regression estimation method. Such an analytical approach fails to account for the non-independence of observations within a neighbourhood. It is therefore only with a multilevel modelling approach that the within and between neighbourhood variation can be partitioned; that is to say that it is only with a multilevel approach that we can know the explanatory power of neighbourhood context in individual health outcomes.

3.4 This study

3.4.1 Hypotheses

Hypothesis 1: Residing in an area with a higher concentration of affluence, operationalised as an educational index of concentration at the extremes, is associated with better (lower) allostatic load scores since individuals, irrespective of personal resource and circumstance will be positioned to draw upon the collective resources of the neighbourhood made available by concentrated affluence, as theoretically hypothesised under the *collective resources model*.

Hypothesis 2: It is plausible that the socioeconomic context of the neighbourhood may affect advantaged and disadvantaged individuals’ differently. According to the *relative deprivation thesis*, individuals who are disadvantaged relative to others in a neighbourhood will enter into stress inducing social comparisons which can have adverse consequences for individual health. This study therefore hypothesises that disadvantaged individuals residing in neighbourhoods characterised by greater advantage will have poorer (higher) allostatic load scores than disadvantaged individuals in less advantaged neighbourhoods.

3.4.2 Academic contribution

Only one other empirical study, to our knowledge, has examined the association between neighbourhood socioeconomic context, operationalised specifically as an educational Index of Concentration at the Extremes, and allostatic load (Finch et al., 2010). While interaction effects between individual and neighbourhood level resources were identified, the study utilised data from the Third National Health and Nutrition Examination Survey (NHANES III), which was collected in the US between 1988 and 1994. Thus although informative, conclusions drawn from this study may have limited relevance in the UK, where neighbourhood profiles and educational attainment patterns differ. Furthermore, neighbourhoods were operationalised at the Census Tract level, with an average population size of between 1,200 and 8,000 people. Wilkinson’s relative deprivation thesis suggests it is at larger geographies that individuals are more likely to enter into stress inducing status comparisons given the greater heterogeneity at these levels.[7]This study therefore contributes to the empirical literature in two distinct ways:

(1) This study represents the first empirical analysis of the association between neighbourhood socioeconomic context, operationalised specifically as an educational Index of Concentration at the Extremes, and allostatic load in England.
(2) This is the first study in this subject area to operationalise neighbourhood at a larger geography, which, according to Wilkinson's relative deprivation thesis, may better reflect relevant social comparison groups.

3.5 Data and methods

3.5.1 Data

This study utilises the nurse assessment from waves two and three of Understanding Society: the UK Household Longitudinal Study (UKHLS). Starting in 2009, Understanding Society provides detailed information about the social and economic situations of people living in the UK. Approximately 40,000 households within the United Kingdom were selected into the survey at wave one and have been interviewed annually since. The sample is comprised of five components including a general population sample (GPS) and former British Household Panel Survey (BHPS) sample (Lynn, 2009). Further information relating to each component and applicable recruitment strategy can be found elsewhere (Lynn, 2009).

At wave two respondents from the BHPS who were still active in the study at its final wave (wave 18, 2008) were invited to participate in Understanding Society. There was, therefore, a 2 year period between the final wave of the BHPS and the samples integration into

[7] This assumption has been tested elsewhere and, in some cases, refuted. As such, it is important to examine the association between neighbourhood socioeconomic context and allostatic load at a larger geography than previous studies.

Understanding Society. Further information on the sample characteristics and patterns of attrition among BHPS respondents can be found in the Understanding Society User Guide (Lynn, 2009).

Nurse assessments were undertaken at wave two for the Understanding Society sample and at wave three for the former BHPS sample. For the purpose of this study and to increase sample sizes, the BHPS sample from wave three and Understanding Society GPS sample from wave two have been pooled for a cross-sectional analysis. With its collection of biological, socio-demographic and wider geographical information, Understanding Society represents a unique opportunity to study the interplay between biology, place and individual circumstance in a nationally representative sample.

Nurse assessment

Five months after the main stage survey (wave two for GPS sample; wave three for BHPS sample) a sub sample of UKHLS respondents were invited to participate in a nurse assessment where a range of physical health measures and blood biomarkers were collected. The purpose of the nurse health assessment was to provide objective measures of individual health status and health risk factors that may be understood as 'clinical precursors to major chronic health conditions' (McFall et al, 2014). Using the collected blood samples, a range of biomarkers have been produced which can be understood as characteristics 'objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes, or pharmacologic responses to a therapeutic intervention' (National Institute of Health, 1998). Inclusion of specific biomarkers measured in Understanding Society were based on the following criteria: (1) there must be an environmental and/ or behavioural effect on the (bio)marker, (2) there must be evidence of pathways linking the marker to important health outcomes or conditions and (3) the marker must be sufficiently prevalent in the population (Benzeval et al, 2014).[8]

A total of 21 blood biomarkers are available in Understanding Society, including inflammatory markers, markers of liver and kidney function, and hormones with at least 1 biomarker available for 13,107 respondents.[9]

Geographical identifiers

Special licence access was obtained to access a look-up file linking household identifiers to select local area statistics. Using these identifiers, individual and household level information in Understanding Society is linked to Census area statistics. Information on educational outcomes is collected at each Census and aggregated to various spatial levels as part of the Census statistical geographies. This study utilises this information from the 2011 Census at the Middle Super Output Area (MSOA) level; a refined spatial level comprising between 5,000 and 15,000 individuals. In 2011, there were 6,791 MSOA's in England.[10]

Neighbourhoods are operationalised at MSOA level for two key reasons. Firstly, as per the relative deprivation thesis, the association between neighbourhood socioeconomic context and allostatic load is hypothesised to be more salient at a larger geography. MSOA, rather than LSOA, geographies were therefore considered more appropriate for this study. Secondly, given the spatial focus of this study, it is important to ensure there are enough individuals nested within a neighbourhood to permit meaningful analysis.

