The University Of Sheffield.

A theory-driven approach to understanding the effect of ethnic density on mental ill-health in England

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Thesis submitted in fulfilment of the degree of Doctor of Philosophy

20th December 2021

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Declaration

I, the author, confirm that the Thesis is my own work. I am aware of the University's Guidance on the Use of Unfair Means (www.sheffield.ac.uk/ssid/unfair-means). This work has not previously been presented for an award at this, or any other university.

Acknowledgements

There are several people I would like to take this opportunity to thank. Firstly, I would like to express my gratitude to my supervisors Professor Sarah Salway and Dr Aneta Piekut for their invaluable advice and guidance throughout this process. Thanks also go to Dr Bruno Castanho Silva for his generosity in offering support and advice with all things MSEM. I would also like to express my sincere thanks to NIHR SPHR for funding this project and to the SPHR network for the support and opportunities provided throughout my studies.

I would like to show my appreciation for Dr Elizabeth Walton, the Deep End Patient and Public Involvement Panel, Yvonne Witter at Darnall Wellbeing and all those who kindly gave up their time to contribute to my Patient and Public Involvement sessions. Thanks also go to the Understanding Society survey respondents and the UK Data Service for making access to the data possible.

I would also like to thank Dr Margaret Byron, my personal tutor during my undergraduate studies at the University of Leicester, who first taught me to truly think critically about race, racism and ethnicity and inspired my interest in this area of health research.

Thanks to the friends I have made during my time at Sheffield who have been a source of sanity during the unexpected additional challenge of completing this PhD during a pandemic. Thanks also to Trixie Leyshon, whose kindness and hospitality enabled me to complete my master's degree which was a pivotal step to beginning my doctoral research. Special thanks also go to the Venesses for their kindness and support and to Judith Barrow for all her amazing and inspiring stories.

I would like to thank my wonderful family for their love and support. I will be forever grateful for everything you have given me.

Finally, the most heartfelt thank you to Rémy, for always being there, for always believing in me and for supporting all of my choices unconditionally.

Abstract

This thesis examines the pathways behind the so-called 'ethnic density effect', whereby individuals from minority ethnic backgrounds have better health when they live in areas where they are more numerous. Despite a long-standing interest in the effect, little progress has been made in elucidating the pathways by which it operates. This thesis sought to address this gap using a theory-driven approach, in which existing knowledge was used to guide the research and analysis decisions made.

Firstly, a systematic review was conducted to collate and evaluate UK-based evidence on the 'ethnic density effect' on mental health and on the pathways which have been proposed. From the results, a conceptual framework showing these proposed pathways was created. Guided by this framework, analyses of a sample of minority ethnic respondents from Wave 3 (2011-2013) of the survey Understanding Society, linked to area level census data, were conducted. A novel application of Structural Equation Modelling (SEM) was employed which allowed specification of both multilevel and multigroup components.

The primary pathways identified by the systematic review were: racism, social support, social cohesion and social stress. Evidence for the 'ethnic density effect' and its pathways varied across ethnic groups. Through performing a Multi-Group Multilevel SEM, it was possible to test two paths: social cohesion and racism. Factor analysis was applied to the measurement of social cohesion, revealing a two-factor structure (social capital and belonging) which were invariant at the metric level across ethnic groups. In the final model no paths to or from social cohesion were statistically significant. However, a negative association between ethnic density and racism was found in three ethnic groups and a full indirect path for one ethnic group. The findings of this thesis are relevant to local governments in understanding the health implications of the geographical distribution of minority ethnic groups.

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AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
DIC	Deviance Information Criterion
EFA	Exploratory Factor Analysis
EID	English Indices of Deprivation
EMB	Ethnic Minority Boost sample
EM-LDA	Ethnic Minority Low Density Area sample
GHQ-12	General Health Questionnaire 12
GPCS	General Population Comparison Sample
GPS	General Population Sample
LSOA	Lower Super Output Area
MGCFA	Multi Group Confirmatory Factor Analysis
MG-MSEM	Multi Group Multilevel Structural Equation Model
ML-CFA	Multilevel Confirmatory Factor Analysis
MSEM	Multilevel Structural Equation Model
MSOA	Middle Super Output Area
OA	Output Area
PPI	Patient and Public Involvement
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Model
SRMR	Standardised Root Mean Squared Residual
TLI	Tucker-Lewis Index
UKDS	UK Data Service
UKHLS	UK Household Longitudinal Survey (also known as Understanding Society)

1 Chapter 1: Introduction and background

This thesis is concerned with understanding the 'ethnic density effect' on the mental health of minority ethnic people in England. In particular, this thesis aims to provide new knowledge regarding the pathways hypothesised to be in operation between ethnic density and mental health.

England is becoming an increasingly ethnically diverse country, with around 19.5% of the population identifying themselves as belonging to a minority ethnic group in the 2011 census (ONS, 2012) compared with 12.6% in the 2001 Census (ONS, 2020). This diversity is increasing within a context of long-standing ambivalence towards people from minority ethnic backgrounds and an explicitly hostile environment towards migrants since 2012 (Griffiths and Yeo, 2021). A number of political approaches to 'managing' growing ethnic diversity have been developed alongside these hostile migration policies, with the current approach drawing on concepts related to community cohesion (Bloch et al., 2013). In addition to this, there has been increasing political interest in the residential patterns of these minority ethnic groups. In the past, these groups have often been claimed to cluster geographically and segregate to the detriment of society (Cantle, 2001), a sentiment which remains a feature in political discourse today (Local Government Association, 2019), despite more recent evidence indicating otherwise (Catney, 2016a; Finney and Simpson, 2009b). In spite of these claims, a well-established body of research indicates that this clustering is beneficial for the health of people from minority ethnic groups. This observed association is termed the 'ethnic density effect'.

There are known inequalities in mental health outcomes, treatment access and pathways to care across ethnic groups, and these patterns vary across different ethnic groups (Weich et al., 2004; McManus et al., 2016; Rees et al., 2016). Evidence from national surveys suggests that these inequalities exist across a range of mental health conditions and also vary according to age and gender (McManus et al., 2016). These inequalities are important to understand and address as the population of England continues to become more diverse. Furthermore, mental health can impact the full participation of individuals in society and is costly to the economy, with one report putting the estimated cost of mental ill health in England at over £105 billion between 2009 and 2010 (Centre for Mental Health, 2010). There is a large evidence base suggesting that this so-called 'ethnic density effect' is protective of the mental health of people from minority ethnic groups (Baker et al., 2021; Halpern, 1993; Shaw et al., 2012; Bosqui et al., 2014). A series of review articles on the topic demonstrate protective associations between ethnic density and health across a range of contexts (Halpern, 1993; Williams and Collins, 2001; Acevedo-Garcia et al., 2003; Pickett and Wilkinson, 2008; Kramer and Hogue, 2009; Landrine and Corral, 2009; White and Borrell, 2011; Shaw et al., 2012;

Bécares et al., 2012b; Bosqui et al., 2014; Bécares et al., 2018; Yang et al., 2020; Baker et al., 2021). However, despite this now large body of research, little progress has been made in exploring and understanding the possible pathways operating behind the ethnic density effect.

This thesis aims to describe and investigate the hypothesised pathways operating between ethnic density and mental health for people belonging to the largest minority ethnic groups in England. It builds on existing evidence on these pathways (Bécares, 2014) by assessing several hypothesised pathways and how these might operate differently across the ethnic groups selected.

In the remainder of this chapter, I provide an overview of the key concepts and extant literature which are important for understanding the ethnic density effect on mental health. I then set out the research questions this thesis aims to address and provide a brief introduction to the methods used (Chapter 2). Following this, Chapter 3 presents a systematic review of research on the ethnic density effect on mental health in the UK. Chapter 4 presents and describes the theoretical framework drawn from the results of the systematic review. Chapter 5 introduces the datasets and samples used to quantitatively investigate the pathways in operation between ethnic density and mental health. It then presents demographic information about the sample, descriptive statistics on both ethnic density and mental health, and the associations between them. Chapter 6 presents descriptive statistics for the hypothesised mediating variables in the theoretical framework resulting from the findings of the systematic review and their associations between ethnic density and mental health. Chapter 7 describes the measurement process undertaken using factor analysis to study social cohesion and the resulting factor structure identified. Chapter 8 describes and presents the final, Multi-Group Multilevel Structural Equation Modelling approach taken to modelling the hypothesised pathways between ethnic density and mental health across ethnic groups. Finally, Chapter 9 describes the key findings of the thesis, and puts these in the context of existing research. It identifies the strengths and challenges of the research before providing some concluding remarks and avenues for future research.

Notes of clarification

Before moving on to introducing the key concepts and background to the research, some important notes of clarification are first provided.

Geographies employed

Throughout this thesis, different geographies are referred to due to varying traditions within different bodies of research, as well as due to data limitations and different focuses of existing

research. The background literature describing migration patterns and history often refers to Britain, whereas the census statistics readily available from the ONS (2012) and described in the literature refer to England and Wales. The systematic review conducted in this thesis employs a UK focus, so that all relevant studies from similar contexts could be retained. However, due to sample size and design, the secondary analysis of quantitative data conducted later in the thesis focuses on England only. This discrepancy in geography consistency is flagged here so that readers are aware of the reasons behind it. In the following, I refer to the geographies employed by the authors of the studies cited when describing published research. In the empirical analyses conducted, I provide a rationale for the various geographies employed.

Defining 'theory-driven'

In this thesis, the use of the phrase 'theory-driven' refers to how existing knowledge, theory and research inform the research design and analysis decisions made. This approach guides the empirical research conducted in this thesis. The results of the systematic review, conducted as the first element of analysis, are used to produce a theoretical framework to guide the subsequent elements of empirical analysis. As well as being informed by this theoretical framework, the model specification decisions made when conducting the Structural Equation Modelling in Chapter 8 are also guided by a theory-driven approach, rather than by the data.

Defining 'pathways'

The term 'pathways' is taken in this thesis to refer to connections of several steps operating behind the ethnic density effect. This terminology is chosen to reflect the often complex and numerous factors in operation between ethnic density and mental health. The use of this term also links to the language associated with Structural Equation Modelling employed later in the thesis. In particular, mechanistic language is avoided as this terminology typically implies a singular mechanism of biological nature and is more closely linked to causal approaches, which are not employed in this thesis.

1.1 Background and rationale

In this literature review, I will introduce the core concepts and points of contention involved in understanding the so-called 'ethnic density effect'. Firstly, I provide a brief summary of Britain's migration history, followed by an overview of the ethnic makeup of England and Wales from the 2011 census (section 1.2), a description of residential patterns and an introduction to 'ethnic density' (section 1.3). I then describe the key public and political discourses surrounding this ethnic

diversity, including segregation, social cohesion, and austerity (section 1.4). I then turn to carefully consider how 'ethnicity' is conceptualised and operationalised in research, including the approach taken in this thesis (section 1.5). Following this, I describe how mental health has been conceptualised and how it is understood in this thesis (section 1.6). I go on to describe the ethnic inequalities observed in mental health outcomes in the UK, followed by a summary of some of the key explanations for these inequalities (section 1.7). I then introduce the ethnic density effect itself, and the pathways by which it is thought to operate (section 1.8). Finally, I make some concluding remarks to summarise the gaps, challenges and inconsistencies of the existing research (section 1.9), before introducing Chapter 2.

1.2 Ethnic diversity in Britain

Migration history

Britain is an ethnically diverse country with a long history of migration (as argued by Platt and Nandi, 2020). The population identifying as 'White British' is itself made up of a plethora of past migrations (Winder, 2013). Between 10,000 and 15,000 people from Africa were thought to have lived in Britain during the 18th century (associated with the slave trade), but in the 19th century the largest migrant groups in Britain were the Irish and the Jewish (Panayi, 2014). However, Panayi marks 1945 as a turning point for the greater increase in diversity of migration to Britain and a rise in the settlement of people outside of London (Panayi, 2014). The histories of migration and reception of these groups, as well as policies relating to migration are important to consider in order to understand the racialisation and social construction of different ethnic groups in Britain today. Indeed, in the context of the ethnic density effect it has been suggested that the differential racialisation of Black Caribbean ethnic groups in the UK compared to the US may explain the different results of ethnic density on health across the two contexts (Bécares et al., 2012c). These different migration histories and processes of racialisation are important for understanding between ethnic group differences in the ethnic density effect and in health outcomes. The complex history of migration to Britain and the UK has been summarised in detail by Reeve (2008), who highlights the economic and political processes that have determined these periods of migration to date and the settlement patterns of these migrants within the UK. As a result of this long migration history, there exists a large, well-established minority ethnic population with migrant ancestry in Britain, as well as newer arrivals.

In the relatively recent past, there have been various migration periods, characterised by the migration of particular ethnic groups. Here, I highlight some of these periods of migration relevant to the minority ethnic populations studied in this thesis. As described above, the Irish group were

arguably the largest early migrant group in Britain, and whose migration was largely driven by economic needs following from the Great Irish Famine of the 1840s (Panayi, 2014). Although it has been noted that, despite the long history of Irish migrants, they are often overlooked in migration and ethnicity studies (Hickman and Ryan, 2020). This is an issue returned to later in this thesis. Migration began to increase from commonwealth countries after the British Nationality Act of 1948, including migration from India, Pakistan and the West Indies (notably, the Caribbean) (Peach, 2006). The arrival of the Empire Windrush in 1948 is often noted as a marker of this period of migration from the West Indies, with migration peaking around 1950-1960, largely driven by labour shortages in Britain (Peach, 1986). Migration to Britain by South Asian groups is said to have largely commenced around the 1950s (Panayi, 2014), slightly after the initial period of migration from the West Indies, with peak migration around the 1960s to 1970s (Peach 2006). More recently, European migration from countries such as Poland increased after the inclusion of the Accession 8 countries in the EU in 2004 (Salt and Millar, 2006). This increase is reflected in the increase in the 'White other' category in the 2011 census (see Table 1.1). Importantly, each of these periods of migration were driven by different factors, and have been characterised by different policy, political discourse and contexts of reception. This is important for understanding the residential patterns and racialisation of these different ethnic groups and therefore, for understanding the differential effects of ethnic density across ethnic groups in Britain.

At this point, it should also be noted that migration background is distinct from ethnic background, though the two are often conflated. Indeed, as is described in the following section, a large proportion of people from minority ethnic backgrounds in the UK are born here (Finney and Simpson, 2009b) and are not migrants themselves. Migration background is important to consider, both in terms of exclusionary politics and as a stressful experience (see section 1.7 on the explanations behind ethnic inequalities in mental health). In addition, the migration experiences of parents or grandparents, or the migration experiences of a partner may form an important part of an individual's identity. However, not all people from minority ethnic backgrounds will have direct migration experiences and it is therefore not necessarily relevant to all people of minority ethnic background.

Ethnic makeup of England and Wales

In England, and the rest of the UK, ethnicity is measured by grouping people into broad country-focused categories, with some of them also drawing on race-based concepts, with additional 'White' or 'Black' options. The category of 'White British' is considered to represent the majority ethnic group, and is comprised of English, Scottish, Welsh, and Northern Irish identities. The most recent

census data available (from 2011) showed that people who identify as White British are the largest ethnic group at 80.5%. In terms of broad ethnic categories, the second largest ethnic group is the Asian category (7.5%), followed by the 'Black/African/Caribbean/Black British' category (3.3%), followed by 'Mixed' (2.2%) and 'Other' (1.0%) (ONS, 2012). Table 1.1 adapted from the ONS (2020) shows the proportion of each ethnic group in England and Wales at both the 2001 and 2011 censuses.

Currently, the modes of migration and countries of origin are the most diverse they ever have been (Reeve, 2008; Finney and Simpson, 2009b) and the proportion of people who identify with ethnic groups other than White British continues to increase. Importantly, increasing ethnic diversity in England and Wales is not only a result of increased immigration, but also due to increasing numbers of people from minority ethnic backgrounds who are born here (Finney and Simpson, 2009b). However, change in the proportion of different ethnic groups has been larger for some groups than others. For example, as mentioned previously, the 'White other' group has seen an especially large increase (see Table 1.1). The overall increase in the proportion of people identifying with ethnic identities other than White British can be seen in spatial residential patterns. In 2011, 429 (5.0%) wards in England were 'majority non-White' areas compared with just 119 (1.3%) in 2001 (Kaufmann and Harris, 2014). Greater detail on residential patterns is presented in the following section.

Table 1-1 – ONS Census data: proportion of people identifying with each ethnic group in 2001 and 2011 in England and Wales

Ethnic group	2001 (%)	2011(%)	Difference
Asian: Total	4.8	7.5	2.7
Bangladeshi	0.5	0.8	0.3
Chinese	0.4	0.7	0.3
Indian	2.0	2.5	0.5
Pakistani	1.4	2.0	0.6
Asian other	0.5	1.5	1.0
Black: Total	2.2	3.4	1.2
Black African	0.9	1.8	0.9
Black Caribbean	1.1	1.1	0.0
Black other	0.2	0.5	0.3
Mixed: Total	1.4	2.2	0.8
Mixed White/Asian	0.4	0.6	0.2
Mixed White/Black African	0.2	0.3	0.1
Mixed White/Black Caribbean	0.5	0.8	0.3
Mixed other	0.3	0.5	0.2
White: Total	91.2	85.9	-5.3
White British	87.4	80.5	-6.9
White Irish	1.2	0.9	-0.3
White Gypsy/Traveller	N/A	0.1	0.1
White other	2.6	4.4	1.8
Other: Total	0.4	1.0	0.6
Arab	N/A	0.4	0.4
Any other	0.4	0.6	0.2

Residential patterns

The residential patterning of minority ethnic groups is a key focus of this thesis. The average proportion of people from a minority ethnic background in England per Middle Super Output Area[1] (MSOA) was 19.12% (SD 21.55) in 2011. Over half of the MSOAs in England had fewer than 10% of residents identifying as belonging to a minority ethnic group (n= 3,566) and roughly one eighth had 50% or more residents identifying as belonging to a minority ethnic group[2] (n= 828). The residential patterns of minority ethnic groups at the 2011 census are shown in Figure 1.1.