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[8] A 'Biomarker User Guide & Glossary' is available to support the use of this data. The nurse assessment and blood analytes data is available in anonymised form through the UK Data Archive as with other Understanding Society data files. A special licence application is necessary to access specific information relating to medication use.

[9] Where data is available, age-sex distributions for each biomarker collected in Understanding Society are compared to HSE or ELSA data to illustrate similarities in parameters across data sources.

[10] MSOA level Information is not available for both Northern Ireland and Scotland due to geographical statistics being aggregated differentially.

3.5.2 Sample characteristics

In this study, all analyses are restricted to England only so that potential country level effects are not conflated with any neighbourhood level effects identified (Knies et al, 2014). The analytical strategy taken in this thesis was complete case analysis, meaning that individuals with missing data on any of the variables included in this study were excluded. This results in a final sample size of 6,990 individuals across 3,327 MSOAs. Statistical tests (results detailed in appendix 3) indicate that those excluded from the final analytical sample are, on average, more likely to be single and male. Income, education, and age profiles do not, however, statistically differ.

The number of individuals (level one) nested in a neighbourhood (level two) ranges from between 1 and 12. Given the study's sampling strategy of recruiting in areas with varying characteristics, sufficient variation in neighbourhood socioeconomic profiles is expected.

A number of analysis weights have been prepared for Understanding Society's biomarker data to allow estimation samples to be representative of the general population. Given the significant selection among respondents, descriptive statistics and multilevel analyses are weighted to adjust for Understanding Society's complex survey design. This study specifically utilises a cross-sectional weight variable for the combined BHPS and GPS sample (Lynn & Kaminska, 2010). Further information on weighting Understanding Society's biomarker data can be found in the information guide accompanying the data release.

3.5.3 Measures

Allostatic load

Allostatic load is operationalised in this study as a composite measure across cardiovascular, inflammatory and metabolic systems in the body. While calculating allostatic load scores is computationally simple, a number of factors must be considered in the analysis of biomarkers, as discussed above. The following sets out the specific biomarkers utilised in this study and steps followed to derive individual allostatic load scores.

Individual biomarkers

A total of 12 biomarkers are used in this study across cardiovascular, inflammatory and metabolic systems: body mass index (BMI), waist circumference, diastolic blood pressure, systolic blood pressure, HbA1c, HDL-cholesterol, triglycerides, insulin-like growth factor-1 (IG1-F), Dihydroepiandrosterone suphate (DHEAs), C-reactive protein (CRP), fibrinogen and total cholesterol. While there is no universally agreed measure of allostatic load, the individual biomarkers chosen for inclusion in this study are routinely used in the wider empirical literature (Benzeval et al, 2014; McEwen & Seeman, 1999)

Adjustment for medication use

Derived variables, indicating whether a respondent has reported taking prescribed medications known to affect specific individual biomarkers, are available in Understanding Society. In this study, specific value adjustments are made for medication use where established values are available and the simple count method, i.e. automatic assignment of a score of one for medication use, otherwise.

Identification of at risk individuals

Of the 12 individual biomarkers utilised in this study, 9 have established clinical thresholds, above which an individual is identified as ‘at risk’. IGF-1, fibrinogen and DHEAs, in contrast, are continuous measures with no established clinical cut-points. In this study, individuals are identified as at risk where they are above the clinical thresholds for those biomarkers with established cut-points and if they are in the highest quartile of the sample distribution for all other biomarkers. The proportion of individuals identified as ‘at risk’ will therefore vary according to the identification method utilised.

Calculating allostatic load scores

Once value adjustments have been made for medication use and ‘at risk’ individuals identified, assigning allostatic load scores is computationally simple. A value of one is assigned to ‘at risk’ individuals and a zero otherwise across each of the 12 biomarkers. These scores are then summed across all biomarkers for a total allostatic load score, which is retained as a continuous measure. Scores therefore range between zero and 12 with a higher score indicative of poorer health.

Table 3.1 below sets out for each individual biomarker (1) the clinical significance of each measure, (2) specific adjustments for medication use, (3) identification of clinical cut-points, and (4) the proportion identified as ‘at risk’.

Table 3.1: Operationalisation of allostatic load

Individual biomarker	**Clinical significance of biomarker**	**Clinical cut point, where established**	**Adjustment for medication use**	**Other adjustments**	**Proportion of sample identified as 'at risk'**
Total cholesterol	Risk factor for cardiovascular disease (CVD).	Above 5mmol/L.	**Statins**: 1.18mmol/L added where respondents are taking statins (Robertson et al., 2015). **Diuretics**: values are reduced by 4% where respondents are taking diuretic medication (Weir & Moser, 2000; Robertson et al.,		68.50 percent

			2015).		
<u>HDL-cholesterol</u>	Protective against CVD.	Below 1mmol/L.	**Beta-blockers**: HDL values are increased by 10% where respondents are taking beta-blockers (Robertson et al., 2015). **Statins**: no established value adjustment; automatically assigned score of one for related biomarker.		21.83 percent

Triglycerides	Predictive of CVD.	Above <2mmol/L.[11]	**Statins**: no established value adjustment; automatically assigned score of one for related biomarker.		40.50 percent
HbA1c	Gold standard indicator of diabetes risk	Values >48mmol/L indicates diagnosis of diabetes; values between 39mmol/L and 47mmol/L indicates pre-diabetes. Values of	**Chronic ingestion of aspirin:** no established value adjustment; automatically assigned score of one for related biomarker. **Anti-inflammatory**		35.08 percent

[11] Desirable non-fasting level. Respondents were not required to fast for data collection but differences between fasted and non-fasted samples have been found to be small (Understanding Society: Biomarker User Guide and Glossary, 2014).

		39mmol/L and above are utilised as the clinical cut-point in this study.	**medication**: no established value adjustment; automatically assigned score of one for related biomarker.		
C-reactive protein (CRP)	Marker of inflammatory load; high values are associated with adverse CVD mortality.	>3mg/L are considered a risk factor for CVD.[12]	**Statins**: no established value adjustment; automatically assigned score of one for related biomarker.* **Anti-inflammatory medication**: no established value	Values > 10mg/L are considered to reflect recent infection. These data were removed before analysis was undertaken (556 observations).bnf 7_conhrt	39.15 percent

[12] Values > 10mg/L are considered to reflect recent infection. In line with recommendations set out in the *Biomarker User Guide & Glossary* accompanying this data collection, these data were removed before analysis was undertaken. A total of 552 observations were deleted.

			adjustment; automatically assigned score of one for related biomarker.* **Contraception and hormone replacement therapy (HRT)**: no established value adjustment; automatically assigned score of one for related biomarker.* * Respondent assigned a value of one if taking <u>any</u> of the above medication.		

<u>Fibrinogen</u>	Marker of inflammation. Higher levels of fibrinogen are implicated in the development of CVD.	Data are continuous and there are no clinical cut-points.	**Contraception and hormone replacement therapy (HRT)**: no established value adjustment; automatically assigned score of one for related biomarker.* **Antifibrinolytic and haemostatics medications**: no established value adjustment; automatically assigned score of one for related biomarker.* * Respondent		28.05 percent.

			assigned a value of one if taking any of the above medication.		
Insulin-like growth factor-1 (IGF-1)	Low levels have been shown to be associated with heart disease.	There are no clinical cut-points published.			31.67 percent.
Dihydroepiandro sterone suphate (DHEAs)	Implicated in cardiovascular health; low levels are associated with all-cause mortality.	Data are continuous and there are no clinical cut-points.			26.47 percent.
Body mass index (BMI)	Metabolic syndrome is associated with the risk of	Overweight = 25 – 29.9; obese = 30 – 39.9.[13]			28.99 percent.

[13] There are a number of limitations associated with BMI as a measure of health; BMI is not always an accurate measure for the elderly or individuals with a high percentage of body muscle. Underweight individuals were excluded from this analysis; a total of 80 observations (% of the sample) were deleted.

	developing CVD and type 2 diabetes.	Values above 30 are utilised as the clinical cut-point in this study.			
<u>Diastolic blood pressure</u>	High systolic blood pressure is associated with an increased risk of a number of health conditions including CVD and stroke.	80> = pre high blood pressure. 90> = high blood pressure. Values above 80 are utilised as the clinical cut-point in this study.	**Hypertension medication**: 5mmHG added where respondents are taking hypertension medication (Robertson et al., 2015).		28.34 percent.
<u>Systolic blood pressure</u>	High systolic blood pressure is associated with an increased risk of a number of health conditions	120> = pre high blood pressure. 140> = high blood pressure. Values above 120 are utilised as the	**Hypertension medication**: 10mmHG added where respondents are taking		66.26 percent.

	including CVD and stroke.	clinical cut-point in this study.	hypertension medication (Robertson et al., 2015).		
Waist circumference	Provides information about the distribution of body fat and is a measure of risk for conditions such as CVD.	Men: a waist circumference of no more than 94cm. Women: a waist circumference of no more than 80cm.		Sex specific adjustments made.	

Source: Understanding Society, waves 2 & 3

Neighbourhood socioeconomic context: Index of Concentration at the Extremes

Neighbourhood socioeconomic context is operationalised as an educational Index of Concentration at the Extremes (Massey, 2001) using Census 2011 data at the Middle Super Output Area (MSOA) level.[14] For the purpose of this study, concentrated advantage is operationalised as the proportion of individuals within a neighbourhood who have a degree while concentrated disadvantage is operationalised as the proportion of individuals without any qualifications. Those with qualifications ranging from GCSE's through to A Levels therefore represent the bridge of the continuum between the two extremes.

$_{\text{Education}}$ICE scores are mathematically defined as: (number of advantaged individuals – number of disadvantaged individuals / total population in area)*100

The scale therefore ranges from – 100 to + 100, with negative 100 indicating that all persons in the neighbourhood are disadvantaged while positive 100 indicates all are advantaged. Zero therefore represents an equal balance of advantaged and disadvantaged individuals. Thus, as a demonstrative example, in a neighbourhood with 5000 residents, where 1500 have a degree (advantaged) and 800 have no qualifications (disadvantaged), an $_{\text{education}}$ICE score would be computed as follows:

1500 – 800 / 5000 = 0.14

0.14*100 = 14

This example neighbourhood therefore represents a neighbourhood with a greater concentration of advantage than disadvantage. Information on the distribution of neighbourhood $_{\text{education}}$ICE scores can be found in table 3.3 below.

[14] A derived variable is available as part of the Census 2011 data with educational qualifications collapsed from 12 categories into five (five being the highest).

While other studies in this area frequently measure neighbourhood socioeconomic context with income, this was not possible here. Information on neighbourhood income is not available as a continuous measure which is necessary to construct an ICE measure. Associated caveats are discussed further in the strengths and limitations section of this study.

Individual level education

Individual level education is the main level one independent variable of interest in this study. Individual level education is utilised as a marker of socioeconomic status and has been used elsewhere in the empirical literature relating to allostatic load (Kubzansky et al., 1999; Seeman et al., 2004). Education is hypothesised to be the most appropriate marker of socioeconomic status for this study for several reasons. Firstly, education is a stable measure of SES in adulthood and may be a better measure of SES for women than either income or occupation. While correlated with other domains of SES, i.e. income, education has been shown to be a stronger SES predictor in the empirical literature (Antonovsky, 1967; Winkleby, 1992). More practically, information on education does not suffer from the high item non-response that is characteristic of other SES measures, notably income (Riphahn & Serfling, 2002). A derived variable relating to highest education qualification is available in Understanding Society and is operationalised as a binary variable in this study where a value of one represents having a degree and a zero otherwise.