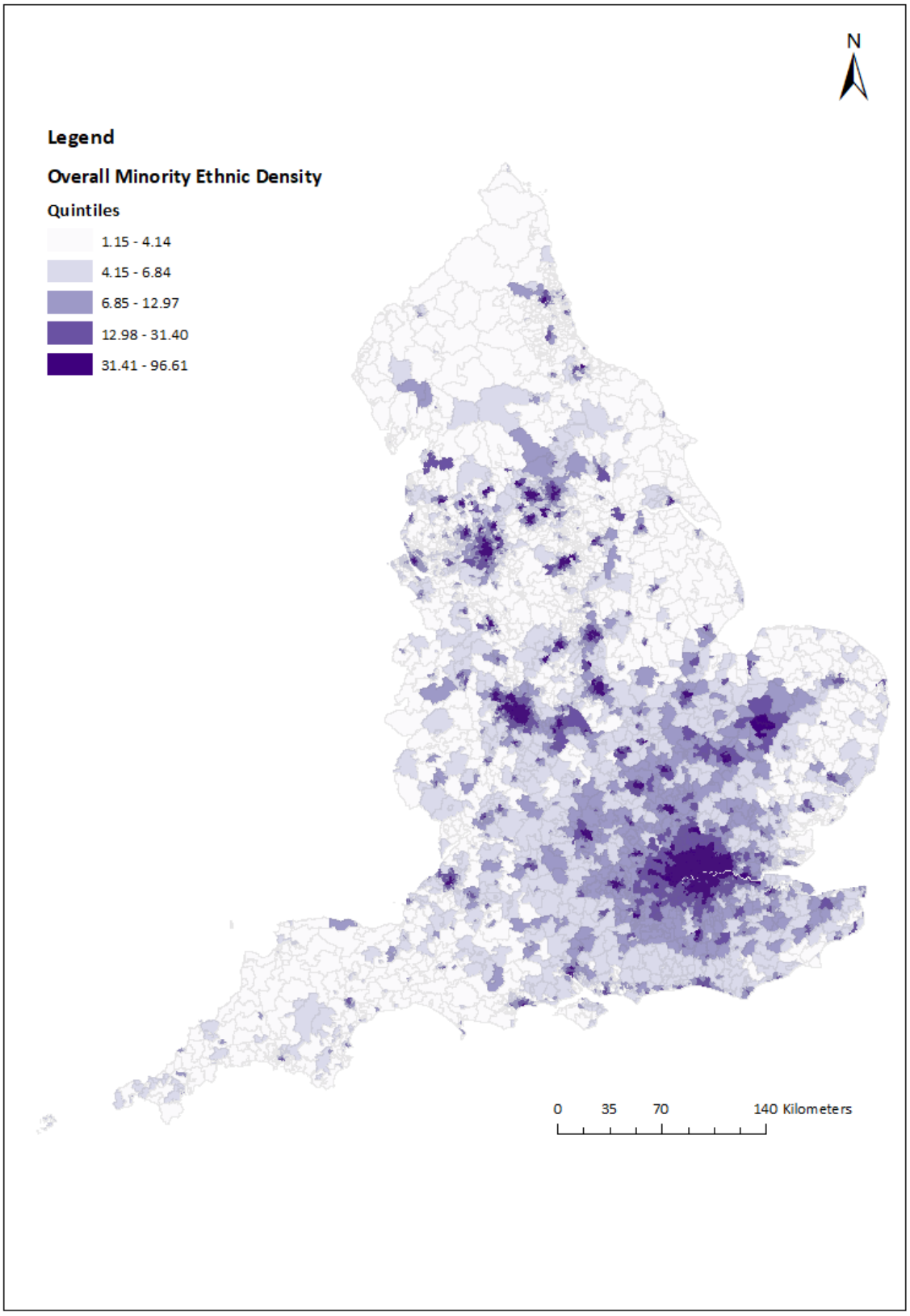
[1] Average population per MSOA = 7,787

[2] Based on calculations performed using publicly available 2011 ONS census data (Nomis, 2021)

There is a history of racism and discriminatory practices driving the clustering of people from minority ethnic backgrounds in more deprived areas in the UK. From a national perspective, the residential patterns of migrants have typically followed patterns of industry and labour shortages, as well as housing market conditions (Reeve, 2008). Settlement from very early periods of migration often centred around London and international slave trading ports (Panayi, 2014). However, within regions of England, in the not too distant past, people from minority ethnic backgrounds were explicitly excluded from private housing. Signage declaring "No Blacks. No Irish. No Dogs." on private lodgings in the post- World War Two period were said to be common place in metropolitan areas like London and Birmingham (Hickman and Ryan 2020; McKee et al., 2020). Evidence suggests that discriminatory practices towards minority ethnic groups, though less overt in nature, continued both in private and social housing between 1960 and 1980 (Harrison and Phillips, 2003). Discriminatory practices within the housing market, affordability issues and restrictions in welfare access of new migrants have continued since 1980. More recently, this has also included the of responsibility for landlords to check the immigration status of prospective renters (see Lukes et al., 2019 for a detailed overview). These factors combine to restrict the access of people from minority ethnic backgrounds to housing which is generally in areas which are more deprived (Lukes et al., 2019). These deprived areas are typically those which have suffered prolonged neglect and disinvestment, resulting in a concentration of deprivation which persists over time (Rae, 2012).

The geography of diversity in the UK has changed in the period between 1991 and 2011 (Catney, 2016a). Though the areas with greater proportions of people from minority ethnic backgrounds tend to be urban, it has been argued that there is now a gradual trend of people from minority ethnic backgrounds moving out of urban centres to suburban areas (Rees and Butt, 2004). From a local perspective, Stillwell and Phillips discuss the de-concentration of minority ethnic groups they observe in Leeds in terms of a growing minority ethnic middle class (Stillwell and Phillips, 2006). However, they highlight that income does not fully explain residential patterns observed, and that some higher earners remain in more affordable housing due to fear of harassment (Stillwell and Phillips, 2006). The more affordable housing made available by the movement of more established minority ethnic communities is often filled by less established minority ethnic groups and newer migrants (Reeve, 2008). Similarly, research also suggests that people from a Chinese background do not exhibit the same tendency to 'cluster' as often seen in other ethnic groups (Catney, 2016b; Catney, 2018). These different residential patterns and histories also have implications for ethnic density levels for different ethnic groups, and for the discourses surrounding diversity. However, before moving on to discuss these public and political discourses, the definition of 'ethnic density' is first described in detail.

Figure 1-1 - Proportion of people of minority ethnic backgrounds per Middle Super Output Area 2011 in England



Produced using ONS 2011 census statistics and MSOA boundaries in ArcGIS software

1.3 Defining 'ethnic density'

Ethnic density, in terms of the 'ethnic density effect' investigated in this thesis, refers to the proportion of a people in a particular ethnic category within a defined area. Due to the differential residential patterns of different ethnic groups, as described previously, 'ethnic density' levels differ by location, ethnic group and country context. The concept of ethnic density comes from a tradition of quantitative research (qualitative studies employing the concept are rare) and is typically measured through the use of census data and associated area units. The categories used therefore usually mirror those available in the census or aggregates of these groups, such as South Asian density or Black density. When the percentage of individuals from the same ethnic background as the participant in a study are linked, terms like 'own-group' or 'co-ethnic' density are often used. In addition, 'overall minority ethnic' density is sometimes used (as shown in Figure 1.1), where the overall percentage of people from a minority ethnic background is linked to participants belonging to any minority ethnic group.

Ethnic density is different from measures of 'segregation' or 'dissimilarity' (Massey and Denton, 1988), 'diversity' or indeed 'superdiversity'. Though related to these terms, ethnic density describes the proportion of minority ethnic people in an area, and not qualities of their distribution, which these other terms imply. Therefore, it should be made clear from the outset that studies assessing ethnic density are not able to convey information about the distribution of groups within area units, the diversity of areas, or the likelihood of contact between ethnic groups. Ethnic density describes the proportion of a certain ethnic group within a defined geographical area (and on occasion, within schools, though this is not a focus of this thesis). Based on the residential patterns described above, ethnically dense areas in the UK are usually concentrated in urban areas and are typically found in areas of high deprivation (Bécares et al., 2009). In reaction to the residential patterns and clustering of minority ethnic groups, several key public and political discourses have emerged.

1.4 Policy and public discourses relating to migration and ethnicity

As diversity in the UK continues to grow, two predominant policy approaches to ethnic diversity and migration which have emerged in recent years should be considered. These are a social and community cohesion framing to ethnic diversity and a hostile migration policy environment. However, other discourses relating to austerity and segregation are also relevant here. These discourses play a role in the racialisation and stigmatisation of minority ethnic groups.

The current political climate around migrants and refugees has been termed the 'hostile environment'. This is a state-endorsed and facilitated approach to the exclusion and marginalisation of migrants in the UK and was first explicitly voiced by the then-Home Secretary Theresa May in 2012 (Griffiths and Yeo, 2021). Although it should be noted that immigration policy in the UK has long-since been hostile towards migrants (Spencer, 2002), this current period arguably has distinct characteristics. Indeed, the 'vote leave' campaign in the referendum on membership of the European Union (Brexit) in 2016 drew heavily on anti-immigrant sentiment (Goodwin and Milazzo, 2017). Furthermore, it has been argued that the vote was perceived by some as legitimating xenophobia and overt racism and there was a spike in the number of incidents of racially motivated violence and hate crime in the aftermath of the Brexit vote (Institute of Race Relations 2016; Burnett, 2017; Home Office 2017). More recent research has also suggested that there was an increase in fear of racial harassment after the referendum (Nandi and Luthra, 2021).

The othering and racialisation of migrants is important, as this process typically conflates migrant and minority ethnic identity. Indeed, the victims of the racist incidents which occurred immediately after the Brexit vote were identified by perpetrators based upon perceived "'right' to be here" (Burnett, 2017, p.87) meaning anyone who did not visibly appear to be White British was a possible target. Evidence from one study in the UK relating to the referendum period demonstrated a detrimental association between the area-level percentage of leave voters and anxiety disorder in migrants (Frost, 2020). Relatedly, speaking from a US context, Viruell-Fuentes and colleagues argue "because anti-immigrant policies have heightened the racialization of anyone perceived to be an immigrant, their effects are likely to extend to documented immigrants and their U.S.-born co-ethnics" (p.2103). The same could be said of the hostile environment and its impacts on both UK born and foreign-born people from minority ethnic backgrounds. This is important as it has been argued that social and migration policies can be considered as a form of health policy (Viruell-Fuentes et al., 2012) and policies which serve to actively exclude migrants from accessing central services can be understood as a form of structural racism (Gee and Ford, 2011). As a result of the racialisation of migrant groups, it is likely that the detrimental effects of the hostile environment and related policies extend beyond migrants, to anyone with a minority ethnic identity. These public and policy discourses are especially relevant to the study of ethnic density, as it is probable that they will affect the likelihood of encountering racism, potentially increase the protective role of high ethnic density. In addition, it is worth noting the timing of these events, as existing research typically approaches ethnic density with an implicit understanding that it's meaning is static. However, as demonstrated here, it is likely that the meaning of living in an area of higher ethnic density may change over time. The data employed later in this thesis cover the period between January 2011 and

June 2013, encompassing the date of the hostile environment made by May in 2012 (Griffiths and Yeo, 2021). This observation and its relevance for the study findings is discussed later in Chapter 9.

The segregation myth and 'community cohesion'

Despite evidence suggesting otherwise (Catney 2016b; Finney and Simpson 2009), a narrative of minority ethnic groups segregating themselves from the rest of society remains dominant in the media and political sphere (Local Government Association, 2019; Warren 2017). Phillips (2006) highlights the pivotal role which the reaction to and discourse around the disturbances in Northern cities like Bradford in 2001 played in this narrative. For example, the 2000 report on The Future of Multi-Ethnic Britain (Parekh, 2000), published just a short time before the disturbances, did not discuss segregation as a key issue. However, this was a central focus of the Cantle report which highlighted the dangers of communities living 'parallel lives' (Phillips 2006; Cantle 2001). It was argued that a policy of 'multiculturalism' had encouraged social and spatial separateness (Finney and Simpson, 2009, ch.9) which had ultimately led to conflict and violence (Hickman et al., 2012). This concern over segregation remains in policy discourse today (as seen in recent government documents HM Government, 2018 and LGA Research Team, 2019).

Bloch and colleagues (2013) discuss a number of different political 'epochs' surrounding managing this growing ethnic diversity and multiculture in England, which overlap and inform each other (Bloch et al., 2013). These epochs are influenced by social and political events, and they argue that, partly as a result of these events, the political stance towards ethnic diversity turned away from multiculturalism in the early 2000s towards a discourse of cohesion (Bloch et al., 2013). These events and the resulting reports, such as the widely criticised 2001 Cantle report, are said to have brought increased political concern over more 'ethnically dense areas' (meaning areas that are home to minority ethnic people) (Cantle 2001; Hickman et al., 2012). Importantly though, areas of high proportions of minority ethnic groups, where White British populations are fewer are considered 'extreme', while areas where White British is the majority ethnic group are not (Finney and Simpson, 2009). Additionally, there is equally no similar anxiety over social and spatial class segregation of White citizens (Phillips, 2006).

Cohesion policy

In order to address anxieties about segregation and 'parallel lives', an emphasis has been placed on 'cohesion' and 'integration' policy. The terms 'cohesion' and 'integration' policy are often used but less often defined, both in academic literature and political discourse, and as a result are commonly used interchangeably. However, it has been argued that the political language surrounding cohesion

and integration is a reflection of previous assimilationist language (Worley, 2005). As Burnett (2008) highlights, “an understanding of community cohesion that is at its heart assimilatory seeks to blame levels of inequality on understandings of culture and values, rather than the contours of statecraft” (p.48). Burnett also asserts that “where the basis of social policy becomes integration and cohesion, inequality, discrimination and ultimately institutional racism are downplayed” (Burnett, 2008 p.48). The cohesion policy agenda has been criticised for the way it is sometimes used to specifically target and problematise the South Asian and Muslim communities (Reeve, 2008) particularly concerning the idea of differing or even incompatible cultures. As argued by Small and Solomos, an emphasis on cultural adoption and adaptation of the minority ethnic population not only continues to construct minority ethnic people as the problem but avoids recognising and tackling White racism (Small and Solomos, 2006). Concern for so-called ‘community cohesion’ thinly veils the sustained hostile environment towards migrants, and by extension, people of minority ethnic backgrounds. This is exemplified by the funding available from the ‘Controlling Migration Fund’, a fund set up to provide financial support to local authorities which have new migrant populations. The funding was made available in November 2016 and is said to have provided a total of £100 million to local governments (HM Government, 2019). The fund bizarrely paired funding for welcoming new migrants and easing “local service pressures as a result of recent migration” (p.5) with immigration enforcement (Ministry of Housing Communities & Local Government, 2018). Alongside this, a specific fund for ‘integration’ purposes was also available to local governments. The green paper published alongside this integration funding maintains that there are issues surrounding a lack of social mixing and residential segregation (HM Government, 2018). Though the language of ‘cohesion’ is less often used in these documents, the narrative remains the same.

It is worth noting briefly that, cohesion in itself, outside of the context of policy discourse, is not necessarily negative and the term is typically defined in a positive and inclusive manner. For example, Fonseca and colleagues (2019) stress the importance of resilience as a part of social cohesion and describe it as “the ongoing process of developing well-being, sense of belonging, and voluntary social participation of the members of society, while developing communities that tolerate and promote a multiplicity of values and cultures, and granting at the same time equal rights and opportunities in society” (Fonseca et al., 2019, p.246). This conceptualisation of social cohesion is returned to later in the thesis.

Austerity

Finally, the influence of austerity (in response to financial crisis, characterised by reduced spending on welfare and social services and increasing taxes) should be considered in order to fully

understand the context and interplay of these public and political discourses. Over the past decade, it has become increasingly accepted that national policy beyond the health sector, such as policy that shapes welfare regimes, educational opportunities and access to employment, contributes to overall health and health inequalities within nations. For example, Nosrati and Marmot state that "it is urgent that we adopt a multidimensional understanding of inequalities and their upstream determinants" (Nosrati and Marmot, 2019, p.377). This is accompanied by other recent calls from Bambra and colleagues (2019) who, building on the idea of a relational view of place (Cummins et al., 2007), argue for a political economy approach to health inequality. This approach foregrounds the vertical (political and institutional) as well as horizontal (local level and individual factors) determinants of health which lead to geographical inequalities in health outcomes (Bambra et al., 2019). Particularly, Bambra and colleagues emphasise the multidimensional determinants of health, the upstream 'causes of the causes' (World Health Organization, 2009), and the role of broader contextual environments like national austerity and its influence on local level policy (Nosrati and Marmot, 2019). A political economy approach to health inequality is useful in that it moves away from individualised approaches and emphasises the importance of going beyond the false dichotomy of context (the characteristics of a place) versus composition (the people who live in that place) (Cummins et al., 2007; Bambra et al., 2019).

Arguably, the popularity of the current social cohesion discourse cannot be separated from discussions on the topic of resources and welfare provision (Hickman et al., 2012). For example, recent political emphasis on 'problematic' increasing European immigration and the sharing of limited local and state resources has arguably had greater salience with the voting public due, in part, to the current context of austerity (Morris, 2019). It has been argued that the success of the leave campaign in the referendum on the EU in part hinged upon the conceptualisation of migrants as both an economic threat to a society struggling to get by under austerity, but also as a threat to national security (Virdee and McGeever, 2018). In the context of austerity, a focus on fostering community cohesion conveniently places emphasis on individuals and communities. Although referring to social capital at the time, the following statement from Wilkinson is highly applicable to community cohesion: "no doubt it is a popular concept because it holds out the idea that there are costless ways of making society and the economy work better—implying that poor communities can pull themselves up by the boot-straps without extra money" (Wilkinson, 2000, p.411). It is therefore important to understand the way local cohesion policy, within a context of austerity and a 'hostile environment' (Platt and Nandi, 2020), can contribute to health outcomes, particularly as these policies disproportionately affect minority ethnic groups and migrants. This policy context is an important consideration within ethnic density effects research, as more deprived areas (where high

ethnic density areas are typically found) have been shown to be more likely to have experienced greater cuts in spending (Gray and Barford, 2018). Deprivation has been shown to be associated with worse perceptions of social cohesion (Bécares et al., 2011), suggesting austerity is likely to undermine social cohesion further in these areas (Curtis et al., 2020). Furthermore, evidence suggests that austerity negatively impacts the social risk factors for health conditions, such as unemployment, as well as on health systems (Stuckler et al., 2017). It is therefore likely that more ethnically dense areas will have felt the effects of austerity more keenly, with possible implications for health and health inequality. This, combined with the effects of the hostile environment described above, suggests that the meaning and effects of living in an ethnically dense area are likely contingent upon time and context.

1.5 Conceptualising and operationalising ethnicity

Before introducing the literature surrounding ethnic inequalities in health and the importance of the aforementioned residential patterns, it is important to first reflect upon the use of 'ethnicity' in this thesis. 'Ethnicity', as both a term and a concept, requires careful consideration, particularly within quantitative research. Ethnicity is often not adequately defined as a concept in empirical work (Bradby, 2003) and used under the implicit assumption that there is a consensus on its definition which is commonly understood, contributing to implicit ideas of genetic determinism (Gravlee, 2009). It is argued by Bhopal and others that in all empirical research, researchers should describe their use and understanding of ethnicity and related concepts (Bhopal, 2004; Mir et al., 2013). Much of the epidemiological research to date, though frequently showing consideration of the implications of categorising ethnic identities, often ultimately fails to acknowledge the social and political construction of ethnicity. My understanding of ethnicity draws upon the conceptualisation of Barth (1998) in that the meaning of ethnicity primarily lies in the role of self-identification of ethnic groups and how the boundaries between different groups are involved in the maintenance of these identities (Barth, 1998; Meer, 2014). More specifically, ethnicity is described by Bhopal as "a multi-faceted quality that refers to the group to which people belong, and/or are perceived to belong, as a result of certain shared characteristics, including geographical and ancestral origins, but particularly cultural traditions and languages" (Bhopal, 2004). Furthermore, ethnic identities are not static and should be understood within the context of social systems (Meer, 2014). In this thesis, I understand ethnicity both as a self- ascribed identity, but also as a socio-political process of grouping together individuals who have similar traits and experiences. I utilise the concept of ethnicity under the understanding that it is socially constructed, but with real, lived implications.

In relation to ethnic inequalities in health, Smaje argues that "any impact upon health is not to be viewed simply as an outcome of particular ethnic cultural patterns, so much as a consequence of the broader socio-political contexts within which the construction of ethnic identity takes place" (Smaje, 1995, p.257). The social construction of ethnicity is a product of social and political histories, as well as current contexts (Ford and Kelly, 2005). Bradby (2003) explains "ethnicity is culturally and historically specific in two related ways: first, in the sense that its recognition and measurement by the scientific community has changed over time and currently varies between places; and, second, in the way that ethnicity informs individual and group identities" (Bradby, 2003, p.11). Ethnic identification is contingent upon context and also varies temporally and because of this, caution should be exercised when comparing studies focused on ethnic group specific health outcomes across different contexts (Zuberi and Bonilla-Silva, 2008). Specifically, this has implications for the comparison of ethnic density studies across contexts, as well as for interpreting the results of ethnic group-specific results in empirical research.