Covariates

Individual level characteristics associated with selection into neighbourhoods and allostatic load are included in this study: age, sex, marital status and number of children in the household. The social patterning of allostatic load, as documented elsewhere, is captured via the main independent variable of this study, education. Equivalised household income is operationalised as a log transformation and tenure status as a series of dummy variables: owner occupier, social renter and private renter. Given the study focus on neighbourhood context, all models also include a binary indicator of whether a respondent resides in an 'urban' area, defined as an area with a population of more than 10,000.

3.5.4 Analytical method

Multilevel modelling

Weighted multilevel models are estimated using STATA 14 and the *xtmixed* command (StataCorp, 2014) with MSOA specified as the grouping variable.

Multilevel modelling allows for the analysis of clustered data where observations are nested within groups, thereby accounting for the non-independence of observations (Rabe-Hesketh & Skrondal, 2012). Multilevel modelling allows us to study the effects of higher level explanatory variables on individual level outcomes and the extent to which they can explain the variance at level two (Leckie, 2010). In this analysis, level one relates to individual level predictors, including education and a range of other sociodemographic characteristics while level two relates to the educational profile of the neighbourhood (operationalised at the MSOA level).

Cross-level interactions

Cross-level interactions allow us to formally test the hypothesis that the association between neighbourhood socioeconomic context, operationalised as a continuum of advantage through to disadvantage (ICE), and allostatic load varies as a function of individual level education.

3.5.5 Model specifications

In accordance with recommendations set out elsewhere in the methodological literature (Leckie, 2010), models are specified in a stepwise manner with a total of five models estimated: (1) a null, random intercept only, model to identify the between neighbourhood variation in allostatic load outcomes, (2) adjustment for individual level sociodemographic characteristics, including level of education, (3) extending model 2 to allow the both the intercept and slope for education to vary randomly across neighbourhoods, (4) adjustment for the contextual effect of $_{education}$ICE and (5) adjustment for a cross-level interaction between individual level education and $_{education}$ICE.

In models one and two, therefore, the intercept is allowed to vary across neighbourhoods, in order to accommodate cross-neighbourhood differences in allostatic load. From model three onwards, a random slope is estimated for individual level education meaning that the slope of the regression line for education can vary randomly across neighbourhoods.

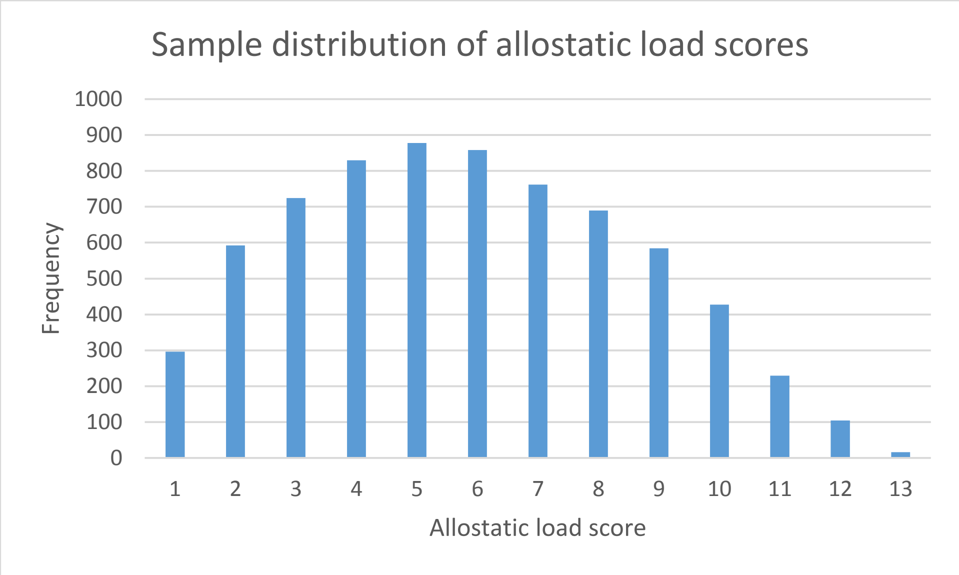
The Intraclass Correlation Coefficient (ICC) indicates the variance in allostatic load scores that can be attributed to differences between neighbourhoods and is calculated as the between neighbourhood (level 2) variance divided by the total variance (between neighbourhood variance + within neighbourhood, between individual variance) for each random intercept model estimated.

$$\frac{\sigma_{\alpha}^2}{\sigma_{\alpha}^2 + \sigma_{\epsilon}^2}.$$

Likelihood ratio tests will be conducted to compare the goodness of fit between the models specified above, thus identifying the most parsimonious model. Specifically, while a random intercept model assumes that the effect of the explanatory variable is consistent across neighbourhoods, a random coefficients model relaxes this assumption thereby allowing the slopes to differ for each group. The null model, that is the random intercept only model, is rejected where $p<0.05$, thereby indicating that the slope for each educational level modelled differs across neighbourhoods.

3.6 Results

Figure 3.1: Distribution of allostatic load scores in sample



Source: Understanding Society, waves 2 & 3

Table 3.2: Weighted population characteristics, stratified by neighbourhood socioeconomic context

	Overall	Top 20% most deprived neighbourhoods	Top 20% least deprived neighbourhoods
Mean age	50.6	49.7	50.1
Male (%)	45.8	47.4	47.0
Married (%)	58.5	54.2	60.8
Single (%)	23.5	23.7	25.1
Widowed (%)	6.7	8.0	5.7
Separated (%)	11.3	14.1	8.5
Mean N of children in household	0.48	0.50	0.50
Home owner (%)	75.2	66.1	77.3
Social renter (%)	13.7	22.8	8.8
Private renter (%)	11.1	11.1	13.9
Residence in urban area (%)	78.3	90.4	74.5
Degree (%)	36.6	20.7	55.5
A-levels (%)	18.7	18.3	16.1
GCSEs (%)	20.5	24.6	14.2
Other qualifications (%)	11.3	15.1	7.2
No qualifications (%)	13	21.3	6.9
Mean neighbourhood ICE score	4.57	-19.0	29.2

Source: Understanding Society, waves 2 & 3

3.6.1 Descriptive statistics

Table 3.3 presents survey weighted population characteristics, stratified by neighbourhood socioeconomic context. The mean age in this study is 50.6 years with little variation between the most and least deprived neighbourhoods. Again there is little difference between the least and most deprived neighbourhoods in sex profiles, at approximately 47 percent men, while this is marginally lower at 45.8 percent in the study overall. Differences emerge between the least and deprived neighbourhoods by marital status, with a lower proportion of married individuals in the most deprived neighbourhoods, at 54.2 and 60.8 percent respectively and a higher proportion of separation at 14.1 and 8.5 percent respectively. Average number of children is, however, comparable between the least and most deprived neighbourhoods. Greater differences emerge for tenure status; 77.3 percent of individuals in the least deprived neighbourhoods are homeowners while in the most deprived neighbourhoods this is less at 66.1 percent. Social renting is much more common in the most deprived neighbourhoods at 22.8 percent vs. 8.8 percent in the least deprived. 78.3 percent of neighbourhoods are in urban areas overall while, for the most deprived neighbourhoods this is greater at 90.4 percent. As expected, there are clear differences across neighbourhoods in profiles of educational attainment. In the least deprived neighbourhoods, 55.5 percent of individuals have a degree, while in the most deprived neighbourhoods this is only 20.7 percent. While the proportion of individuals with A-levels is comparable, differences emerge for proportion with GCSEs only. While 14.2 percent of individuals have GCSEs only in the least deprived neighbourhoods, this is greater in more deprived areas at 24.6 percent. While 21.3 percent of individuals do not have any qualifications in the most deprived neighbourhoods, this is much lower at only 6.9 percent in the least deprived. Overall, the weighted population characteristics set out above are as expected, with known correlates of low SES greater in the most deprived neighbourhoods.

Table 3.3: Multilevel models (I) empty random intercept model, (II) adjusted for individual level characteristics, (III) adjusted for random slope for education, (IV) adjustment for neighbourhood level characteristics and (V) adjustment for cross level interaction

	Model I Coefficient (SE)	Model II Coefficient (SE)	Model III Coefficient (SE)	Model IV Coefficient (SE)	Model V Coefficient (SE)
Intercept	4.71 (0.04) ***	5.02 (0.08) ***	5.03 (0.08) ***	5.07 (0.08) ***	5.08 (0.08) ***
Individual level education		-0.49 (0.06) ***	-0.49 (0.06) ***	-0.38 (0.06) ***	-0.40 (0.07) ***
Female		-0.19 (0.06) **	-0.20 (0.06) **	-0.19 (0.06) **	-0.19 (0.06) **
Age		0.09 (0.00) ***	0.09 (0.002) ***	0.09 (0.002) ***	0.09 (0.002) ***
Single		-0.42 (0.09) ***	-0.43 (0.09) ***	-0.40 (0.09) ***	-0.40 (0.09) ***
Divorced or separated		0.02 (0.09)	0.01 (0.09)	0.002 (0.09)	0.003 (0.09)
Widowed		-0.16 (0.12)	-0.16 (0.12)	-0.17 (0.12)	-0.17 (0.12)
Number of children		-0.20 (0.04) ***	-0.21 (0.04) ***	-0.20 (0.04) ***	-0.20 (0.04) ***
Income		-2.00E-06	-2.00E-06	-2.00E-06	-9.82E-06
Social renter		0.71 (0.10) ***	0.72 (0.10) ***	0.67 (0.10) ***	0.67 (0.10) ***
Private renter		0.25 (0.11) **	0.23 (0.11) *	0.26 (0.11) *	0.26 (0.11) *
Resides in urban area		0.23 (0.07) **	0.23 (0.07) **	0.17 (0.07) *	0.17 (0.07) *
EducationICE				-0.01 (0.002) ***	-0.02 (0.002) ***
Cross level interaction					0.002 (0.004)
Between neighbourhood variance	0.994	0.451	0.654	0.600	0.600
Within neighbourhood variance	6.732	4.502	0.649	0.699	0.694
Covariance			-0.458	-0.471	-0.469

Source: Understanding Society, waves 2 & 3

3.6.2 Multilevel models

Table 3.4 presents estimates from a series of multilevel models. Model I presents estimates for a null model, which allows for neighbourhood effects on allostatic load, but does not include any explanatory variables. The intercept indicates that the overall allostatic load score across neighbourhoods is estimated at 4.71 (0.004) (the grand mean) and is statistically different from zero. The Intraclass Correlation (ICC) is 0.13, meaning that 13 percent of the variance in allostatic load can be attributed to differences between neighbourhoods, with the remaining 91 percent attributable to individual differences. A likelihood ratio test comparing the null multilevel model with a null single level model indicates that there is evidence of neighbourhood effects on allostatic load. While results suggest that there are indeed neighbourhood differences in allostatic load scores, model I does not adjust for individual level characteristics, and thus does not account for the composition of the neighbourhood.