The authors of some of the studies included in this background literature review from other country contexts choose to employ language and concepts relating to 'race' rather than 'ethnicity'. Though often used interchangeably, the use of the concept of 'ethnicity' compared to 'race' is important to consider and is somewhat specific to UK-based studies. The more common use of 'ethnicity' in UK-based research may be a result of researchers acknowledging that the social identity options presented underneath the umbrella of ethnicity categories may be more meaningful to participants and may also reflect the official adoption of the concept ethnicity which is used in the UK census (Ellison et al., 2017). Defining ethnicity, ethnic categories and other related terms within health research is frequently debated. There are a number of differing conceptualisations of ethnicity, such as shared beliefs, shared geographical origins and as a process by which a social hierarchy is constructed, emphasising prejudice and discrimination (Salway et al., 2009). However, there are no internationally agreed definitions or glossaries of these terms, though some initial attempts at glossaries have been made (Johnson et al., 2019; Bhopal, 2004). It has been argued that there has been a tendency in the epidemiological literature to frame ethnicity and ethnic inequalities in such a way that implies that ethnic differences are a product of inherent biological difference (Krieger, 2000). This is an argument made by Zuberi and Bonilla-Silva (2008) who explain that this language of causality ignores the social construction of ethnicity and society's role in responding to ethnic identities. This kind of treatment is said to perpetuate misunderstanding and misuse of the concept of ethnicity (Zuberi and Bonilla-Silva, 2008).

However, it has been argued that the use of 'ethnicity' over 'race' in a context where both terms are often used interchangeably only serves to rename 'race' rather than remove it (Bhopal et al., 2020). Despite this, others have suggested that the continued use of 'race' is misleading, arguing instead for a focus on processes of racialisation (Namer and Razum, 2020). For example, as argued by Nazroo (2003), racism is a central element responsible for the differences seen in health outcomes between different ethnic identities and should therefore always be considered in any attempt to explain ethnic inequalities in health (Nazroo, 2003). There is therefore place for emphasis on processes of racialisation and racism in health research, but not, in my opinion, for the use of 'race' as a term. In particular, I have chosen to avoid the combined term 'race/ethnicity' in this thesis. Though this is commonly used in some US-based research, I believe it can, in some circumstances, suggest a lack of critical engagement and consideration of the exact construct and processes under investigation.

Language and the use of the term 'minority ethnic'

As described above, there has been substantial debate in recent years around adequate terminology to refer to people from backgrounds other than White British in the UK. This debate has recently received heightened attention in the context of the Covid-19 pandemic. During this period, a proliferation of studies assessing Covid-19 cases and deaths revealed ethnic inequalities using 'BAME' terminology, and media outlets relayed this information using the same language (Khunti et al., 2020). This prompted several publications in public health and epidemiology journals to critically reflect on the use of this homogenising language (Khunti et al., 2020; Milner and Jumbe, 2020; Selvarajah et al., 2020; Aspinall, 2021; Flanagin et al., 2021). The acronyms 'BME' (Black and Minority Ethnic) or 'BAME' (Black, Asian and Minority Ethnic) have largely been rejected by those whom they are said to describe (Aspinall, 2021) and numerous calls for a cessation of their use featured in the above publications. In addition, towards the end of 2021, a report by the Sir Lenny Henry Centre for Media Diversity condemning the use of the acronym 'BAME' was also published, with UK broadcasters agreeing to end the use of the term where possible. A core issue with these terms is that they are typically used to refer to those who are not White British, with definitions rarely given, resulting in confusion as to who the different acronyms refer to. Furthermore, it has been argued that these terms may exclude other minority ethnic groups, like White minority groups such as the Irish and Roma (Aspinall, 2021). These terms are often deployed to refer to groups who may be discriminated against based upon how they look. Other terms, such as non-White, are argued to be equally unhelpful and are ethno-centric (Aspinall, 2020). It is based on this line of thinking, of not defining ethnic groups other than White British by their relation to the White British group, that I choose to invert the more commonly used 'ethnic minority' phrase to 'minority ethnic' in this thesis.

Some argue that a concern over the order of the two words is overly pedantic and ultimately makes little difference. However, I follow the logic that this ordering emphasises the fact that ethnicity is something which everyone, even White British people, have (Aspinall, 2020).

Ethnic categorisations for research purposes

In most statistical and empirical analysis, ethnicity is operationalised as a categorical variable, understood to be static and unchanging. However, ethnic identity is known to be complex and fluid, and the use of these rigid categories can therefore be problematic (Salway et al., 2009). For example, research investigating the 'stability' of ethnic identity categories across census waves identified some instances of individuals changing their ethnic identity category as well as issues relating to multiple simultaneously valid identifications (though much of the variability observed by the authors was a result question wording changes or technical issues) (Simpson et al., 2016). The assumption that everyone will fit into one category neatly is therefore flawed (Bradby, 2003). The inclusion of a write-in option for ethnicity in the 2021 (ONS, 2021) census may reveal the extent of respondents who do not feel represented by any of these categories when this data becomes available. However, there remains little consensus on how best to measure ethnicity (Nandi and Platt, 2012) or how to best conduct health research relating to ethnicity. In order to address this lack of consensus, Mir and colleagues (2013) undertook a Delphi exercise in order to establish principles for research on ethnicity and health, producing a final list of 10 key principles. One main area of agreement from the study was that ethnic identity categories should be meaningful to the research questions but also that these categories alone may not be enough to fully explore the mechanisms in any relationships observed (Mir et al., 2013). Though ethnic identity is self-defined in most current studies (perhaps with the exception of some studies which use patient records) (Tippu et al., 2017), these categories are limited, often with no option to select multiple and those whose identities are not covered by the categories provided are assigned 'other'. In more recent studies, and as in the most recent census, the option to instead write in one's ethnic identity where 'other' is selected is sometimes available. The practice of providing only grouped ethnic categories in data collection forms, as well as combining sub-groups into broader groups in analyses due to small sample sizes is highly criticised and problematic, particularly relating to terms which put many different countries of origin together under one title such as 'Black African' (Aspinall and Chinouya, 2008). However, it is also important to consider the justifications for and implications of the use of different ethnic categorisations for the investigation of different health outcomes and mechanisms. For example, Salway and colleagues argue that, depending on the hypothesised mechanism under investigation, different groupings of ethnic group categories may be more or less useful (Salway et al., 2009).

Relatedly, it is also important to consider the implications of the use of these different categories for understanding ethnic inequalities in health and how they may lead to different findings and inform different kinds of action and interventions.

Similarly, a long-standing critique of health research is the assumption of homogeneity within these, often arbitrary, categorisations which persist despite a wealth of research demonstrating the heterogeneity both between and within ethnic groups (Aspinall and Chinouya, 2008; Bhopal, 2004). For example, the use of the category 'White' is critiqued in the literature for this reason, particularly within a UK context, as Irish and other ethnicities considered to be minority groups such as the Roma are often hidden under these headings (Aspinall, 2009). However, though problematic, it can be argued that it is necessary to make some crude attempt at categorisation in order to determine ethnic group specific outcomes within health research in order to produce effective policy (Bhopal, 2004). Gunaratnam (2003) refers to the idea of "temporary moments of closure" (p.38) of defining ethnic categories. These moments are said to be necessary in order to conduct research. However, they must be opened up and revisited when analysing and interpreting findings, so that a focus on how these categories come into being and have meaning is retained (Gunaratnam, 2003).

Throughout this thesis, specific ethnic groups are referred to by the terminology used in the 2011 Census. This is for consistency and for analysis purposes, as this is the language available to identify ethnic groups in both data sources employed later in the thesis (in both Understanding Society and the Census). I do not employ these terms under the misconception that they represent homogenous or unified groups, nor that they necessarily best represent how an individual would freely describe their ethnic background. However, they are used in this thesis to, as best as possible, group together individuals who, in terms of experiences, culture and heritage, are similar. In other words, they group together participants in meaningful ways which allow the pathways between ethnic density and mental health to be better understood. Having a clear conceptualisation of ethnicity, ethnic categories and the implications of the use of these terms and definitions is important for this thesis, particularly due to its focus on ethnic density and the statistical analyses of the role of ethnic density on mental health for different ethnic groups.

1.6 Conceptualising mental health

The research conducted in this thesis is primarily concerned with ethnic inequalities in mental health, and the role of neighbourhood ethnic composition in influencing mental health outcomes (the so-called 'ethnic density effect'). Therefore, before proceeding to introduce the 'ethnic density effect' and its association with mental health, I first reflect upon the definition, conceptualisation

and measurement of mental health. Psychological understandings of mental health and its aetiology have developed over time. Today, the two most common approaches to the measurement of mental health are the psychiatric disorder and psychological distress perspectives (Rogge, 2011). Under the disorder approach, a binary is established whereby an individual either has, or does not have a psychiatric disorder. Alternatively, the psychological distress approach understands mental health to be a continuum (Rogge, 2011). However, from a public health perspective, mental health has increasingly come to be understood as more than just the absence of mental ill health. As described by the World Health Organisation's (WHO) definition of health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organisation, 2001). This turn towards a kind of positive psychology (Rogge, 2011) foregrounds mental well-being as an important aspect of mental health. Psychologists who employ this positive approach argue that mental well-being is comprised of two key dimensions, eudaimonia and hedonism (Ryan and Deci, 2001). The eudaimonic concept outlines that positive mental well-being cannot be achieved by happiness alone and places emphasis on meaningful actions and values a state of 'personal expressiveness' (Waterman, 1990). The hedonic aspect emphasises the central importance of positive affect or 'happiness' in order to achieve mental well-being (Ryan and Deci, 2001). The current consensus among scholars of positive psychology is that mental well-being is best understood through encompassing both of these aspects (Huppert, 2005).

Following this broad understanding of mental health, epidemiologists have explored a variety of mental health constructs and conditions, including: common mental disorder (such as anxiety and depression), psychosis, schizophrenia, happiness, and life satisfaction. There is a wealth of measurement tools available to capture both the positive and negative aspects of mental health and to facilitate population-level study of these outcomes. Mental health statistics are gathered from a range of sources and include: hospital admission data, GP prescribing codes, and self-report questionnaire scales. Each of these data sources has its own unique types of bias and their use and interpretation requires different considerations. This is important to reflect upon when evaluating research and synthesising evidence on the ethnic density effect, as described in Chapter 3.

In this thesis, when studying the pathways between ethnic density and mental health, I understand mental health by this more comprehensive definition, which encompasses well-being. However, where mental ill-health is dealt with in secondary survey data later in the thesis, it is operationalised to be on a spectrum of mental distress, rather than through the binary disorder approach.

The importance of, and inequalities in, mental health

Globally mental health disorders are one of the biggest causes of years lived with disability. In 2010, depressive disorders accounted for 40.5% of DALYs (Disability Adjusted Life Years) and anxiety disorders accounted for 16.4% of DALYs (Whiteford et al., 2013). In England, approximately 17% of adults surveyed by the Adult Psychiatric Morbidity Survey in 2014 met the criteria for having a common mental disorder (McManus et al., 2016). Mental health plays an important role in a healthy and functioning society and there are associated financial costs of poor mental health. One report estimated that the cost of all mental health problems in England in the period 2009-2010 was around £105.2 billion (Centre for Mental Health, 2010), with another estimating a cost to the economy of £34.9 billion as a result of sickness, reduced productivity and staff turnover in the 2016-2017 financial year (Parsonage and Saini, 2017).

Inequalities in mental health outcomes are found across different social categories in England. For example, the overall rates of common mental disorders since 2000 have remained the same in men and increased steadily in women (McManus et al., 2016). Mental health also varies across the life course (Bell, 2014), with recent research over a 26-year period in Britain suggesting there is a decline in mental health with increasing age, which begins to improve in 'late-middle-age', before declining again in later years (Prior et al., 2020). Importantly, there are inequalities by gender in the association between age and mental health, whereby average mental health scores appear to be worse for women (McManus et al., 2016; Bell, 2014). In addition, inequalities are also observed in mental health outcomes (Halvorsrud et al., 2019), routes to accessing to care (Halvorsrud et al., 2018) and service use (Cooper et al., 2013) across different minority ethnic groups in the UK. Evidence from the 2014 Adult Psychiatric Morbidity Survey suggested that common mental disorders were more common in Black and Black British women, but sample size limited the comparisons that the authors could make between ethnic groups for specific mental health outcomes (McManus et al., 2016). These inequalities are important to address, especially as the proportion of people from a minority ethnic background in England and Wales is large and growing, as shown in census statistics (ONS, 2020). Though there has been a long-standing interest in ethnic inequalities in health from a policy perspective, this has received renewed interest in the wake of the Covid-19 pandemic, with the recent establishment of the NHS Race and Health Observatory (Naqvi et al., 2021).

The history of the study of mental health and race

It is important to acknowledge that the disciplines of Epidemiology, Psychology and Sociology are tied in with the history of Eugenics (Zuberi, 2001; Rogers and Pilgrim, 2014). Several of the statistical techniques commonly employed in Epidemiology to this day were developed by some of the key figures in the Eugenics movement (namely Karl Pearson and Ronald Fisher among others). In addition, as argued by Pilgrim "there is a traceable link between the original eugenic-genetic model of madness and taken-for-granted aspects of current psychiatric thinking" (Pilgrim, 2017, p.183). Historically, mental ill-health was thought to be indicative of a 'tainted' gene pool (Rogers and Pilgrim, 2014). The intertwined histories of both mental health and race studies in the eugenics movement, although widely considered to be unacceptable today, continues to shape the way we conduct research. For example, in Psychology, the diagnosis of some conditions focusses on departure from what is 'ordinary', yet ordinariness is based upon the perception of norms from the dominant group in that context, which is in the British context, a White British person (Rogers and Pilgrim, 2014). In Epidemiology, the use of the phrase 'the effect of race' is prolific (Zuberi and Bonilla-Silva, 2008) and, as outlined above, the use of ethnicity and meaning of ethnic categories are not commonly defined by authors. The genetic determinism which has been a long-standing feature of psychological research, combined with a tendency of epidemiologists to unthinkingly deploy ethnicity and race as though they are biologically defined categories, has serious implications for research on ethnicity and mental health. Conducting research with the complex and varying socio-political and historical contexts of ethnicity in mind is important in order to counter genetic determinism and to prevent the perpetuation of negative stereotypes of minority ethnic groups and individuals (Mir et al., 2013). However, it remains important to continue to discuss how processes of racialisation 'get under the skin' and result in the embodiment of inequality in minority ethnic groups (Gravlee, 2009). In this thesis, I have conducted each element of research and synthesised the results with this history in mind. The theory-driven approach taken in this thesis and applied to the studies included necessitates a careful consideration and clear definition of the construct under study, aiding resistance against these tendencies towards genetic determinism.

1.7 Ethnic inequalities in mental health in the UK

With these important issues in view, I turn to provide a more comprehensive discussion of ethnic inequalities in mental health. When discussing ethnic groups and categories, the original language of the authors is preserved and indicated with quotation marks. As touched upon at the start of this chapter, ethnic inequalities have been documented in mental health diagnoses, care access and pathways in the UK, but the patterns are complex and vary by the outcome assessed. Below I

summarise some of the inequalities which have been reported in mental health research across ethnic groups.

A recent meta-analysis of studies from England confirmed that the risk of being diagnosed with affective or non-affective psychosis was higher for people from all minority ethnic backgrounds, but especially high for people from 'Black' ethnic groups (Halvorsrud et al., 2019). Other studies have shown persistent elevated incidence rates of psychotic disorders in 'black Caribbean' groups (Tortelli et al., 2015). In addition, there is a now well documented striking inequality in pathways to mental health care for 'severe' mental illness for people from a 'Black African' and 'African-Caribbean' ethnic background (Morgan et al., 2005). Inequalities have also been demonstrated in health-related quality of life outcomes. In a study of adults aged over 55 in England, Watkinson and colleagues reported that worse average scores were found for some ethnic groups compared to the 'White British' group, particularly the 'Gypsy or Irish Traveller', 'Pakistani', 'Bangladeshi' and 'Arab' ethnic groups (Watkinson et al., 2021). Studies assessing common mental disorders (including anxiety and depression) also reveal inequalities. For example, Weich and colleagues reported higher prevalence of common mental disorder in Irish and Pakistani men aged 35 to 54, and Indian and Pakistani women aged 55 to 74 than the White population of the same age and gender (Weich et al., 2004). The results of the most recent Adult Psychiatric Morbidity in England survey (2014) showed no evidence of differences in the prevalence of common mental disorder by broad ethnic group for men. However, for women, those who identified with the Black or Black British ethnic group were more likely to have a common mental disorder than White British women (29.3% compared with 20.9%) (McManus et al., 2016). In addition, the authors reported some evidence of higher prevalence of panic disorder in women from Black, Asian, mixed and other ethnic groups. However, the authors of the report used only aggregated minority ethnic groups and also cautioned that small sample sizes meant disorder specific rates should be interpreted with caution. Issues surrounding small sample sizes and a lack of ethnic group specific data on mental health is a recurring theme throughout research attempting to address ethnic inequalities in mental health in the UK. This lack of adequate data is another reflection of endemic racism in the health sciences. Finally, a recent study by Jonsson et al., (2018) showed that mental well-being varied significantly by ethnicity for young people (between 10 and 15 years of age). We therefore see evidence that mental health outcomes vary across ethnic groups, and across the many domains of mental health, but that the patterns are complex (Weich et al., 2004). In addition, there is a particular dearth of information relating to other minority ethnic groups, like the Chinese, for example.

Explanations for inequalities in health across ethnic groups

Working from an understanding of ethnicity as socially constructed, but with lived consequences, I now turn to consider how these inequalities across ethnic groups can be explained. Firstly, evidence suggests that the inequalities seen in mental health are most likely a result of external and contextual factors, rather than a product of supposed genetic differences. For example, several studies have noted that, comparing evidence from studies which have assessed the mental health of minority ethnic groups in the UK to studies which assessed the mental health of people from the same ethnic group in their 'country of origin', indicates that the elevated rates of diagnoses like schizophrenia are not seen in the 'country of origin' (Halvorsrud et al., 2019). Based on the argument that in large part, ethnic inequalities in health are not a result of inherent differences, there are three primary, broad explanatory domains discussed in the literature for these inequalities: racism, migration and culture. In the following, examples from a range of health outcomes are drawn upon to demonstrate how these explanations can influence ethnic inequalities in health.

Racism

Racism has been conceptualised and operationalised in a variety of ways in health research. Williams and colleagues define racism as "… an organized social system in which the dominant racial group, based on an ideology of inferiority, categorizes and ranks people into social groups called "races" and uses its power to devalue, disempower, and differentially allocate valued societal resources and opportunities to groups defined as inferior" (Williams et al., 2019, p.106). There are several core explanations for how racism and discrimination impact upon health via biological pathways and these have been described in detail by Williams and Mohammed (2013) and Harrell and colleagues (2011). Perhaps one of the most common conceptualisations of the role of racism on health is that of racism as a stressful experience, which is linked to mental health outcomes through well-established stress-related biological pathways (Harrell et al., 2011). In addition to this, authors often discuss the associated compounding impacts of internalising racism (Speight, 2007) and poor self-esteem (Williams and Mohammed 2013). The biological pathways linking racism to mental health via stress are numerous and include increased allostatic load and inflammatory biomarkers, as well as issues with hormone regulation (Bailey et al., 2017; Berger and Sarnyai 2015).

There are also several other important, less proximal explanations for how racism impacts health. Firstly, research suggests that access to health services are disrupted by racism. Ethnically dense areas tend to be more socioeconomically deprived, and suffer from lower uptake of mental health support services and worse outcomes and recovery rates (Delgadillo et al., 2016). Secondly, a large

body of research shows that people from minority ethnic backgrounds can be reluctant to access mental health support for fear of stigmatisation from their community and anticipated discrimination by health service providers (Memon et al., 2016). Research also shows that people from certain minority ethnic backgrounds are less likely to be offered some types of treatment over others (Suresh and Bhui 2006). In addition, areas which are more deprived are more likely to suffer from higher 'social fragmentation' (Fagg et al., 2008) and from neighbourhood problems like antisocial behaviour and vandalism which constitute chronic strains and have been shown to be associated with worse mental health (Steptoe and Feldman, 2001). Finally, different forms of racism (discussed below) also combine to limit the social mobility of people from minority ethnic backgrounds, meaning they are poorly represented in higher paying professions (Brynin and Güveli, 2012) and are disproportionately represented in the 10% most deprived areas in the UK (Ministry of Housing, Communities and Local Government, 2020). This increases their likelihood of suffering from chronic stressors like difficulties in paying household bills, which is associated with increased stress (Das-Munshi et al., 2012).