Model II therefore presents estimates from a random intercept model, adjusted for individual level characteristics, including our level one variable of interest, education. This model therefore assumes that the association between individual level education and allostatic load is the same across neighbourhoods, i.e. the slope of the regression line is fixed. The intercept indicates that the grand mean for allostatic load, adjusting for individual level characteristics, is 5.02 (0.08), and is statistically significant. Compared to individuals without a degree, the expected allostatic load score for individuals with a degree is -0.49 (0.06) lower, and is statistically significant. Put simply, individuals with a degree have lower allostatic scores than those without, controlling for other covariates. After adjusting for individual level characteristics, the proportion of unexplained variance that is due to differences between neighbourhoods' decreases from 13 percent to 9 percent.

In model III, the slope of the line is no longer assumed to be fixed, meaning that both the intercept and slope can now vary randomly across neighbourhoods. The effect of education is now therefore no longer assumed to be the same for all neighbourhoods. Again, a likelihood ratio test indicates that the effect of individual level characteristics varies across schools. The intercept is now 5.03 (0.08), and statistically significant. For the 'average' neighbourhood model III predicts a decrease of -0.49 (0.06) points in allostatic load for those with a degree. A 95 percent coverage interval for the neighbourhood slopes is estimated at between -2.069 and 1.089. Assuming a normal distribution, therefore, we would expect the middle 95 percent of schools to have a slope between -2.069 and 1.089.[15]

The intercept variance of .654 is interpreted as the between-neighbourhood variance when degree (and other controls) is equal to zero, i.e. for individuals without a degree. The negative covariance estimate of -0.458 means that neighbourhoods with a high intercept, i.e. above average allostatic load scores tend to have a flatter than average slope. Similarly, neighbourhoods with a low slope tend to have seen a more marked increase in allostatic load scores between education levels (above average slope).

In model IV, the contextual effect of neighbourhood composition, operationalised as an educational Index of Concentration at the Extremes (ICE), is introduced. Model IV, therefore, allows us to assess the effect of neighbourhood socioeconomic composition on individual level allostatic load scores, and the extent to which this can explain level two variance. The intercept indicates that the grand mean for allostatic load is 5.07 (0.08). Controlling for other covariates, having a degree is associated with a decreased allostatic load score of -0.38 (0.06), compared to individuals without a degree. The effect of education has attenuated compared to model III, although it remains at a level of statistical significance. The neighbourhood level variance has marginally reduced in model IV, as compared to model III. Accounting for

[15] Calculated as $-0.49 \pm 1.96\sqrt{0.648815}$

neighbourhood level socioeconomic context, the between neighbourhood variance for individuals without a degree (the intercept variance) reduces from 0.654 to 0.600. The educational Index of Concentration at the Extremes is negatively associated with allostatic load, meaning a 1 unit increase in the ICE score is associated with a -0.01 (0.002) point decrease in allostatic load. Simply put, as neighbourhood concentrated advantage increases, allostatic load scores decrease, controlling for other covariates.

In model V, the cross level interaction between individual level education and neighbourhood level educational ICE is introduced. Likelihood ratio tests indicate, however, that the model specification is not improved by including this cross level interaction. Point estimates and associated significance confirm that the cross level interaction is not statistically significant. This therefore means that the effect of having a degree does not differ according to the educational profile of the neighbourhood, even though neighbourhood differences in allostatic load do vary as a function of individual level education.

3.7 Discussion

Using a linear multilevel modelling approach, this study sought to empirically examine two discrete hypotheses linking neighbourhood socioeconomic context and allostatic load.

3.7.1 Neighbourhood effects

In accordance with other studies in the empirical literature, neighbourhood differences in allostatic load scores were identified, independent of individual level characteristics (Bird et al., 2010). Operationalised as a marker of SES, our main level one variable of interest, individual level education, operated in the expected direction; having a degree was associated with lower (better) allostatic load scores. Again, our level 2 measure of interest, education ICE, was also independently associated with allostatic load; increasing concentrated advantage was associated with lower allostatic scores. This finding may, therefore, provide preliminary evidence of the collective resource model, i.e. as neighbourhood concentrated advantage increases, so too do average allostatic load scores.

Further, the negative covariance suggests neighbourhoods with a high intercept, i.e. above average allostatic load scores tend to have a flatter than average slope. Similarly, neighbourhoods with a low slope tend to have seen a more marked increase in allostatic load scores between education levels (above average slope).

Evidence of statistically significant associations indicate that MSOA geographies, where population averages between 5,000 and 15,000 individuals, represent an appropriate spatial level to undertake research linking neighbourhood socioeconomic context and health.

3.7.2 The interaction between person and place

While both neighbourhood ICE scores and individual level education were independently associated with neighbourhood allostatic load, cross level interactions were not statistically significant. This, therefore, tells us that while the effect (slope) of individual level education varies across neighbourhoods, these differences are not explained by the educational profile of the neighbourhood. As such, the results from this study do not support the relative deprivation thesis which asserts that individuals who are disadvantaged, relative to others in a neighbourhood, will enter into stress inducing social comparisons which can have adverse consequences for individual health (Wilkinson, 2002; Stafford & Marmot, 2003).

It may be that neighbourhood level variables operationalised with information on the distribution of income, rather than education, within a neighbourhood better capture the interactions between person and place via stress inducing social comparisons. Other studies in the area frequently operationalise neighbourhood socioeconomic context with an income related measure, e.g. the proportion of individuals below the median income. It was not, however, possible to utilise information on neighbourhood income profiles to construct an Index of Concentration at the Extremes since a continuous measure of income is not available at the neighbourhood level. The small number of individuals in a neighbourhood in this study meant it was also not possible to aggregate individual level information to the neighbourhood. Nevertheless, while education is correlated with income and represents an indicator of skills requisite for acquiring economic resources, it may not be an appropriate measure to capture neighbourhood differences.

3.8 Strengths and limitations

This study represents the first empirical analysis of the association between neighbourhood socioeconomic context, operationalised as an educational Index of Concentration at the Extremes, and allostatic load in England. Neighbourhood socioeconomic context is frequently operationalised as concentrated deprivation, or low SES, in the empirical literature (Schulz et al., 2012; Robinette et al., 2016). As set out earlier in this chapter, the absence of deprivation does not, however, necessarily mean the concentration of advantage; the two are not always perfectly collinear. Neighbourhood socioeconomic context can instead be understood as a continuum, ranging from concentrated disadvantage through to concentrated advantage (Massey, 2001; Finch et al., 2010). By measuring the full distribution of neighbourhood socioeconomic context in a single measure, this study has circumvented issues of multicollinearity to estimate the effect of both concentrated neighbourhood advantage and disadvantage on allostatic load.

With the collection of biomarkers, *Understanding Society*, a nationally representative prospective social survey, represents a unique opportunity to explore the processes by which individual pathways interact with the wider environment to shape health outcomes in the UK today (Hobcraft, 2009). As objective measures of health status, biomarkers circumvent potential issues of reporting bias and measurement error associated with self-report health measures (Johnston et al, 2007).

Despite this, biomarkers are associated with their own considerations, specifically issues of data quality and deterioration related to mode of blood collection and transportation and adjustment for medication use (Understanding Society: Biomarker User Guide and Glossary, 2014). Specific value adjustments were made for medication use where established clinical guidelines exist and the simple count method otherwise. Three of the twelve biomarkers utilised in this study are continuous and do not have established clinical thresholds. Consistent with the wider literature, this study therefore utilised clinically agreed thresholds as indictors of risk where available and the simple count method otherwise (Robertson et al., 2015).

The cross-sectional nature of this analysis, however, means it is not possible to disentangle the social causation and health selection hypotheses. Specifically, the findings presented in this study cannot further the debate on whether neighbourhood socioeconomic context leads to poor health or whether those with poorer health are selectively sorted into deprived neighbourhoods (Bergstrom & van Ham, 2010). Despite the cross-sectional nature of this study, evidence of neighbourhood effects have been found elsewhere in a randomized controlled study. The *Moving to Opportunity* programme in the US, which randomly allocated families living in deprived neighbourhoods into new neighbourhoods via a housing benefit voucher transfer scheme, found that both physical and mental health outcomes were improved among those who moved into better neighbourhoods, thereby supporting a social causation thesis (Leventhal & Brooks-Gunn, 2003; Sharma, 2014). Frequently, studies utilising a cross section of observational data estimate neighbourhood effects among social renters only, as part of sensitivity analyses. Since social housing tenants often have less choice in where they live, it is assumed that there is less selective sorting across neighbourhoods among this group and thus estimates are closer to a causal association (van Ham & Manley, 2013). Unfortunately this was not possible in this study given the small number of individuals in social housing. Nevertheless, other studies have found evidence to support the social causation thesis, suggesting neighbourhoods play a causal role in pathophysiological processes related to poorer health (Ludwig et al., 2011).

Information on neighbourhood socioeconomic context is not collected annually. As such, it was not possible to assess how the associations reported in this study vary as a function of changing neighbourhood composition and expected induction times.

3.9 Conclusion

Individuals in disadvantaged areas, on average, have worse health than those in advantaged areas, and within areas, disadvantage is also associated with ill health (Daniel et al., 2008). This study represents an important contribution to a growing empirical literature linking place with health (Dragano et al., 2007; Grafova et al., 2008; Stimpson et al., 2007) and discourse concentrated on place based intervention, to look at how ‘the social gets under the skin’

(Hobcraft, 2009). Using data from Understanding Society's biomarker collection, this study empirically examined the association between neighbourhood socioeconomic context, operationalised as an educational Index of Concentration at the Extremes (ICE), and allostatic load. While cross level interactions were not statistically significant, the findings from this study nevertheless suggest neighbourhood differences in allostatic load do vary as a function of individual level education. Future research should therefore consider the role of alternative operationalisations of neighbourhood socioeconomic context and its interaction with individual level education.

The analytical strategy taken in this study was complete case analysis, meaning that individuals with missing data on any of the variables included in this study were excluded. It is plausible, therefore, that the characteristics of the final sample utilised in each study, differ from the larger population, and given the non-random nature of item non-response, may be correlated with the variables chosen in this study. Statistical tests do, to some extent, support this hypothesis, indicating that those excluded from the final analytical sample are, on average, more likely to be single and male. Income, education, age, and neighbourhood socioeconomic profiles do not, however, statistically differ. Allostatic load is structured by age, with younger groups, on average, having lower allostatic load scores (Crimmins et al., 2003). While it is therefore possible that the analytical sample derived in this study finds evidence of a stronger association than may be prevalent across the population in England, the difference in age profiles between the samples is small. The results presented here should therefore be considered alongside other studies in this area.

While the interaction between biology and socioeconomic context is complex and multifaceted, a biological approach, as applied here, does not undermine the primary importance of social organisation in generating health inequalities (Bruner, 1997);

increasingly, sociobiologic models are recognised as key to furthering our collective understanding in the study of the social gradient in health (Daniel et al., 2008).

Conclusion

Health inequalities arise as a consequence of social inequalities. Reducing inequalities in health therefore demands action across all of the social determinants of health (Siegrist & Marmot, 2004; Marmot Review, Institute of Health Equity, 2010). Such action, however, necessitates clear evidence and a comprehensive understanding of the structural drivers of health inequalities. Using Understanding Society, a nationally representative panel study, this thesis empirically examined the ethnic and spatial patterning of health in England today. This thesis, therefore, represents an important contribution to research and policy agendas in these areas.