Racism is often conceptualised as belonging to one of three broad classifications: interpersonal, institutional and structural (Nazroo et al., 2020). Overwhelmingly the study of racism has focused on interpersonal racism to date, measured at the individual-level (Neblett and Enrique, 2019). This is perhaps surprising, given that the two main conceptual models often employed in the study of the stress related effects of racism on health both describe the role of structural and institutional racism, as well as interpersonal racism (Harrell, 2000; Clark et al., 1999). In addition, it has been argued that the impacts of structural racism are likely to exert a greater effect on health than individual level factors (Gee and Ford, 2011). Structural racism is defined by Bailey and colleagues as the "totality of ways in which societies foster racial discrimination through mutually reinforcing systems of housing, education, employment, earnings, benefits, credit, media, health care, and criminal justice" (Bailey et al., 2017, p.1453). More recently, there have been attempts to systematically collate evidence on the study of structural racism (Groos et al., 2018) and provide guidance to its measurement (Adkins-Jackson et al., 2021), in an effort to inspire greater focus on this aspect. However, the measurement of structural racism, and particularly the role of discriminatory policies, requires different methods and approaches. These separate challenges associated with measuring structural racism at the policy level and its effects are reflected in the distinct lack of research available on the topic compared with interpersonal racism, particularly from a UK context.

It has been argued that a primary focus on interpersonal racism limits our understanding of the pervasive effects of racism on health (Neblett and Enrique, 2019). While the measurement of acute

interpersonal incidents of racism may appear more straight-forward, there are a multitude of aspects of racism to consider, including severity, frequency, duration, context and more (see Krieger 2000b for a detailed discussion of these issues). The study of racism from a life course perspective, where the effects of racism may accumulate over time, is now receiving growing attention (Wallace et al., 2016). Relatedly, work on the intergenerational transmission of the effects of racism (Kuzawa and Sweet, 2009; Krieger, 2005) and 'intergenerational drag' (Gee and Ford, 2011) is also receiving increasing interest. In studies of the effects of interpersonal racism, these aspects are less often considered.

Migration

Secondly, the migration process as a stressful 'life event' and 'migrant' as a stigmatised identity category, precarious residency status and lower levels of 'integration' can explain some ethnic differences in mental health. Evidence suggests that stress experienced throughout the migration process is associated with negative mental health outcomes (Bustamante et al., 2017), especially for those with refugee status (Sangalang et al., 2019). Migrants are also often deliberately excluded from accessing health services (Weller et al., 2019), contributing to inequalities in health outcomes. Importantly, this could also be considered as a manifestation of structural racism, signalling the often-blurred boundaries of these different explanations for ethnic inequalities. Contrastingly, there are also arguments that those who become migrants typically have better health, and this selection process produces an effect known as the 'healthy migrant effect' (Dhadda and Greene, 2018). However, more recently studies have shown that first generation migrants have better health than their children born in the country they migrated to. This has been termed the 'integration health paradox' and suggests that, as migrants and their children become more 'integrated', their health becomes worse (Nandi et al., 2020; Steinmann, 2019).

Cultural difference

Finally, explanations based upon cultural differences are often operationalised in the literature. Cultural explanations point toward differences in health-related norms and behaviours, such as diet and smoking, as well as social norms relating to support and to so-called 'acculturation'. For example, Smith and colleagues reported an increase in obesity risk for 'second generation' people from minority ethnic backgrounds, which they hypothesised was a result of acculturation (Smith et al., 2012). However, cultural explanations often draw on crude stereotypes and racist tropes which essentialise diverse groups, presenting culture as a static set of attitudes and behaviours, and responsibilise them for their poor health. For example, Nazroo and Iley explain that stereotypes

relating to smoking cannabis have been used to explain the elevated risk of psychotic illnesses in the Black Caribbean community (Nazroo and Iley, 2011). While cultural explanations are important to consider, these are rarely the principal reason behind the ethnic inequalities observed, particularly in relation to mental health. Indeed, Viruell-Fuentes and colleagues have suggested that a focus on cultural explanations distracts from the broader impact of structural factors on health inequalities (Viruell-Fuentes et al., 2012).

1.8 Introducing the 'ethnic density effect'

Drawing on the literature and evidence reviewed on the ethnic makeup of England and Wales, residential patterns, policy context and explanations behind ethnic inequalities in mental health, I now introduce the 'ethnic density effect'. Interest in the study of the 'ethnic density effect' was ignited by the seminal work of Faris and Dunham (1939) in their study of the incidence of schizophrenia in Chicago neighbourhoods. In particular, a key finding of their work was that admissions for Schizophrenia for people from a Black background were higher in neighbourhoods where there were fewer people from Black backgrounds. Since then, there has been a proliferation of studies assessing the so-called 'ethnic density effect'. A variety of health outcomes and their relationship with ethnic density have been studied, including effects on maternal and infant health (Pickett et al., 2009), psychoses (Kirkbride et al., 2014, Kirkbride et al., 2007), common mental disorder (Das-Munshi et al., 2010), life satisfaction (Knies et al., 2016), self-harm (Neeleman et al., 2001) and more. Many studies have found a protective association of ethnic density with health at a variety of scales, supporting the hypothesis of a beneficial effect. For example, in 1999, Neeleman and Wessely in a study based in South London found a decrease in relative risk of suicide of 0.75 (0.59–0.96) per standard deviation increase in minority ethnic density (Neeleman and Wesley, 1999). At a larger scale, Yang and colleagues (2018) using a survey of 2,789 individuals in Philadelphia, US found an increase in odds of reporting good self-rated health of 7% per 10% increase in neighbourhood ethnic density.

However, it is important to note that, area deprivation is strongly associated with ethnic density and impacts on health simultaneously to the protective effects which ethnic density is proposed to exert. Area deprivation negatively impacts health through a plethora of pathways including worse local health services (Fisher et al., 2020), and increased social stressors like crime and poor quality housing and living conditions (Sooman and Macintyre, 1995). Therefore, it is perhaps unsurprising that protective ethnic density effects are often only observed when area-level deprivation is controlled for in analyses.

The availability of greater sample sizes of minority ethnic groups in survey data has allowed for analyses of an ethnic density effect between more narrowly defined ethnic group categories in recent years. This important development has allowed researchers to begin to demonstrate the heterogeneity of effect between groups, rather than analysing 'minority ethnic' or similar aggregations as a homogenous group. For example, Pickett and colleagues (2009) found a positive association between ethnic density and long-term limiting illness for densities between 5 and 30% for Bangladeshi mothers, and at all higher densities compared to baseline density for Pakistani mothers, but no significant association was found in the Black African, Black Caribbean and Indian groups (Pickett et al., 2009). Several other studies have also demonstrated the importance of analysing finer ethnic categorisations when studying the ethnic density effect (Bécares et al., 2009; Bosqui et al., 2014).

However, some studies from a US context have reported that health outcomes are worse among people residing in areas with a higher proportion of people who identify with the same ethnic group (Jackson et al., 2000; Cooper, 2001). Importantly, the average levels of ethnic density in these studies are much higher than in UK studies. In addition, the most consistent evidence of an adverse effect comes from studies on segregation, and not density. For example, in a systematic review, White and Borrell (2011) identified 37 studies measuring a number of health outcomes which reported ethnic residential segregation to have a negative effect on health, in contrast to only 10 finding a positive effect and 11 finding no effect. However, the prior noted confusion between the measures, their definition and measurement can become an issue here as these segregation studies are often mis-titled with the term 'density' or vice versa. For example, despite White and Borrell (2011) claiming to review the literature on segregation in the US, a number of included studies actually measured density (Rodriguez et al., 2007; Jackson et al., 2000; Bird, 1995; Guest et al., 1998; LeClere et al., 1997; Yankauer, 1950). The distinction between these terms is important as the segregation hypothesis describes that communities living separately to the majority population results in a deleterious impact on the health of individuals in those communities (Shaw and Pickett, 2011). They have also been found to have distinct effects, as demonstrated by Kirkbride and colleagues (2007) who reported differing effects on psychoses depending on the measure used. This confusion over terminology can make surveying the evidence from the literature challenging.

The importance of context in measuring the 'ethnic density effect'

Some authors have brought attention to the fact that the nature of density varies significantly between the UK and the US, as well as important differences between migration history, demographics and race related discourses. For example, Bécares and colleagues (2012b) reported

that, of all the studies included in their review, US based studies ranged in Black ethnic density measures from less than 5% to over 90%, whereas 30% was the highest category of density used for a minority group in most UK studies. This is important when considering study comparability (Bécares et al., 2012a). Additionally, Bécares and colleagues (2012c) in an analysis of ethnic density and health of Caribbean people between the US and England, highlighted the importance of the context of migration, which is starkly different in history and context of reception, when presenting results from the two countries (Bécares et al., 2012b). The socio-political and historical context of migration has been shown to be important in influencing health inequalities experienced by minority ethnic groups in different country contexts (Nazroo et al., 2007; Bécares et al., 2012a). Furthermore, these different contexts result in different residential patterns, further resulting in different characteristics and resources (both physical and social), which are likely to have different implications for different ethnic groups.

These differences in migration context and qualities of ethnic density are thought to be some of the reasons behind the divergent results reported between US and UK studies and indeed a reason behind the greater focus on segregation and isolation concepts in the US. This is important because, as explored at the beginning of this chapter, England has a specific and unique migration history shaping its contemporary patterns and meanings of ethnic diversity (Platt and Nandi, 2020). These differences between country contexts are important as in all 11 existing systematic reviews on the topic of ethnic density and mental health (described in more detail in section 3.1 of Chapter 3), studies from a UK context were reviewed alongside studies from other country contexts. Whereas there have been a number of reviews which focus largely or entirely on the US context, the same has not yet been done for the UK context. This may be due to a small literature base from a UK context in the past as the study of ethnic density has largely been a tradition stemming from the US (Bécares et al., 2012a). However, there is now a large body of UK based research that warrants a detailed review.

Analysing the 'ethnic density effect'

Interest in the 'ethnic density effect' appears to have increased in parallel with an uptake in the use of multilevel models to assess area effects (Diez Roux, 2001; Duncan et al., 1998). This is in combination with a turn away from the once predominant focus on lifestyle factors and biomedical models in social epidemiological studies (Arcaya et al., 2016). As described by Wolf, multilevel models can be thought of as 'platial' models, whereby the topic of investigation is the relatedness of individuals living in a defined geographic area, compared with those living in other areas. This contrasts with 'spatial' models, whereby geographic information is used to assess relatedness based

on proximity (Wolf et al., 2021). Therefore, an important element involved in the process of designing a multilevel analysis is that of the chosen area unit of analysis or scale, as this should reflect the hypothesised operation of the contextual effect of interest (Macintyre et al., 2002).

In terms of the ethnic density effect, the scale at which density is measured is contingent upon the questions of the researcher. However, there has been a general lack of understanding of and engagement with the spatial scale at which mechanisms may be operating between ethnic density and health in published research. This is associated with the Modifiable Areal Unit Problem (MAUP) (Openshaw and Taylor, 1979). The MAUP, as a source of bias, means that the outcomes of studies measuring the same relationship and using the same data could be different if they use different scales of analysis or different aggregations of spatial units (Jones et al., 2018). In 1993 Halpern highlighted the lack of consistency in the unit of analysis of ethnic density and suggests this as a reason for some of the inconsistencies in results from UK based studies (Halpern, 1993). This therefore has implications for the comparison of results across studies.

The issue of selecting the most relevant area unit remains today and there has been criticism that the field of ethnic density, like much of the area effects literature, suffers from a lack of critical engagement with this design choice. Area-level variables and geographical area units are frequently selected in an 'off-the-shelf' way, based on availability in the dataset at hand, rather than based on a strong theoretical underpinning (Macintyre et al., 2002). Determining the spatial scale for analysis is a contentious issue in all neighbourhood effects research and has led some authors to test multiple scales, such as Pickett and colleagues (2009) who test both LSOA and MSOA levels in all analyses performed.

Pathways between ethnic density and health

The pathways operating behind the 'ethnic density effect' are the core focus of this thesis and are briefly introduced here, before being revisited in greater detail in Chapter 3, section 3.5. As described above, areas with higher proportions of minority ethnic residents also tend to be areas of greater deprivation, with poor access to services and often, poor service quality. Importantly, the protective effects of ethnic density tend to only be observed when deprivation is controlled for in analyses.

Existing research indicates several core mechanisms which are believed to operate between ethnic density and mental health, such as protection from racism, increased social support, and increased social capital and cohesion. However, there has been limited work to collate, evaluate and quantitatively assess these pathways. Arguably, progress in understanding the effect and its

pathways has been hampered by a long-standing reluctancy towards unpacking the 'black box' in epidemiology (Vandenbroucke, 1988). Indeed, much of the literature on the ethnic density effect to date fails to adequately, if not entirely, engage with the mechanisms which might explain the effects observed. A particular exception to this is work by Dr Laia Bécares in her 2009 PhD thesis on the ethnic density effect. Bécares provides a detailed summary of three core hypothesised pathways (the social norms model, the buffering effects model and the civic-participation model) and a theoretical model of how these pathways operate (Bécares, 2009, pp.62-69). In addition to the lack of engagement with the theory behind the pathways hypothesised to be operating, there is also limited research which has aimed to quantitatively test these pathways. Further, work undertaken to date has been confined to basic multilevel modelling. Again, one exception to this is a US-based study by Bécares in which Structural Equation Modelling is used to assess racism and social cohesion as mediating pathways between ethnic density and psychological distress (Bécares, 2014). Despite these advances made, there has otherwise been little progress in health-based research in better understanding the pathways operating behind the ethnic density effect.

1.9 Summary

This chapter has drawn attention to the long history of, and recent growth in, migration to the UK. To begin, I introduced England's recent migration history and demographic statistics, showing how the population has become more ethnically diverse between 2001 and 2011, with particular growth in the proportion of White minority ethnic groups. I introduced the concept of 'ethnic density', describing the percentage of minority ethnic groups per census area, which I showed is in general not very high in most areas (approximately one eighth of MSOAs in England have minority ethnic density levels over 50%). I then highlighted the key policy orientations of the 'hostile environment' towards migrants and a focus on 'segregation' and community cohesion in relation to managing a population which is becoming increasingly ethnically diverse and their impacts. Following this I provided a careful discussion surrounding the use of 'ethnicity' and ethnic categories in health research. I argued for the importance of understanding ethnicity as socially constructed, but with real world implications and for critically considering the language and categories used to research ethnic inequalities. I then described the ethnic inequalities in mental health observed in the UK in the context of a growing proportion of people from minority ethnic backgrounds, and why these warrant attention and investigation. Subsequently, I summarised three of the key explanations for these inequalities observed: racism, migration and cultural difference. I then presented the core concept of ethnic density effect itself and explained it as the observation that, for people from minority ethnic backgrounds, living in areas with more people from a minority ethnic group is

associated with better mental health. I described the importance of understanding why we see this effect, emphasising the current dearth of knowledge on the pathways by which ethnic density impacts mental health. In investigating this, I highlighted the need to move away from ethnic group aggregations and to focus on context in order to better understand the effects of ethnic density. This thesis aims to address these issues, providing a detailed analysis of the pathways operating behind the ethnic density effects for the largest minority ethnic groups in England.

In the following chapter, I introduce the aim and research questions to be addressed within the present thesis in order to investigate these pathways. I describe methods employed to address each of these questions and present a brief overview of the unique contribution this thesis makes to the overall body of research on the ethnic density effect.

2 Chapter 2: Aim, research question and methods

Despite a growing body of research assessing the ethnic density and mental health, there remains a lack of clarity on what the potential pathways may be and how they operate. The following aim and research questions were designed to address this gap in the literature.

2.1 Aims and research questions

The aim of this research is to investigate the pathways by which ethnic density impacts the mental health of minority ethnic groups in England.

Research questions

1. What is currently known about the relationship between ethnic density and mental health in a UK context?

    1a How have the pathways between ethnic density and mental health been conceptualized in UK based research?

    1b What is the empirical evidence in relation to these hypothesised pathways?

2. What is the relationship between ethnic density and mental health in an ethnically diverse sample from the panel survey Understanding Society (UKHLS)?

    2a Does the relationship between ethnic density and mental health differ by ethnic group?

    2b Does the relationship vary depending on the measure of ethnic density employed?

3. What pathways are operating between ethnic density and mental health in an ethnically diverse sample from the panel survey Understanding Society (UKHLS)?

    3a Is there an association between the hypothesised mediating variables and ethnic density?

    3b Is there an association between the hypothesised mediating variables and mental health?

    3c What is the measurement structure of Buckner's social cohesion short scale and is the measurement and structure of this the same across ethnic groups?

3d Is there statistically significant evidence of cross-level indirect effects for the hypothesised mediating factors?

3e Are the path estimates of the indirect paths different across ethnic groups?

2.2 Methods overview

Following the research questions above, the methods employed in order to answer each are briefly introduced and discussed, before they are described in detail within their respective chapters. As described above, this thesis takes a 'theory-driven' approach, whereby each step of the research is informed by existing theory and evidence. The summary of the methods employed below details how the results of the systematic review were used to inform the decisions made in the subsequent data analyses.

Before commencing this research, ethical approval was sought from the University of Sheffield and updated during the research to reflect changes to appropriate research practices during the Covid-19 pandemic. Patient and Public Involvement (PPI) formed an important part of the project and is a required element of NIHR funded research. In total, three PPI sessions were conducted during the research process to guide the decisions made. Further detail about the ethics process and contributions of PPI to the research can be found in Appendix section 10.1.

2.3 Research question 1 (questions 1a-1b): Systematic literature review

Research questions 1a and 1b relate to gathering and synthesising the research currently available on the ethnic density effect on mental health in the UK. A systematic review was therefore used to address these questions. Knowledge garnered from an initial scoping search and from the narrative review was used as a base on which to build the research questions, search strategy and inclusion criteria for the systematic review. The purpose of the systematic review was to establish the state of the evidence on the association between ethnic density and mental ill-health, with specific attention to the pathways both discussed and tested by these studies. The conduct and presentation of the systematic review adhered to PRISMA guidelines (Page et al., 2021). A narrative synthesis and diagrammatic representation of the pathways discussed and tested were produced. The findings of this systematic review and the resulting diagrams were used to create a theoretical framework which informed the design of the subsequent empirical elements of the research.

2.4 Research question 2 (questions 2a-2b): Regression analyses

Research questions 2a and 2b relate to assessing the association between ethnic density and mental health across ethnic groups. To address these questions, Wave 3 data from the panel study Understanding Society were used, linked to 2011 census data on area-level proportions of ethnic groups. Several linear regression analyses were run to assess the potential differences in associations across ethnic groups and by the ethnic density measure employed. This method allows the relationships between continuous outcomes and predictors to be assessed, whilst controlling for confounding variables likely to be associated with both the outcome and exposure variables.

2.5 Research question 3

2.5.1 Questions 3a-3b: Regression analyses

Research questions 3a and 3b relate to the associations between the hypothesised mediating variables (racism, social cohesion, social support and co-ethnic friends) and ethnic density and mental health. As above, the same datasets were used and regression analyses employed to assess relationships between mediating factors and the exposure and outcome variables, whilst controlling for the potential effects of confounding variables. However, in addition linear regression, logistic and multinomial regression analyses were also employed for the study of the binary and categorical mediating variables in order to assess their associations with ethnic density. These analyses were performed prior to the full models containing the hypothesised mediators (used to address research questions 3d and 3e via inclusion in indirect paths) in order to establish if there was evidence of indirect effects via these variables.