Ethnic inequalities in health are well established. While specific patterns vary across health conditions, Pakistani, Bangladeshi and Caribbean groups experience, on average, the poorest health in the UK (Nazroo, 2001). Yet the drivers of these inequalities are not well understood and there remains a paucity of research in this area (Nazroo, 2014). Despite the commonality of arriving in the United Kingdom, ethnic minority groups do not constitute a homogenous group. There is significant variation by ethnic group according to pattern of migration, age structure, and residential concentration. As such, it is important that research interested in ethnic inequalities in health acknowledges these differences by examining ethnic groups separately.

Ethnic minority groups are disproportionately concentrated in deprived neighbourhoods and are more likely to experience unemployment, known correlates of poor health. Chapters one and two of this thesis therefore empirically examine how the mental health and wellbeing of ethnic minority groups are shaped by the experience of unemployment and the ethnic composition of their neighbourhood, respectively.

In chapter one, the association between unemployment and subjective wellbeing (SWB) is shown to vary as a function of ethnicity. The precise nature of ethnic patterning is specific to each domain of SWB, and intersects with gender, generational and socioeconomic status. Overall, there is little variation by ethnicity among women across life and domain satisfactions, while ethnic differences are more pronounced for psychological wellbeing. Pakistani, Bangladeshi and African women are less negatively affected by unemployment, which may reflect ethnic specific gender norms and expectations or a lower attachment to the labour market. In contrast, strong ethnic effects were identified among men across all domains of SWB.

Chapter two revisited the ethnic density hypothesis to explore whether residing in an area with a higher concentration of co-ethnics is protective for mental health and modelled the mediating role of an alternative formulation of social capital. Study findings suggest that the ethnic density effect does not operate at a more refined geographical level than previously examined in the empirical literature. This represents the first empirical examination of the ethnic density hypothesis at a more refined geography than previously examined for the largest ethnic minority groups in the UK today and therefore represents an important contribution to the empirical literature.

Poor mental health represents a significant contributor to the burden of ill health in the UK, at between 9 and 23 percent, costing £77.4 billion in 2003 (HM Government, 2010). At a time when service pressures are mounting for the National Health Service (NHS) and the prevalence of poor mental health and wellbeing continues to increase, it is imperative we understand how risk factors for poor health vary across ethnic groups. Chapters one and two therefore represent timely and important contributions and should be of interest to policy makers.

While chapter two operationalised neighbourhood effects as protective of health, chapter three considered how neighbourhood socioeconomic context may pose a risk factor for higher allostatic load, a mid term health outcome. As a measure of the body's cost of adaptation across a number of physiological systems, in response to stress, allostatic load represents an important pathway by which 'neighbourhood effects' are translated into poorer health outcomes (Szanton et al., 2005). Specifically, chapter three considered the association between neighbourhood socioeconomic context, operationalised as an educational Index of Concentration at the Extremes (ICE), and allostatic load. Cross level interactions were introduced to test the moderating role of individual level education. Although cross level interactions were not statistically significant, the findings from this study nevertheless suggest neighbourhood differences in allostatic load do vary as a function of individual level education.

To conclude, the findings from this study should be of interest to policy makers interested in understanding how mental health and wellbeing is ethnically patterned and the role of neighbourhoods in contributing to inequalities in health.

Appendices

Appendix 1

Table A.1 below presents results from statistical chi2 and t-tests comparing whether the final derived analytical sample statistically differed from the larger Understanding Society data set for chapter one of this thesis. Tests were carried out by key sociodemographic characteristics.

Table A.1: Statistical tests of comparison for chapter one of thesis

Variable	**Understanding Society**	**Final analytical sample**	**Difference statistically significant?**
Age	45.5	47.6	p=0.00
Sex: percentage female ***	47.2%	55.9%	p=0.00
Household income	2956.8	2956.4	p>0.10
Highest educational qualification: percentage with degree ***	16.9%	23.7%	p=0.00
Marital status: percentage single ***	23.5%	29.6%	p=0.00
Employment status: percentage unemployed ***	5.1%	6.5%	p=0.00
Ethnicity: percentage White British ***	66.9%	82.2%	p=0.00

Appendix 2

Table A.2 below presents results from statistical chi2 and t-tests comparing whether the final derived analytical sample statistically differed from the larger Understanding Society data set for chapter two of this thesis. Tests were carried out by key sociodemographic characteristics.

Table A.2: Statistical tests of comparison for chapter two of thesis

Variable	**Understanding Society**	**Final analytical sample**	**Difference statistically significant?**
Mean co-ethnic concentration: African	12.2%	10.4%	p<0.05
Mean co-ethnic concentration: Caribbean	6.6%	6.8%	p>0.10
Mean co-ethnic concentration: Bangladeshi	32.1%	30.2%	p>0.10
Mean co-ethnic concentration: Indian ***	25.0%	19.0%	p=0.00
Mean co-ethnic	30.7%	29.3%	p>0.10

concentration: Pakistani			
Ethnicity: percentage White British ***	64.7%	80.4%	p=0.00
Age	46.5	47.0	p>0.10
Sex: percentage female ***	46.0%	55.7%	p=0.00
Household income	3179.6	3125.6	p>0.10
Highest educational qualification: percentage with degree ***	17.0%	24.4%	p=0.00
Marital status: percentage single **	27.9%	29.7%	p<0.05

Appendix 3

Table A.3 below presents results from statistical chi2 and t-tests comparing whether the final derived analytical sample statistically differed from the larger Understanding Society data set for chapter three of this thesis. Tests were carried out by key sociodemographic characteristics.

<u>Table A.3: Statistical tests of comparison for chapter three of thesis</u>

Variable	**Understanding Society**	**Final analytical sample**	**Difference statistically significant?**
Age*	50.6 years	51.8 years	p<0.10
Sex: percentage female**	55.8%	50.1%	p<0.05
Household income	2983.4	2946.2	p>0.10
Highest educational qualification: percentage with degree	25.9%	22.6%	p>0.10
Marital status: percentage single **	25.9%	21.3%	p<0.05

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