2.5.2 Question 3c: Exploratory and Confirmatory Factor Analysis

Research question 3c refers specifically to the measurement of Buckner's shortened social cohesion scale (Buckner 1988) (a multi-item measure) included in the Understanding Society survey data. The underlying factors measured by the scale, and whether their measurement varies across ethnic groups, is not well established. Therefore, in order to address the research question, Exploratory and Confirmatory Factor Analysis (EFA and CFA) methods were used in sequence. The aim of EFA is to reveal the underlying latent constructs and structure of multi-item measures, while the aim of CFA is to confirm whether the observed data fit the structure implied by the results of EFA (Finch, 2019). These methods are well suited in cases where concepts are complex and difficult, or impossible, to fully capture using single item measures or composite scales, such as in the case of social cohesion. The final step of the factor analysis process was Multilevel CFA (ML-CFA), used to establish the

measurement of social cohesion across both levels of the analysis (individual and area level). Employing EFA, CFA, ML-CFA and then subsequently models which allowed the inclusion of multilevel latent constructs (see the below description of Multilevel Structural Equation Modelling) whilst accounting for measurement error (Kline, 2005) facilitated a more comprehensive understanding of the measurement of social cohesion.

2.5.3 Questions 3d and 3e: Multilevel Structural Equation Models (MSEM) for modelling the pathways between ethnic density and mental health

Finally, research questions 3d and 3e relate to examining the indirect paths between ethnic density and mental health across ethnic groups. To address these questions, a form of Multilevel Structural Equation Modelling (MSEMs) was employed. MSEMs are a form of Structural Equation Model (SEM) which are especially well suited to analysing the association between ethnic density and mental health. SEMs bring together a group of statistical techniques based on covariance (Beran and Violato, 2010). SEMs allow the option to include both directly observed and latent variables, and to model multiple outcomes and complex paths simultaneously (Kline, 2005). Further to this, the tradition of SEM is theory-driven (Beran and Violato, 2010) and a key principle is one of parsimony (Kline, 2005). This encourages a careful consideration of the items and pathways involved and a distilled specification of the hypothesised causal framework before commencing any analysis.

Due to the nested structure of the data employed in this thesis and the contextual-level measurement of ethnic density, multilevel techniques were also required. Multilevel modelling (MLM) approaches, allow for the specification of hierarchical data and contextual effects (Rice and Leyland, 1996). However, standard MLMs typically allow just one outcome and combine between and within level effects in one estimate (Preacher et al., 2011). In order to account for the hierarchical structure of the data and to model complex paths which exist across levels of the model, Multilevel Structural Equation Models (MSEMs) were employed. Put simply by Silva and colleagues; "…MSEM models are, at their core, structural equation specifications with data at multiple levels of analysis…" (Silva et al., 2019, p.29). In MSEM, the qualities of SEM and multilevel modelling are combined, so that complex paths including both observed and latent variables can be modelled across levels, with the covariance matrix decomposed into two, the within (e.g. person) and the between (e.g. neighbourhood). However, in order to address research question 3e, an advanced form of MSEM had to be applied so that multiple ethnic groups could be assessed. This required the use of Multi-Group Multilevel Structural Equation Models (MG-MSEM), as described by Asparouhov and Muthén (2012).

2.6 Unique contributions of the thesis

This thesis makes a number of original contributions to our knowledge of the ethnic density effect. Broadly, the research aims to foreground the theories and concepts behind the proposed pathways involved in the ethnic density effect in order to advance our understanding of the phenomenon. Despite a large literature base and long-standing academic interest in the ethnic density effect and the pathways by which it operates, existing studies rarely critically interrogate the proposed pathways, or the measurement and meaning of these across ethnic groups and contexts.

Firstly, the research aims to synthesise the existing evidence on the ethnic density effect on common mental disorders in the UK using a systematic review, with a specific focus on the pathways theorised and tested to date. In order to include all the relevant evidence on the possible pathways involved, qualitative studies are also included. No existing reviews on the topic of ethnic density effects on mental ill-health have placed their main emphasis on understanding these pathways and these have therefore not yet been summarised in a systematic and comprehensive manner.

In addition, studies quantitatively assessing the pathways involved in the ethnic density effect often employ measures of complex constructs as single-item or composite measures and assume the meaning of these measures to be constant across ethnic groups. This thesis will assess the underlying factor structure of the social cohesion measure included in UKHLS and will assess the extent to which its measurement is similar across ethnic groups (using MGCFA). As far as I am aware, this is the first time that Exploratory Factor Analysis has been used to assess the underlying factor structure of the shortened version Buckner's cohesion scale included within Understanding Society. It is also the first time that the multilevel structure of the shortened scale has been assessed and incorporated into a model which can simultaneously assess the individual and area level elements of social cohesion.

Finally, the results of the systematic review, MGCFA and ML-CFA contribute to the theoretical model of the pathways by which ethnic density impacts upon mental health, tested in a Multi-Group Multilevel Structural Equation Model (MG-MSEM). Though MSEM is not a recent innovation, it remains uncommon in health research and has not yet been applied to the study of ethnic density. In addition, this thesis presents the first empirical application of the MG-MSEM approach (described by Asparouhov and Muthén, 2012). Employing this unique method, in combination with a multigroup framework, advances our understanding of the ethnic group-specific pathways by

employing a multilevel structure that allows for differences in effects to be observed across ethnic groups.

2.7 Summary

In this chapter, the overall aim of the thesis and research questions were introduced, followed by the methods which will be used to address them. In the following chapter (Chapter 3), the first two research questions (1a and 1b) are addressed via a systematic review. From the results of this review, a theoretical framework (presented in Chapter 4) is produced which is then used to guide the rest of the research.

3 Chapter 3: What is known about the ethnic density effect on mental health in the UK: a systematic review of the evidence on effects and pathways

3.1 Introduction

In order to address research questions 1a and 1b, and to guide the analysis required for research questions two and three, a systematic review was conducted of the existing UK-based research on the 'ethnic density effect' on mental health.

As described in Chapter 1, the association between ethnic density and mental health has generally been more consistently observed than associations with other health outcomes. In a study by Bécares and colleagues (2012b), it was suggested that this greater consistency may be the result of the largely psychosocial pathways involved, meaning any associations observed in other health outcomes may be mediated by an effect on mental health. It has also been argued that a range of contextual factors may influence the relationship observed between ethnic density and health, such as residential patterns, different average ethnic density levels across country contexts, migration histories and the differing racialisation of ethnic identities (Bécares et al., 2012c). Indeed, varied findings on the 'ethnic density effect' have been reported across different contexts (Bécares et al., 2012b). This highlights the need to be cautious when comparing ethnic density studies across different countries and contexts and is the primary reason for the UK only focus of this review.

Existing reviews on the 'ethnic density effect'

At the time of writing, 13 existing systematic reviews on the 'ethnic density effect' in adults were identified via searches of online literature databases from 1993 onwards (summarised in Table 10.1 in Appendix section 10.2) (Halpern, 1993; Williams and Collins, 2001; Acevedo-Garcia et al., 2003; Pickett and Wilkinson, 2008; Kramer and Hogue, 2009; Shaw et al., 2012; Bosqui et al., 2014; Bécares et al., 2018; Yang et al., 2020; Baker et al., 2021; White and Borrell, 2011; Landrine and Corral, 2009; Bécares et al., 2012b). These reviews covered a range of health outcomes and multiple country contexts, although in general there was a greater emphasis on studies from US contexts. The studies in large part synthesised the literature in a narrative form and most of the reviews applied a systematic search strategy. Based on the aforementioned issues with conflation of segregation and density, included here are reviews which assessed either density or segregation. None of the included studies refined their focus to UK studies only, although several focused only on the US (these included: Yang et al., 2020; White and Borrell 2011; Kramer and Hogue 2009; Acevedo-Garcia

et al., 2003). This is important to note as the ethnic density levels found in the US are much greater than those found in the UK (as demonstrated by Bécares et al., 2012c) and the history, migration policies and contexts of reception are different between the US and UK. Many of the more recent reviews included concluding statements about the need for more research on the pathways behind the effect. However, only two of these reviews collated evidence for the pathways involved in the effect, although this was not the primary focus of the review (Bécares et al., 2018; Baker et al., 2021). Therefore, a comprehensive review of both the conceptualisation and quantitative testing of pathways has yet to be carried out. This review aims to fill this gap, by systematically evaluating the evidence for the proposed pathways to date from studies set in a UK context.

3.2 Aims

This systematic review aims to synthesise both quantitative and qualitative evidence on the association between ethnic density and mental health in the UK in order to better understand the evidence base for the pathways in operation behind this effect. Specifically, it aims to synthesise current knowledge of:

- The relationship between ethnic density and differing mental health outcomes in a UK context.
- The pathways involved in these relationships, by looking at:
    - How these pathways have been conceptualised in both quantitative and qualitative research.
    - How these pathways have been tested in quantitative research.

3.3 Methods

Search strategy

The study was pre-registered on PROSPERO before the searches were conducted (see Appendix section 10.3). The key terms included in the search strategy published by Shaw et al. (2012) were used as a starting point for this review and were refined to only include outcome terms specific to mental health. Several additional mental health terms, and some density terms more common to UK based research were also included. Input from a specialist Librarian in ScHARR at the University of Sheffield was sought to help refine the search strategy, improve its efficiency and ensure all appropriate databases were searched. Databases were searched using consistent search terms as far as possible and included: Ovid (Econlit, Ovid MEDLINE, PsycINFO, Social Policy and Practice), Scopus, EBSCO (Child Development & Adolescent Studies, CINAHL, MEDLINE), Web of Science (Core collection), Web of Science (Medline), IBSS Via Proquest, ASSIA Via Proquest, Social Sciences Premium Collection via Proquest. Searches were limited to English language, peer reviewed journal articles. An example search strategy can be found in Appendix section 10.4. Searches were conducted in June 2019, with a top up review completed in March 2020, with no earlier date restriction specified. All included articles underwent backward citation searches. Additional references were also sought via expert recommendation. The results of each search were exported to EppiReviewer4 software (Thomas et al., 2010) where all reference management, screening and subsequent analysis took place.

Screening and inclusion criteria

The inclusion criteria for quantitative studies were as follows: published in a peer-reviewed academic journal, analysed UK based data, included a minority ethnic sample, included a mental health outcome and a measure of ethnic density. There were no other limitations placed on population, study design or analysis methods in order to retain as many studies as possible and to assess the current state of knowledge. Mental health outcomes were defined as broadly as possible, encompassing both clinical measures (such as those recorded in GP read codes) and community survey self-report scales. Density measures were considered acceptable where measures were included for ethnic groups other than just a ‘White’ or ‘White British’ group.

Studies assessing mental ill-health measures (those capturing the negative dimensions of mental health) were of primary interest in this review. Measures capturing the different dimensions of mental health, as introduced in Chapter 1, are considered to be distinct. Any studies identified which

utilised positive dimensions were retained and are described in the discussion section of this chapter, in order to identify any potential differences in association to ethnic density by the dimension of mental health measured.

Qualitative studies were included if they met the following criteria: presented UK based data which focused on a sample or an area which was described as diverse or ethnically dense, included people from minority ethnic backgrounds, and explicitly discussed mental health or well-being. Identified studies were screened first on title and abstract and then by full text. Excluded studies were tagged along with an accompanying justification.

A 5% random sample of papers selected for inclusion by title and abstract (184) were screened by the primary supervisor of this research project. This process did not reveal any uncertainty in the inclusion strategy. A doctoral candidate colleague was sourced as an additional reviewer to double review all excluded articles to minimise the possibility of exclusion of relevant papers by human error, ensuring no important information was missed. No papers excluded by human error were identified. At the full-text stage of screening, a 10% random sample (29 studies) was also screened by the primary supervisor of the project and the results reconciled. No changes were deemed necessary after reconciling the results of screening the random sample.

Quality screening

All studies were assessed for quality using adapted versions of the Critical Appraisal Skills Programme (CASP) forms (CASP, 2018), one for quantitative and one for qualitative studies. The key elements reflected upon using the CASP forms were data volume and quality, study aims and relevance, and variable measurement and the timing of these measures. All studies were retained regardless of quality, though study quality was reflected upon when producing the evidence synthesis of the quantitative studies. Study quality, as well as volume and consistency, were important considerations in relation to the synthesis of evidence on potential causal pathways. Table 3.1 describes the criteria and basis for the quality scoring system used. Studies were assigned to a category based upon meeting criteria set for a high quality paper. Studies were sometimes assigned to a lower category when it was not clear if they had met the criteria based on the information provided within the paper. It should be noted that study quality was based upon the overall design of the study, rather than the quality of the methods employed to test the pathways. This is because not all included studies quantitatively tested a pathway, and as will be discussed in detail, the methods by which pathways were tested in analyses were generally all of low quality.

Table 3-1 - Study quality scoring system

Category	Description
High	Papers were given a high rating where all key confounding variables were accounted for, where sample sizes were large (over 400 per group analysed), where the timing of the collection of data for both exposure and outcome was appropriate, and where the study was well theorised.
Medium high	Papers met all but one of the criteria for a high quality study.
Medium	Papers met more than one of the criteria for a high quality study.
Medium low	Papers met one of the criteria for a high quality study.
Low	Papers were given a 'low' rating where sample sizes were very small (below 100 per group analysed), where no adjustment was made for confounding variables and where exposure and outcome data collection was not appropriately timed (whereby the exposure measure was measured a number of years after the outcome measure).

Data extraction and synthesis

A pilot extraction template was designed, tested and refined in an iterative process as recommended by the IOM committee (Morton et al., 2011) and then applied systematically. A 5% random sample of extraction of included papers was assessed by the primary supervisor of the project to ensure clarity and consistency of the extraction process. All extracted information from the included papers was analysed via cross-tabulations and reports compiled in EppiReviewer4. An interpretative narrative evidence synthesis of the pathways theorised across all included quantitative and qualitative studies was undertaken, followed by a synthesis of the quantitative evidence for these pathways from the quantitative studies only. Narrative approaches are argued by Popay and colleagues (2006) to be the most appropriate to evaluate and summarise diverse and complex sets of studies. Possible approaches to dealing with the complexity of these studies within a meta-analytic approach were considered (such as those described by Deeks et al., 2019), but ultimately it was decided that it was not appropriate for these studies due to the considerable heterogeneity in study designs and measurement of both mental health and ethnic density. In synthesising the content of the included studies, additional literature was sought where relevant to aid comprehension of some of the arguments presented.

Terminology

The terms and categories used to refer to ethnic groups and their operationalisation differs across published research and these are often contested. Therefore, in reviewing these published studies I

opt to retain the authors' original language and labels and indicate this via the use of quotation marks. In contrast, where terminology is my own, this will be presented without quotation marks.

3.4 Results

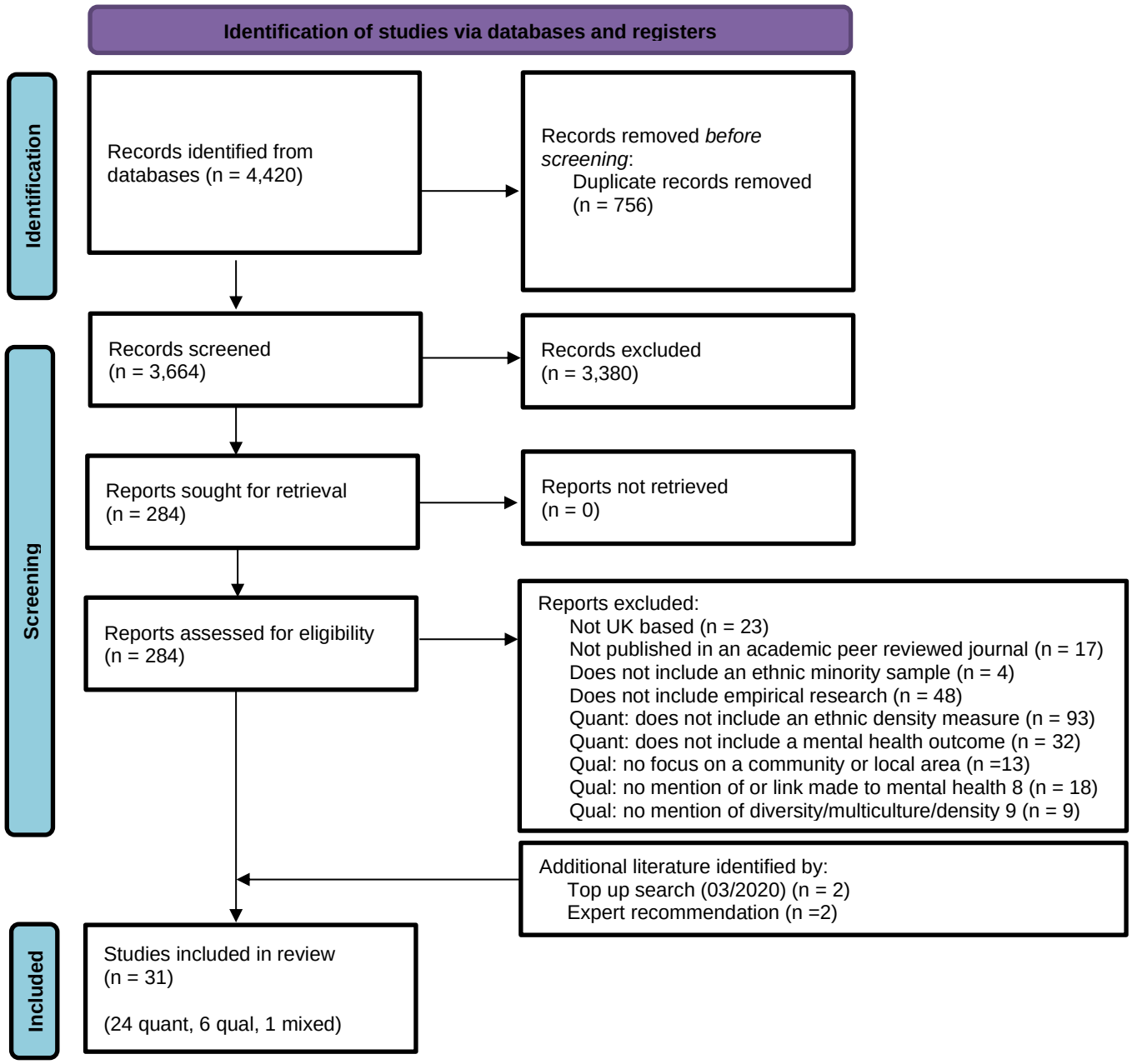
The presentation of results begins with a discussion of the characteristics of included studies, measures, analysis techniques employed, and general findings reported. The pathways theorised across all included studies (both qualitative and quantitative) are then summarised. Next, the available empirical evidence relating to each of the pathways is synthesised, considering 'severe' mental illness, common mental disorders, suicide and suicidal ideation in turn. The discussion section then identifies avenues for further research.

Search results

An initial total of 4,420 records were identified by the database searches. After the removal of duplicates this number stood at 3,664. Screening the results based on title and abstract identified 284 potential articles. Upon full-text screening, 27 studies met all inclusion criteria. Reasons for exclusion included: having no ethnic density and/or mental health measure, not analysing UK based data, not being a peer-reviewed journal article and not having a minority ethnic sample. A further four articles were identified by the top up review and by expert recommendation, bringing the total number of included papers to 31. In total, six qualitative studies were identified, 24 quantitative studies and one mixed method study with both qualitative and quantitative elements (a table summarising the qualitative studies is included in the Appendix, section 10.5, Table 10.2). The process of study inclusion is detailed in the PRISMA flow chart below (Figure 3.1). The included quantitative studies employed a total of 16 different datasets. Descriptive information and the key findings of each study within the three study groups ('severe' mental illness, anxiety and depression, and suicide, suicidal ideation and self-harm) are detailed at the end of this chapter in Tables 3.2, 3.3 and 3.4.

PRISMA flow chart[3]

Figure 3-1 - PRISMA flow chart



[3] (Page et al., 2021)

3.5 Hypothesised pathways

The most commonly theorised pathways by which ethnic density impacts mental health identified in the studies were categorised as: higher levels of inter-personal social support, reduced exposure to racism and discrimination, and higher levels of social capital and cohesion. These pathways were mostly conceptualised as mediators by the authors of these studies, rather than moderators of other pathways. Though the authors of most included studies made reference to at least one pathway they hypothesised to be operating behind the ethnic density effect, few articulated exactly *how* these were thought to operate. It was common to see only a few key pathways listed, with little elaboration and for authors to include potential pathways in analyses for which they did not provide a rationale, nor offer any theoretical basis behind. This part of the review summarises the pathways that have been theorised to date in both the quantitative and qualitative studies identified by this review, drawing on additional literature where necessary to make sense of the arguments presented. Further detail is provided on the measures employed to quantitatively test these hypothesised pathways in the following sections summarising the quantitative evidence for these pathways (sections 3.7, 3.8 and 3.9).

Examining the paths between ethnic density and mental health: Hypothesised mediators

Increased interpersonal social support

A total of 21 quantitative studies discussed social support (Astell-Burt Thomas, et al., 2012; Bécares et al., 2009; Bécares et al., 2012c; Bécares and Nazroo, 2013; Bécares and Das-Munshi 2013; Boydell et al., 2001; Cochrane and Bal 1988; Das-Munshi et al., 2010; Das-Munshi et al., 2012; Das-Munshi et al., 2019; Du Preez et al., 2016; Halpern and Nazroo 2000; Jonsson et al., 2018; Jun et al., 2020; Kirkbride et al., 2007; Kirkbride et al., 2014; Pickett et al., 2009; Schofield et al., 2011; Schofield et al., 2016b; Yan et al., 2019; Shields and Wailoo, 2002). However, few studies made any attempt to define 'social support'. Four qualitative studies discussed social support and in general, provided better detail on their conceptualisation of social support than the quantitative studies (Ochieng, 2011; Campbell and McLean, 2002; Whitley, 2006; Schofield et al., 2019). In reading and synthesising the results of both the quantitative and qualitative studies, I assume an implicit definition of social support, which encompasses the key attributes of "emotional, instrumental, appraisal and informational support" (Langford et al., 1997, p.99). In these studies, social support was often implied to operate via two pathways, both directly and via a stress-buffering process, in accordance with existing knowledge of the role of social support in health outcomes (Kawachi and Berkman,

2001). Importantly, social support was discussed as an individual attribute or resource, differentiating it from the social capital and cohesion pathways outlined later, which was typically used to refer to aspects of communities, networks and the local area.

Higher ethnic density was argued in included studies to be associated with greater social support (Das-Munshi et al., 2010; Halpern and Nazroo 2000), emotional support (Yan et al., 2019) and a reduced likelihood of experiencing isolation (Cochrane and Bal, 1988; Schofield et al., 2011). These relationships could be described as the 'direct' effects of increased social support. The 'buffering' effects of social support are discussed in the following section on the 'buffering effect' in the moderating pathways section.

Reduced exposure to racism and stigma

Reduced frequency of, or protection from, racist encounters was discussed explicitly in 12 quantitative studies (Astell-Burt et al., 2012; Bécares et al., 2009; Bécares and Nazroo, 2013; Bécares and Das-Munshi, 2013; Boydell et al., 2001; Das-Munshi et al., 2010; Das-Munshi et al., 2012; Halpern and Nazroo, 2000; Jonsson et al., 2018; Pickett et al., 2009; Schofield et al., 2016b; Yan et al., 2019) and three qualitative studies (Whitley, 2006; Campbell and McLean, 2002; Ochieng, 2011). One of the most commonly postulated pathways linking higher 'own-group' ethnic density to better mental health was reduced exposure to interpersonal racist encounters (Bécares et al., 2012c; Das-Munshi et al., 2010; Halpern and Nazroo, 2000). The included studies typically regarded these racist encounters as predominantly negatively impacting on health through increased stress, as discussed by Boydell and colleagues (2001). In addition, the argument was also made that living in higher ethnic density areas mitigated the potential psychosocial risks to mental health associated with the stigma of occupying a marginal position within society (Cochrane and Bal, 1988) or with having low social status (Bécares et al., 2012c).

Increased social capital and cohesion

Social capital and cohesion here refer to an umbrella of related but distinct pathways. A total of 12 quantitative studies (Bécares et al., 2009; Bécares et al., 2012c; Bécares and Nazroo, 2013; Das-Munshi et al., 2010; Das-Munshi et al., 2019; Halpern and Nazroo, 2000; Jun et al., 2020; Kirkbride et al., 2007; Kirkbride et al., 2008; Neeleman and Wessely, 1999; Pickett et al., 2009; Schofield et al., 2016b) and three qualitative studies (Campbell and McLean, 2002; Whitley, 2006; Wainwright et al., 2019) made reference to either social capital or cohesion. The concepts of social capital and cohesion were regularly conflated and operationalised with similar definitions, or with no definition at all. Indeed, social epidemiologists have been grappling with defining and measuring social

cohesion for some time (Szreter and Woolcock, 2004). However, it has been argued in the broader literature that the two concepts are in fact distinct, with socially cohesive societies having a large volume of social capital available (Kawachi and Berkman, 2000, ch.8). Kawachi and Berkman define social cohesion as "the extent of connectedness and solidarity among groups in a society" and social capital as "features of social structures- such as levels of interpersonal trust and norms of reciprocity and mutual aid- which act as resources for individuals and facilitate collective action" (Kawachi and Berkman, 2000, p.175). The conflation of social capital and cohesion within the included studies made attempting to separate them as distinct concepts futile and they are therefore presented here together. In the following section, the pathways emerging from the literature under the umbrella of social capital and cohesion are described. Though these are presented separately, the numerous pathways often overlap.

Social capital and cohesion: Service provision and access

Five quantitative studies (Bécares and Nazroo, 2013; Das-munshi et al., 2010; Kirkbride et al., 2008; Neeleman and Wessley, 1999; Whitley, 2006) and one qualitative study (Ochieng, 2011) discussed service provision and access in relation to social cohesion. Bécares and Nazroo (2013) hypothesised social capital to be beneficial in terms of improved access to culturally appropriate services. Conversely, low density was hypothesised to be associated with worse mental health due to lack of access to local and culturally specific services (Whitley, 2006). Relatedly, it was suggested that increased social cohesion may increase mental health service access rates because individuals are more likely to be identified by these services (Kirkbride et al., 2008).

In addition, it was also suggested that social capital was associated with greater 'upward mobility' (Bécares and Nazroo, 2013), referring to improved socioeconomic circumstances. In a number of papers, social cohesion was also said to combat the negative effects of area deprivation on mental health (Neeleman and Wessley, 1999; Das-munshi et al., 2010) often by communities stepping up to provide the services and resources which are lacking (Ochieng, 2011).

Social capital and cohesion: Collective action

Five quantitative studies (Bécares et. al., 2009; Bécares and Nazroo, 2013; Kirkbride et al., 2007; Kirkbride et al., 2008; Kirkbride et al., 2014) and one qualitative study (Campbell and Mclean, 2002) referred to increased political and civic engagement which in turn was said to improve service access and a sense of belonging, positively impacting mental health. Firstly, higher ethnic density was argued to increase political and civic participation (Bécares et al., 2009; Bécares and Nazroo, 2013). One study argued that the participation of community members in decision making processes,

specifically those related to the provision of health services, was also a benefit stemming from increased social capital associated with ethnic density (Campbell and Mclean, 2002). This study went on to hypothesise that increased involvement promoted the creation of culturally competent health care services, helping to address racism and inequalities in access to care via collaboration between the government and local communities (Campbell and Mclean, 2002).

Social capital and cohesion: Place-based identity and belonging

Eight quantitative studies (Bécares et al., 2009; Bécares et al., 2012c; Bécares and Nazroo 2013; Halpern and Nazroo, 2000; Jonsson et al., 2018; Jun et al., 2020; Neeleman et al., 2001; Yan et al., 2019) and one qualitative study (Wainwright et al., 2019) referred to the role of social capital and cohesion in creating a sense of belonging. Higher ethnic density was hypothesised to promote feelings of belonging to neighbourhoods, described by Wainwright and colleagues (2019) as being composed of two elements: an affinity for place and place-based identity. In addition, Wainwright and colleagues (2019) suggested that place-based belonging and identity mitigates the negative impacts of a poor physical and social environment. Further to this, they also suggested that pride based on shared heritage, history and culture associated with place is linked to a positive sense of identity, which in turn may contribute to countering the negative mental health impacts of racism. Areas with higher ethnic density were also thought to be more likely to have shops, services and places of worship catering to the preferences of people in that ethnic community and for these facilities to promote a sense of attachment and therefore, mental well-being (Yan et al., 2019). Yan and colleagues also argued that ethnically dense areas provide networks based on shared norms which also inspire neighbourhood belonging (Yan et al., 2019). In addition, greater involvement in the local community and government as described above was also thought to improve mental health by fostering a greater sense of belonging and improving social cohesion (Bécares et al., 2009).

Social capital and cohesion: Isolation and exclusion

Three quantitative studies (Das-munshi et al., 2010; Kirkbride et al., 2008; Schofield et al., 2019) and one qualitative study (Wainwright et al., 2019) discussed social cohesion in relation to the possible exclusion of some people from this. It was hypothesised that high levels of cohesion within a large group may further marginalise and exclude those from other minority groups living in the same area, but with a lower density of their own ethnic group (Das-munshi et al., 2010; Kirkbride et al., 2008). Some authors speculated that living within a highly cohesive ethnic minority community could also have other negative implications for mental health. For example, some hypothesised that greater

density and cohesion may be associated with greater mental health related stigma (Schofield et al., 2019).

Examining the paths between ethnic density and mental health: Hypothesised moderators and factors with more complex relationships

In addition to the key mediating pathways described above, there are several important factors which were thought to modify these associations. These pathways were more complex, often with moderating effects hypothesised on several paths, and were also in some cases said to have additional mediation effects. The following hypothesised modifiers were the most frequently discussed in the included studies.

Deprivation

Eight quantitative studies (Astell-Burt et al., 2012; Bécares et al., 2009; Das-Munshi et al., 2010; Jun et al., 2020; Kirkbride et al., 2014; Neeleman and Wessely, 1999; Pickett et al., 2009; Yan et al., 2019) and one qualitative study (Schofield et al., 2019) discussed socioeconomic deprivation specifically as a factor which in turn may modify some of the pathways discussed above. Areas with high minority ethnic density are more likely to also be socio-economically deprived (Bécares et al., 2012c), with more limited access to resources which is associated with worse mental health. Deprivation was usually understood as an extrinsic factor in the relationship between ethnic density and mental health. However, one study alluded to the fact that structural racism underpins ethnic minority residential concentration in more economically deprived areas (Bécares et al., 2009). In another study by Yan and colleagues (2019), high levels of socio-economic deprivation were hypothesised to moderate the association between ethnic density and mental health by lessening the protective effects of other pathways, or even negating their effects entirely. Relatedly, Das-Munshi et al., (2010) suggested that deprivation may have an interactive association with other pathways such as social capital. Finally, as described in greater detail below, contexts of high deprivation were thought to be associated with increased likelihood of encountering stressors in daily life (Schofield et al., 2019).

Chronic strains and social stress

Chronic stressors and strains were explicitly suggested as important factors affecting the relationship between ethnic density and mental health by five quantitative studies (Das-Munshi et al., 2012, Halpern and Nazroo, 2000, Kirkbride et al., 2008, Pickett et al., 2009, Shields and Wailoo, 2002) and two qualitative studies (Polling et al., 2020; Schofield et al., 2019). Due to the co-incidence of ethnic

density and high deprivation, the experience of stressors and chronic strains like difficulties in paying the bills and acute stress like having had property damaged, were often said to be more common in high density areas. Two qualitative studies (Polling et al., 2020; Schofield et al., 2019) suggested that an accumulation of stressors or stressful events were more likely in high ethnic density areas and that these may accumulate over the life course and between generations. Using the Stress Process Model, the authors argued that these stressors directly impacted mental health (Polling et al., 2020). However, in general the quantitative studies argued that chronic stress and strains decreased with increasing density via indirect pathways related to social cohesion and support (Das-Munshi et al., 2012; Halpern and Nazroo 2000; Kirkbride et al., 2008). In one study, the theory of informal social control was mentioned (Kirkbride et al., 2008). This theory proposes that public order is maintained, and the behaviours of a group are regulated by the social norms of neighbourhoods (Sampson et al., 1997). Under this theory it is plausible that acute incidents of social stress, including racism, may be less likely in high-density areas due to this presence of informal social control. The hypothesised relationship between density, deprivation and stress is therefore complex. Greater minority ethnic density is linked to a greater likelihood of experiencing stress, yet it is simultaneously said to provide social support and informal social control to potentially mitigate or prevent it.

Migration, language and 'acculturation'

Eight quantitative studies (Bécares and Nazroo 2013; Bécares et al., 2012b; Cochrane and Bal 1988; Das-Munshi et al., 2010; Dorsett et al., 2019; Pickett et al., 2009; Schofield et al., 2016a; Yan et al., 2019) and two qualitative studies (Polling et al., 2020; Schofield et al., 2019) discussed at least one pathway relating to migration. Typically, the authors of these studies hypothesised that being a migrant (often termed "migrant status") was deleterious in terms of poorer language skills and limited integration, hampering the development of social support and capital with the 'native' population (Dorsett et al., 2019; Yan et al., 2019). However, an alternative hypothesis was that there may be health benefits associated with the 'healthy migrant effect' (Dorsett et al., 2019) which may degrade over time and generations with increasing 'acculturation' (Pickett et al., 2009). This hypothesis appears to be based on combined theories of the 'healthy migrant effect' and the 'integration paradox'. In the 'healthy migrant effect' theory, a form of selection bias initially occurs, whereby those with better health are more likely to become migrants. However, in the 'integration paradox' this mental health advantage wears off over time with the adoption of negative health behaviours of the 'host' society or with the accumulation of the effects of discrimination (Luthra et al., 2020).

In addition, one qualitative study referred to migration as a stressful 'life event' (Schofield et al., 2019) and another discussed it as a stressor based on the stigma which surrounds migrant status (Polling et al., 2020). Relatedly, the importance of the differing contexts of reception that new migrants experience and the timing of their migration was highlighted by some studies as a factor which may explain between-country and between-ethnic group differences observed in the wider literature (Bécares et al., 2012c; Bécares and Nazroo, 2013).

The 'buffering effect'

In total, seven quantitative studies (Bécares et al., 2009; Bécares and Nazroo, 2013; Bécares and Das-Munshi, 2013; Das-Munshi et al., 2010; Das-Munshi et al., 2012; Jun et al., 2020; Schofield et al., 2016b) and three qualitative studies (Ochieng, 2011; Polling et al., 2020; Wainwright et al., 2019) discussed the 'buffering effect'. This is the indirect effect of social support, whereby the detrimental impacts of deprivation, stress and racism are lessened in the presence of social support. This was commonly discussed as a distinct pathway in its own right and was often conceptualised separately to social support. It was suggested that this 'buffering effect' operated via several pathways. Firstly, it was argued that it mitigates the effects of stressors (Kirkbride et al., 2007; Kirkbride et al., 2008; Polling et al., 2020), including chronic strains (Das-Munshi et al., 2012) and the detrimental impacts these have on mental health. Secondly, it was said to lessen the impact of interpersonal racist events and enacted stigma (Pickett et al., 2009) on mental health. Relatedly, the likelihood of internalising this racism was said to reduce (Bécares et al., 2009; Bécares et al., 2012c). Internalisation is described by Krieger and Sidney as "referring to how people belonging to social groups historically and adversely defined, in part, by discrimination may internalize these negative views and consider their subordinate status to be evidence of their own deficiencies rather than discrimination" (Krieger and Sidney, 1996, p.1370). Finally, one qualitative study also suggested that this buffering effect may be further bolstered via validation of experience by a mutual understanding of the same struggles (Polling et al., 2020). Social validation is a key mechanism of social support among minority groups which is often drawn upon in support groups (Grier-Reed, 2013).

3.6 Examining the available evidence for the proposed pathways

I now turn to consider the quantitative evidence available in the included studies for the operation of these hypothesised pathways in practice. The quantitative studies are grouped by broad mental health outcome: 'severe' mental illness, anxiety and depression, and suicide, suicidal ideation and self-harm. The characteristics of each study group are described, followed by a summary of the main findings on the 'ethnic density effect' itself, followed finally by a synthesis of the findings of each of

the pathways tested within that mental health outcome group. In identifying evidence in support of a particular pathway from each individual study, the approach was to report only results which were found to be statistically significant.

Overall summary of the design of the quantitative studies and their approach to testing the proposed pathways

Regression modelling was the most commonly applied method, with pathways predominantly tested via inclusion of a covariate in regression models, and less commonly via tests for interaction with ethnic density (as seen in: Bécares et al., 2009; Das-Munshi et al., 2012). None of the included studies employed any more sophisticated causal analysis techniques and most were cross sectional in design. Therefore, the conclusions which can be drawn from these studies regarding the causal chain between ethnic density and mental health are limited.

Ethnic density was modelled per unit increase in some studies, and per unit decrease in others. In addition, the mental health outcome measures employed were diverse and variously scaled, with higher scores meaning better mental health in some studies, and worse in others.

3.7 'Severe' mental illness studies (psychosis and schizophrenia)

Study characteristics

Eleven studies assessed ethnic density effects on 'severe' mental illnesses which included psychosis (including both affective and non-affective psychosis) or schizophrenia, with varying measures used (see Table 3.2). In general, these studies employed small area units (from Ward to Regional Health Authority) and were entirely cross-sectional. A defining characteristic of this group of studies was that over half (n= 6) employed GP records in population-based studies to confirm cases. Of these studies, five out of six focused on London or smaller geographies within London. It is arguable that these studies are therefore not representative of the rest of England due to the unique demographic and residential patterns, particularly of minority ethnic groups, within London. These studies were also more limited in ability to control for key confounding variables such as an individual's socio-economic status and in the ability to test possible pathways. In general, the studies using self-report measures were assessed as being of higher quality than those using GP records. The lower quality assessment of the studies using GP records was typically due to: small sample sizes (often meaning authors were forced to combine minority groups into larger, more generalised groups such as 'Black' or 'BAME'); a lack of ability to control for important confounders; and measurement of ethnic density during or after the measurement of the mental health outcome (Boydell et al., 2001;

Schofield et al., 2011; Kirkbride et al., 2008). All studies in this outcome group examined adult populations.

3.7.1 Ethnic density mental health relationship

Evidence for the relationship between ethnic density and 'severe' mental illness outcomes was consistent overall, with most studies showing a protective association (Table 3.2). In total, ten studies reported an overall protective relationship for one or more ethnic groups (Schofield et al., 2011; Schofield et al., 2016b; Boydell et al., 2001; Halpern and Nazroo 2000; Kirkbride et al., 2007; Kirkbride et. al., 2008; Kirkbride et al., 2014; Bécares and Das-Munshi, 2013; Das-Munshi et al., 2012). One study (Bécares et al., 2009) reported more mixed results with protective associations found for some ethnic groups, but a detrimental association reported for the 'Pakistani' group.

3.7.2 Examining the evidence for the mediation pathways proposed

Six of the 11 studies assessing 'severe' mental illness outcomes tested one or more hypothesised pathways between ethnic density and mental health. It is important to note that no specific techniques were employed to assess the operation of these variables, though they were typically hypothesised as mediating variables by the study authors. The following hypothesised mediating variables were specifically assessed by studies in this group.

Increased social support

Two studies (using data representative of England and Wales and England respectively) provided some evidence on the potential protective effects of social support. The two studies assessed social support in different ways. One medium low quality study[4] measured aspects relating to 'mutual support', including giving help to others outside one's household, sending money to dependants and receiving money from individuals outside the household (Halpern and Nazroo, 2000). The second, high quality study, assessed the support received from the participant's nominated closest friend, via practical support, confiding support and negative aspects of support (Das-Munshi et al., 2012).

In the study by Das-Munshi and colleagues (2012), evidence was reported of an interactive association with social support. Predicted probabilities of reporting psychotic symptoms for the combined category of 'minority ethnic' were found to be lower with higher 'own-group' density.

[4] Quality ratings (the criteria for which are described in Table 3.1) are employed on the basis of the appraisal conducted.

Interaction effects tested with measures of 'confiding support' and 'practical support' were found, where higher levels of both confiding and practical support were associated with a steeper reduction in reporting psychotic experiences with increasing 'own-group' density. For the combined minority ethnic group, in a multilevel model adjusted for all relevant covariates and other hypothesised pathways, evidence was found only for practical support. The authors find lower odds of reporting psychotic symptoms for the highest tertile compared with the lowest two tertiles. In models analysing finer ethnic categories, the authors reported only confiding support to be associated with psychotic experiences for the 'Black Caribbean' group only, indicating higher odds of reporting symptoms for this group at higher levels of support. In the study by Halpern and Nazroo (2000), a positive association was reported between increasing ethnic density and mutual social support, and a protective association between ethnic density and mental health. However, the authors did not analyse all of these pathway elements within one model.

Reduced racism

Two high quality studies (Das-Munshi et al., 2012; Bécares et al., 2009) (using data representative of England and England and Wales respectively) provided evidence of a negative association between ethnic density and reported experiences of racism, and of a buffering of the effect of racism on health in the presence of increased ethnic density. In both studies, interpersonal racism was measured, using questions relating to having been attacked, had property damaged or been verbally insulted. In addition to this, Das-Munshi and colleagues (2012) also assessed work-based racism via questions relating to having been refused a job and having been treated unfairly at work. Across these two studies, and even within both elements of racism assessed by Das-Munshi et al., (2012), these questions were asked inconsistently. Bécares et al., (2009) utilised survey questions on interpersonal racism in relation to 'race or colour' whereas Das-Munshi et al., (2012) utilised questions on interpersonal racism in relation to 'ethnicity' and work-based questions in relation to 'race, colour or religious or ethnic background'.

Bécares et al., (2009) reported a detrimental association between increasing racism and mental health, statistically significant in the overall ethnic minority group, the 'Caribbean' and the 'Indian' group. In addition, the authors recorded a protective association between increasing density and racism for the combined minority ethnic group and for the 'Bangladeshi' group in a model adjusted for important covariates. Interactions were tested between ethnic density and racism, but no statistically significant evidence of an interaction was reported in any group. In the study by Das-Munshi and colleagues (2012), a 10% decrease in ethnic density was associated with an increase in relative odds of experiencing interpersonal racism to a statistically significant level for the

'Bangladeshi' group only. A 10% decrease in ethnic density was associated with increased relative odds of experiencing work-based racism for the overall minority ethnic group, the 'White British' and the 'Black Caribbean' groups. In the final model for the combined minority ethnic group containing all relevant covariates, other hypothesized pathways and ethnicity density, both interpersonal and work-based discrimination were associated with significantly higher odds of schizophrenia. This evidence suggests that racism is associated with both ethnic density and 'severe' mental illness.

Social capital & cohesion

Three, medium to medium high quality studies, all by the same first author, provided some inconsistent evidence for the role of social capital and cohesion in mediating the association between ethnic density and 'severe' mental illness (all representative of small South, Southeast or East areas of London). Kirkbride and colleagues (2008) in a medium quality study assessed social capital using five questions of the Sampson instrument measuring 'social cohesion and trust' (Sampson et al., 1997). The other two medium high quality studies used 'voter turnout', which the authors argue can be used as a proxy for 'social capital' (Kirkbride et al., 2007) and 'social cohesion' (Kirkbride et al., 2014), though the extent to which this measure is a useful proxy for these is arguable.

One study (Kirkbride et al., 2014) did not find evidence of a statistically significant association between voter turnout and non-affective psychosis (the authors did not describe tests of association for voter turnout and ethnic density). The remaining two studies both reported some statistically significant associations with social cohesion. Kirkbride et al., (2008) reported that for the sample as a whole, ethnic density was negatively correlated with social cohesion. However, in their final, fully adjusted model containing ethnic density for the whole sample, the authors reported a U-shaped association between social cohesion and trust and Schizophrenia, with both high and low levels of social cohesion and trust associated with higher incidence rates of Schizophrenia compared with mid levels. The authors interpreted this finding by suggesting that lower cohesion levels may indicate a lack of opportunities needed to help individuals cope with stress. Conversely, they suggested that higher levels may mean that some individuals did not have access to the social capital reported, or that a schizophrenia diagnosis was more common due to a greater likelihood of interaction with services due to informal social control (Kirkbride et al., 2008). Finally, Kirkbride et al., (2007) reported that a 1% increase in area voter turnout was associated with a 5% decrease in Schizophrenia incidence, though the authors did not find ethnic density to be associated with Schizophrenia. However, they reported that voter turnout was also associated with a decrease in the incidence of other non-affective psychoses, in a model containing ethnic density.

3.7.3 Examining the evidence for the other pathways proposed

The following studies assessed variables with more complex roles in the association between ethnic density and mental health. Although social stress was thought to have some mediation effects (and is as a result, depicted in Figure 3.2) these variables were often hypothesised to be moderating factors for the one or more of the pathways between ethnic density and 'severe' mental illness, though they were not typically tested in a manner which suggests moderation (such as via interaction effects).

Reduced social stress

Three studies of varied quality provided inconsistent evidence on the relationships between ethnic density, social stress and 'severe' mental illness. Across these studies, social stress was conceptualised and measured inconsistently. In a high quality study (representative of England), Das-Munshi et al., (2012) assessed chronic strains and difficulties, measured through the reporting of a number of issues including paying the bills, physical issues with housing, issues with family and issues with the local neighbourhood (such as lack of services and noise). In a medium quality study (representative of South London), Kirkbride et al., (2008) measured 'social disorganisation' with questions relating to the local area, including questions on vandalism and graffiti, attacks and theft. Halpern and Nazroo (2000) in a mid low quality study (representative of England and Wales) assessed victimisation, though notably not attributable to any kind of personal characteristic, using questions relating to having been attacked or had property damaged in the last 12 months.

Halpern and Nazroo (2000) reported significantly lower levels of property damage with higher own-group density for people from a minority ethnic background, though the authors found no significant association for attack. Kirkbride and colleagues (2008) did not find evidence of an association between social disorganisation and Schizophrenia in their final model, likely due to its high correlation with other similar measures included in the analysis (such as social cohesion as explored above). The authors do not describe the association between social disorganisation and ethnic density. Das-Munshi et al., (2012) reported lower odds of reporting difficulties with housing per ten percent decrease in own-group density for the combined minority group, higher odds of problems with relatives for the 'Irish', 'Bangladeshi' and 'Indian' and combined groups, and reporting one or more strains for the 'Irish' group. In the final multilevel model for the combined minority ethnic group containing all relevant covariates, other hypothesized pathways and ethnicity density, the authors reported a detrimental association between experiencing one or more chronic strains and reporting psychotic experiences. Similar multilevel models for finer ethnic groups showed the same

effect direction and were all found to be statistically significant except for in the model for the 'Bangladeshi' group.

Migration status and language

Two studies were identified which analysed migration related factors, both of which used data representative of England and Wales. In a medium low quality study, Halpern and Nazroo (2000) examined 'acculturation' via both English language fluency and age at migration. In a high quality study, Das-Munshi et al., (2012) examined 'generational status' via country of birth.

Halpern and Nazroo (2000) reported that those who were less fluent on average reported more symptoms and that this measure was also associated with ethnic density. In addition, those who migrated at an older age on average reported fewer psychiatric symptoms, though the authors did not find this to be associated with ethnic density. Das-Munshi and colleagues (2012) tested but did not report any statistically significant interactions between 'generational status' and ethnic density in reporting psychotic experiences.

3.7.4 Summary of the findings relating to 'severe' mental illness

In summary, the evidence on the pathways linking ethnic density to 'severe' mental illness was limited in volume and quality. Some consistent evidence was reported by two studies for ethnic density reducing exposure to racism, as well as for increased racism negatively impacting 'severe' mental illness outcomes. The evidence found on social support suggested that increasing social support was protective of 'severe' mental illness and that it increased with increasing density. Some evidence was reported for the role of social capital and cohesion in the relationship between ethnic density and 'severe' mental illness; however, this was inconsistent. Finally, the somewhat disparate papers grouped together under the umbrella of 'social stress' had the most inconsistent findings, which was unsurprising given that no two papers measured the same construct with the same measure. Though no statistically significant associations were reported for social disorganisation or victimisation, the findings on chronic strains as assessed by Das-Munshi et al., (2012) suggested that with decreasing ethnic density, reporting chronic strains became more likely and that chronic strains were associated with an increase in psychotic experiences. The pathways described in this section are summarised in the following diagram (Figure 3.2).

Figure 3-2 – 'Severe' mental illness studies mediation pathway diagram

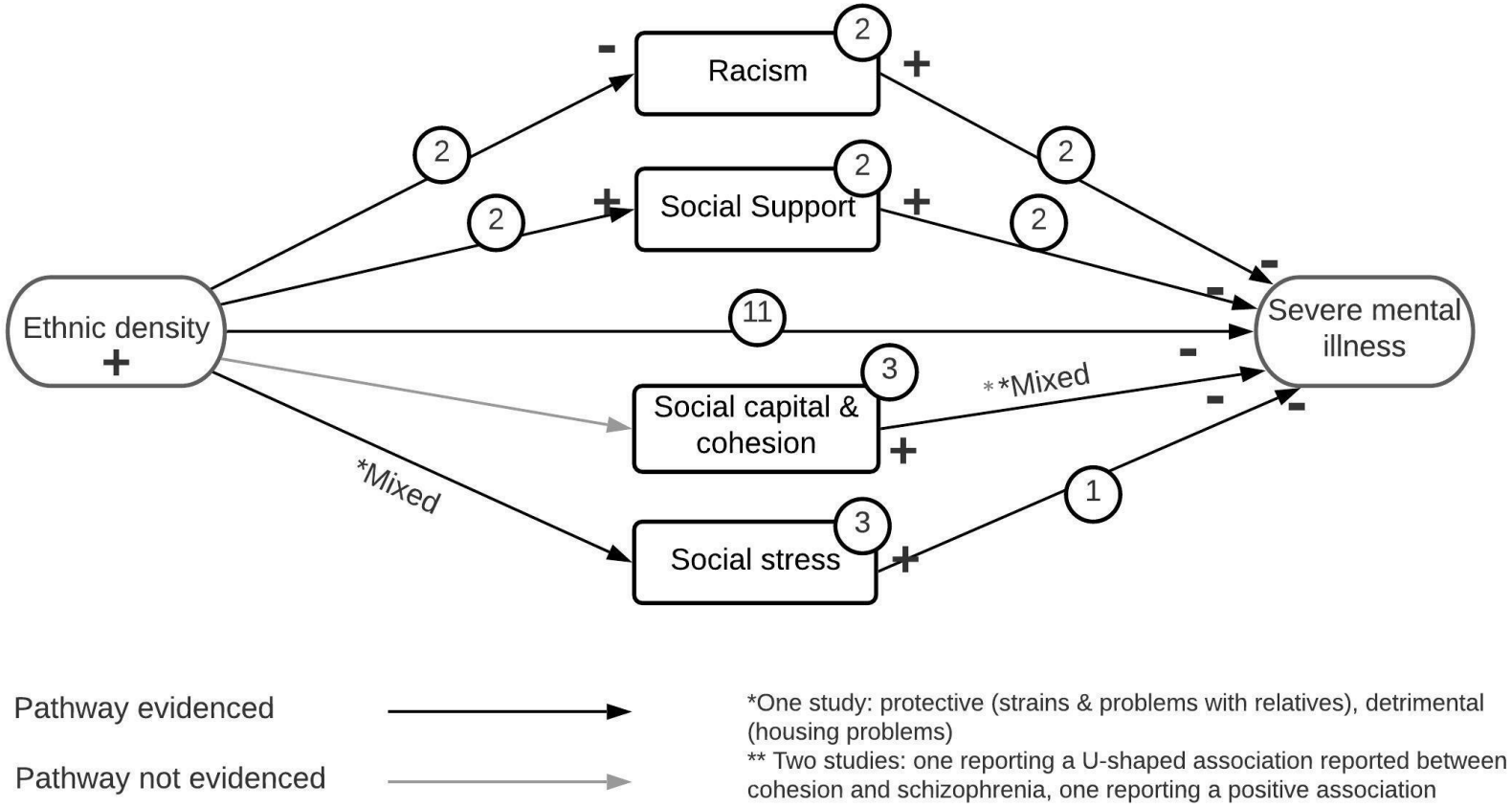


Figure 3.2 shows statistically significant evidence on hypothesised mediating variables from models adjusted for basic covariates. The signs at the start and end of each pathway represent the associations found by the authors unless the evidence is mixed. Where this is the case, a note is added to the diagram to explain the differential findings.

3.8 Anxiety and Depression studies

The largest group of studies included within this review are those which assessed anxiety and depression (n=14). Six of these studies focused on population subgroups, including mothers (Pickett et al., 2009; Du Preez et al., 2016), young people (Jun et al., 2020; Jonsson et al., 2018; Astell-Burt et al., 2012), and men from minority ethnic groups (Shields and Wailoo, 2002). Overall, these studies were of medium to high quality. Those scoring medium on the CASP checklist typically had small sample sizes, and/or did not control for important confounding factors, such as area deprivation. The majority of these studies utilised survey data, meaning more information was available for individual-level covariates than in the 'severe' mental illness studies reported above. As a result, these studies were generally able to control for potential confounding variables more comprehensively. Two of these studies were longitudinal in design, though the samples of both of these studies included young people only and neither reported statistically significant evidence of an ethnic density effect (see Table 3.3). A range of area unit sizes were employed, from Output Area to Local Authority Districts.

3.8.1 Ethnic density mental health relationship

Evidence for the ethnic density effect was more mixed than in the studies assessing 'severe' mental illness outcomes. Five studies reported no statistically significant evidence of an association between ethnic density and common mental disorder outcomes for people from minority ethnic groups (Astell-Burt et al., 2012; Du Preez et al., 2016; Jonsson et al., 2018; Jun et al., 2020; Schofield et al., 2016b). Four out of five of these studies assessed sub-populations and four out of five employed a combined 'minority ethnic' grouping, rather than more fine-grained categories. Five studies reported evidence of a statistically significant association between ethnic density and common mental disorders, in the protective direction only, for at least one ethnic group (Halpern and Nazroo, 2000; Shields and Wailoo, 2002; Das-Munshi et al., 2010; Bécares and Das-Munshi, 2013; Pickett et al., 2009). Three studies reported mixed results, with protective associations observed for some ethnic groups, but statistically significant deleterious associations reported for other ethnic groups. Dorsett et al., (2019) combined broad White versus non-White ethnic categorisation with a measure of migration status to produce the final categories employed in their analysis. They reported a protective association between ethnic density and anxiety and depression for the 'Second-generation non-White', the 'First-generation recent White' and the 'First-generation recent non-White' group. A statistically significant association in the opposite direction was reported for the 'First-generation established White' group. Schofield et al., (2016a), reported associations between ethnic density and new depression diagnosis for all ethnic groups included. These associations were

in the protective direction for all groups except the 'Caribbean' group. Bécares and Nazroo (2013) report a protective effect for the Indian group, but a detrimental effect for the Bangladeshi group. Finally, Yan and colleagues (2019) reported a detrimental association for the highest two quintiles of density for the 'Black Caribbean' group only.

3.8.2 Examining the evidence for the mediation pathways proposed

Ten out of 14 of the studies assessing common mental disorders and related outcomes tested one or more pathways between ethnic density and mental health or pathways which were hypothesised to moderate the relationship.

Social support

Two studies of differing quality assessed social support. In a high quality study by Das-Munshi and colleagues (2010) (representative of England), two questions from the Close Persons Questionnaire were used to assess social support. Relating to a nominated closest person, respondents were asked to "rate how far their nominated closest person provided them with practical support and confiding or emotional support." (Das-Munshi et al., 2010 p.2). In a mid low quality study Halpern and Nazroo (2000) (representative of England and Wales) assessed social support via the following three elements: "providing regular help or service to a friend, relative or neighbour not living with you; receiving money from a person outside the household; and sending money to family or dependants not living in the household" (p.5).

Das-Munshi and colleagues (2010) reported an association between higher ethnic density and improved practical social support, for the 'Bangladeshi' group and the combined minority ethnic group. The authors tested, but reported no evidence of a statistically significant association between confiding and emotional support and ethnic density. Feeling close to three or more people was only found to be statistically significantly associated with ethnic density for the 'Bangladeshi' group, for whom the association was positive. However, based on assessing the shrinkage of the association between ethnic density and mental health after including potential mediators into the model, the authors concluded that there was no evidence in support of social support acting as a mediator. Halpern and Nazroo (2000) reported a positive association between ethnic density and social support, though results were not shown or discussed in relation to anxiety and depression.

Racism

Three studies of medium high to high quality tested racism as a potential mediator. In a high quality study (representative of London, using an adolescent population group), Astell-Burt and colleagues (2012) assessed racism via a dichotomous variable constructed from an affirmative answer to the question "Has anyone made you feel bad or hassled you because of your race, skin colour or where you were born?" (p.5). In another high quality study (representative of England), Das-Munshi and colleagues 2010 created a binary variable from an affirmative response to either of two questions relating to (i) the experience of racism in the last 12 months in relation to interpersonal racism (experience of attack, property damage or verbal abuse) or (ii) work-based racism (having been refused a job or treated unfairly at work). Finally, in a medium high quality study focused on men only (representative of Britain), Shields and Wailoo (2002) included 'living in fear of racial harassment' to assess racism.

Astell-Burt et al., (2002) tested but reported no evidence of an association between own-group ethnic density and Total Difficulties Score (TDS) (a mental health measure tailored to young people). However, the authors did find a statistically significant association between increased racism and poorer TDS scores across all ethnic groups. In addition, the authors also reported the association between racism and TDS to be modified by age, with older age associated with a reduction in the detrimental association between racism and TDS across all ethnic groups. Das-Munshi et al., (2010) reported evidence that increasing 'own-group' ethnic density was associated with decreased reporting of racist experiences (both work-based and interpersonal) for the 'Bangladeshi' group only. In this study, for the 'Black Caribbean' group, the opposite was found in relation to work-based discrimination. However, the authors reported no evidence of interactive effects between racism and ethnic density (Das-Munshi et al., 2010). Finally, Shields and Wailoo (2002), reported an association between increased fear of harassment and increased unhappiness, statistically significant only for the 'South Asian' group, in a model including own-group ethnic density (suggesting that the association exists when the effect of ethnic density is held constant).

Social capital and cohesion

Only one, high quality study assessed social capital as a potential mediator in this collection of studies. Bécares and Nazroo (2013) (using a dataset representative of England) measured 'cognitive' social capital via a factor score created from the following four questions: "whether this area is a place they enjoy living in, whether this area is a place where neighbours look after each other [responses recoded to range from 1 (strongly disagree) to 4 (strongly agree)]; how much of a

problem in their local area are teenagers hanging around on the streets, and how much of a problem in their local area are vandalism, graffiti or deliberate damage to property [responses ranging from 1 (a big problem) to 4 (not a problem at all)]" (p.547).

The authors measured social capital at both the individual level and area level. They reported individual level social capital to be associated with reduced odds of distress for each of the ethnic groups included (Black Caribbean, Black African, Indian, Pakistani and Bangladeshi) in a model containing all relevant covariates. Area level social capital was found to be protective to a statistically significant level in just the 'Indian' group. In models assessing the association between 'own ethnic density' and area-level social cohesion, positive associations were reported for those in the 'Indian' and 'Pakistani' groups, whereas negative associations were reported for those identifying as 'Black Caribbean', 'Black African' and 'Bangladeshi'. Ethnic density was reported to be associated with lower individual-level social cohesion for the 'Black Caribbean' and 'Bangladeshi' groups, and higher density for the 'Indian' and 'Pakistani' groups. However, based on the results of final multilevel models containing the mental health outcome measure (GHQ-12), the authors concluded that social capital did not mediate the association between ethnic density and mental health.

Social stress

Two studies, one of medium low and one of medium high quality, examined social stress. In a medium low quality study (representative of England and Wales), Halpern and Nazroo (2000) assessed social stress via a survey question relating to having been attacked or had property deliberately damaged in the last 12 months. In a medium high quality study (representative of Britain, with population subgroup minority ethnic men), Shields and Wailoo (2002) assessed social stress by utilising survey questions on having been attacked, burgled or having had an accident in the last 12 months, which they termed as 'life events'.

Halpern and Nazroo (2000) reported that higher own-group ethnic density was associated with less reporting of property damage for all minority ethnic groups. The authors did not find evidence of a statistically significant association between own-group density and having been attacked, and no tests of association between these factors and common mental disorder were reported in the study. Shields and Wailoo (2002) reported that being attacked was positively associated with unhappiness for all ethnic groups included in their analyses in a model containing 'own-group' ethnic density, though the association between being attacked and ethnic density was not explored.

3.8.3 Examining the evidence for the other pathways proposed

Migration status and language

A total of six studies of medium to high quality assessed migration related concepts via migration status, language or both. Pickett et al., (2009) (a medium high quality study, representative of England and Wales using a population subgroup of mothers), Yan et al., (2019) (medium quality study representative of England), and Jun et al., (2019) (a high quality study, representative of England, focused specifically on young people), all assessed migration status. Schofield et al., (2016a) (a medium high quality study, representative of Southeast London) assessed whether English was the main language of the participant, and Shields and Wailoo (2002) (a medium high quality study, representative of Britain, focused on minority ethnic men) assessed both English language and whether the individual was born outside of the UK. Finally, in a medium quality study, Dorsett and colleagues (2019) (representative of England) assessed 'migrant generation', years resident in the UK, age at migration and having parents from a non-English speaking country.

Beginning with studies finding no significant associations, neither Pickett et al., (2009) assessing 'nativity', nor Schofield et al., (2016a) and Shields and Wailoo (2002) assessing language, reported any evidence in support of the role of these factors on the association between ethnic density and anxiety and depression.

In terms of statistically significant findings relating to migrant status, Jun et al., (2019) reported that compared to having two native parents, having two parents who were immigrants was associated with lower (better) TDS scores in a model containing own-group ethnic density for young people. Yan et al., (2019) reported a statistically significant interaction of generation with ethnic density, where second generation 'Pakistani', 'Bangladeshi' and 'Indian' individuals had better mental health, than the first generation who had comparatively worse mental health. Dorsett et al., (2019), in their model assessing anxiety and depression, reported evidence of an interactive effect of 'migrant generation' with overall minority ethnic density, with significant interactions for recent first-generation migrants (both 'White' and 'non-White'), first generation established 'White' and second generation 'non-White'. The results of these associations suggested mental health improved with increasing density for all but the 'first generation established White' group. The authors also found associations between having a parent from a non-English speaking country to be protective of anxiety and depression and age at migration and number of years resident in the UK to be detrimental.

3.8.4 Summary of the findings relating to depression and anxiety

Overall, the effects of ethnic density reported in this group of studies were more varied than those reported in the 'severe' mental illness studies, perhaps due to the more fine-grained ethnic groupings that were employed. This greater variability in findings may also be a result of a greater variation in the confounders controlled for, or due to the different outcome measures employed. Though several studies included in this group focused on particular demographic sub-populations, giving greater insight into the ethnic density effect for these sub-groups, they also typically employed crude ethnic group categories and often combined minority ethnic groups into one, with the exception of Astell-Burt et al., (2012) who used finer ethnic categories.

In terms of the pathways assessed, the evidence reported on the racism pathway was partial (with evidence often reported for just one part of the pathway) but typically in the expected direction, though no evidence of a significant interactive effect was found in any of these studies. The research on social stress was limited, with one study providing evidence of a statistically significant association both between social stress and density, and between social stress and mental health. Evidence on social capital and cohesion was also limited to one study, with some evidence of an association with ethnic density varying by ethnic group. The studies assessing social support provided some evidence limited in volume of higher density being associated with greater social support. Finally, three studies reported mixed evidence on measures of language and migration. Figure 3.3 below provides a visual summary of these pathways.

Figure 3-3 - Anxiety and Depression studies mediation pathway diagram

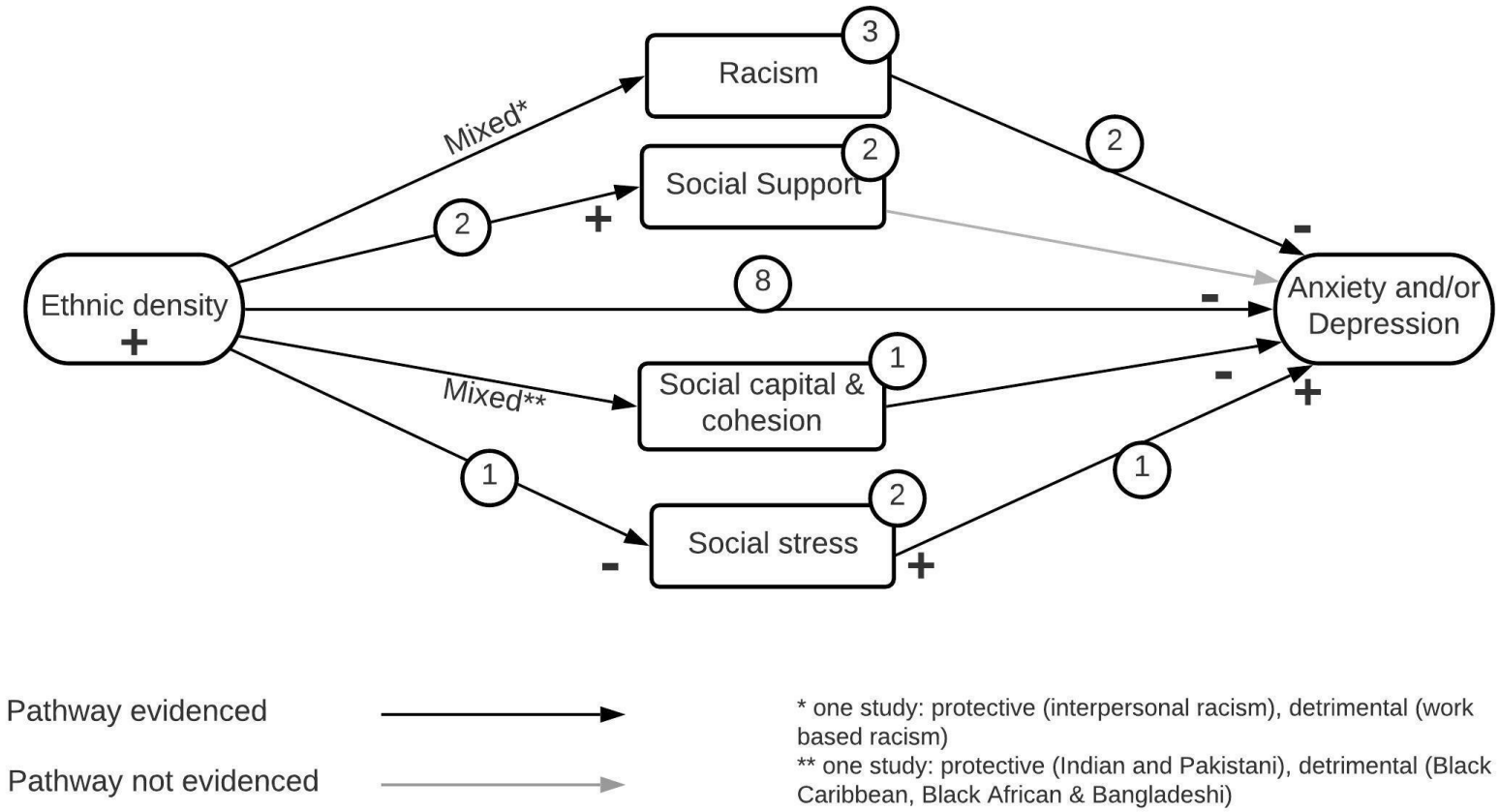


Figure 3.3 shows statistically significant evidence on hypothesised mediating variables from models adjusted for basic covariates. The signs at the start and end of each pathway represent the associations found by the authors unless the evidence is mixed. Due to the greater variation in findings by ethnic groups in this set of studies, evidenced pathways are counted where a statistically significant effect is found in at least one ethnic group. Where results in contrasting directions for the same pathway are found for different ethnic groups, this is indicated.

3.9 Suicide, suicidal ideation and self-harm studies

A total of five studies assessed outcomes related to self-harm, suicidal ideation and suicide. All five studies reported some evidence of a protective association between ethnic density and these indicators of poor mental health, though the results varied by ethnic group and ethnic density measure (see Table 3.4). These studies were cross-sectional and used a range of data sources including survey data, death certificates and attendance at accident and emergency.

Suicide

One study of medium quality (representative of South London) assessed suicide as an outcome (Neeleman and Wessley, 1999). Overall, a statistically significant protective association was reported between ethnic density and suicide for people from a minority ethnic background. For the 'White British' group, higher minority ethnic density was associated with higher suicide rates. This study did not examine any pathways.

Suicidal ideation

Two studies of high quality, both representative of England, assessed the association between ethnic density and suicidal ideation. Bécares et al., (2012c) in a study including only people identifying as 'Caribbean' did not find any statistically significant associations between ethnic density and suicidal ideation. Bécares and Das-Munshi (2013) reported statistically significant evidence of a protective association between own-group ethnic density and suicidal ideation for the 'Bangladeshi' and 'White Irish' groups.

Of the two studies, only Bécares et al., (2012c) tested a pathway. In this paper, the role of work-based racism was explored via the following questions: "have you yourself ever been treated unfairly at work with regard to promotion or a move to a better position for reasons which you think were to do with race, colour or your religious or ethnic background? (I don't mean when applying for a new job.)" And: "Have you ever been refused a job for reasons which you think were to do with your race, colour or your religious or ethnic background?" (p.2110). The authors reported evidence of a protective association between higher 'Black' ethnic density and having been refused a job for people identifying as 'Caribbean' but also an association in the opposite direction when the narrower measure of 'Caribbean' ethnic density was employed. The authors tested interaction terms between ethnic density and racism in reporting suicidal ideation but did not find any evidence of a statistically significant interaction.

Self-injury

Two studies of medium to medium high quality were found which assessed self-injurious behaviour. Neeleman et al., (2001), in a medium quality study (representative of Lambeth, Southwark and Lewisham), reported mixed results across groups and across the two locations used. Importantly, the authors found some evidence of a non-linear association, whereby the relative rate of self-harm was higher at low density, with rates decreasing up to a standardised density score of two, after which rates began to increase again as standardised density became very high. The authors found this curvilinear model to provide a better fit compared to linear models they tested for all three minority ethnic groups they employed. Schofield et al., (2016b) (using data representative of South East London) reported that, in a combined sample including people identifying as 'Black Caribbean' and 'Black African', lower overall 'Black' density was associated with statistically significantly higher rates of parasuicide. Statistical significance was lost when the ethnic groups were analysed separately. Neither of these papers assessed any of the hypothesised causal pathways.

3.9.1 Summary of the findings relating to suicide and self-harm

All of the studies in this group reported some evidence of a protective association between ethnic density and suicidal ideation, suicide or deliberate self-harm, except for the study by Bécares and colleagues (2012c). In this set of studies, only one potential pathway was tested by Bécares and colleagues (2012c). Their findings suggested that higher ethnic density was associated reduced work-based racism, but evidence of ethnic density buffering the association between racism and suicidal ideation was not found.

3.10 Discussion

This review set out to complement existing reviews by describing our current knowledge of the ethnic density effect on mental health in the UK and by identifying the pathways that have been theorised and quantitatively tested to date. Therefore, less information is provided on the finer details of the ethnic density effects observed. For greater detail on the ethnic density effect on mental health, readers are directed to the other high quality reviews on the topic (Shaw et al., 2012; Bosqui et al., 2014; Bécares et al, 2018; Baker et al., 2021).

3.10.1 Ethnic density effect summary

Overall, the findings varied across the different mental health outcomes employed. In the 'severe' mental illness studies, effects were observed almost entirely in the protective direction, whereas in the studies assessing measures of common mental disorder, the findings were more mixed. This has been reported in previous systematic reviews (Bécares et al., 2018; Shaw et al., 2012). These differences may reflect underlying differences in relationships between ethnic density and the mental health measures or be a function of the varied methods employed across the sets of studies. Elements of the study design which could lead to variable findings include ethnic group categorisation, the area units used, and the type of mental health measure and data employed. For example, it is possible that analyses which employ aggregate minority ethnic groupings mask some of the nuances revealed when analyses employ more fine-grained ethnic categories. This may give a false impression of consistency in the 'severe' mental illness studies, which more commonly used aggregate groups. However, even among those 'severe' mental illness studies which did employ fine ethnic groupings (n=7), protective and statistically significant effects were still identified. In addition, it is possible that the consistency observed in the 'severe' mental illness studies is a result of the greater use of GP and hospital record data in these studies (n=7). For example, it may be that these measures provide better true case ascertainment than self-report survey measures which are the predominant measure used in the anxiety and depression studies. However, most of these studies were based in London or smaller areas within London. It is therefore possible that the consistency in results of these studies could be a result of qualities which are particular to London.

Four of the studies which assessed suicide, suicidal ideation and deliberate self-harm reported protective effects of ethnic density on their respective outcomes, and one of the two studies which assessed suicidal ideation reported significant no effect (Bécares et al., 2012c). There were too few of these studies, which employed a diverse range of outcomes to make many conclusions. However, it does appear that ethnic density is largely protective of suicide and self-harm related outcomes in the studies included in this review.

The only studies focused on demographic population subgroups such as young people, mothers and men were found in the anxiety and depression study group. This is likely due to data volume and additional covariates available from larger panel studies which were the predominant data source for these studies. The findings of the studies which focused on young people (Jun et al., 2020; Jonsson et al., 2018; Astell-Burt et al., 2012) are worth noting here. No statistically significant ethnic density effects were noted for any minority ethnic group across all three studies, one of which analysed more refined ethnic groupings (Astell-Burt et al., 2012). All three studies utilised the same

outcome measure (TDS), two of which were longitudinal and utilised separate data sources. Based on these three studies, the argument could be made that the ethnic density effect does not appear to operate in younger populations. Indeed, it is plausible that some of the hypothesised pathways are less relevant to younger people, such those which relate to the political and organising aspects of social cohesion. In addition, it could be argued that younger people do not have a cumulative experience of racism to the same extent that has been demonstrated for adults (Wallace et al., 2016). Finally, it could be argued that the ethnic composition of other spatial units, such as schools, are more relevant to young people, rather than the ethnic composition of the neighbourhood (see Petrović et al., 2020 for a discussion of the importance of critically considering the role of spatial units). However, studies analysing the role of school ethnic composition were not included in this systematic review. If the lack of effect found in the studies on young people is not an artefact of study design, then understanding why no effect is found in this group may help us to better understand the association observed in studies assessing adult populations and how this operates.

Five papers identified statistically significant detrimental associations between ethnic density and the mental health outcome employed for at least one ethnic group. Across these studies (all but one of which were from the anxiety and depression group) detrimental associations were identified for 'Pakistani' (2 studies), 'Bangladeshi' (2 studies), 'Black Caribbean' (2 studies), 'Black African' (1 study) ethnic groups, with one of the five studies finding detrimental associations only for "white native" and "first generation white" groups. Based on the information available, including the study and analysis design and sample characteristics, no clear methodological reason could explain these negative associations identified. This raises questions as to why some studies using similar ethnic groups and similar mental health outcomes find contrasting results. Further research is required to investigate some of the possible reasons for these discrepancies.

3.10.2 Summary of the pathways hypothesised and tested in this review

Pathway measurement

In the quantitative studies reviewed above, the pathways between ethnic density and mental health were generally not well justified or theorised and the authors used inconsistent measurements of the various pathways. Racism and migration status were more consistently assessed than other pathways with less clear or commonly agreed definitions, including social support and social cohesion. Nevertheless, there was a large amount of variation in the measurement of all pathways. For example, no two studies assessed racism in the same way, with different types of racism (interpersonal and work-based) addressed and identified as such by a range of language including

'race or colour' (Bécares et al., 2009), 'ethnicity' (Das-Munshi et al., 2012) or through the use of additional aspects like where the participant was born (Astell-Burt et al., 2012). The measures of racism included in these studies were limited in assessing the many aspects of the experience of racism, such as its intensity or frequency (Krieger, 2000b) and they arguably do not capture the full extent of the experience of racism.

The measures for the other pathways tested were arguably even less consistent than the studies assessing racism. A distinct lack of theorisation of the concepts and how they operate underpinned this inconsistency. Studies assessing 'social support' sometimes strayed over into measures which some would argue are better described as 'social capital', such as sending and receiving money (Halpern and Nazroo, 2000). Social capital and cohesion in these studies were, as described previously, indistinguishable, and just one study assessing this pathway made use of questions from a validated instrument (Kirkbride et al., 2008). Social stress was the least consistently measured and most unclear pathway, with no two studies employing the same measure, and with the measures employed suggesting very different understandings of the concept itself.

Pathway evidence

The pathways which were tested quantitatively were racism, social support, social capital and cohesion and social stress. In addition, factors relating to migration and 'acculturation' were also tested. These are similar to the mechanisms highlighted by a recent review by Bécares and colleagues (2018) of international evidence on the association between ethnic density and mental health. It should be noted that, though there were several high quality studies included in this review, in general the quality of the approach to testing hypothesised causal pathways was low. Including variables aimed at measuring potential pathways as covariates in regression analyses was the most common method of testing hypothesised pathways, though some authors tested interaction terms and performed further sensitivity analyses. There was also a lack of consistency in the findings of the pathways assessed across ethnic groups. The heterogeneity observed across the pathways assessed indicates that these pathways may not necessarily operate in the same way across different ethnic groups.

Despite the lack of evidence of interactive effects of racism by 'own-group ethnic density' on mental health (Bécares et al., 2009; Das-Munshi et al., 2010) the consistent reporting of associations in the same direction across studies, and the clear theory behind its detrimental effects, suggests that it is likely to lie on the causal pathway. This approach to building an evidence base draws on the Bradford Hill guidelines for investigating possible causal pathways (Howick et al., 2019).

The studies assessing social capital and cohesion suggest the role of this pathway is more complex, with Bécares and Nazroo (2013) finding statistically significant associations in opposite directions across ethnic groups, and Kirkbride and colleagues (2008) identifying a 'U' shaped association for a combined minority ethnic sample. In terms of the theory behind the protective effects of social cohesion, it seems plausible that social cohesion lies on the causal pathway.

The findings presented on the social support pathway vary by the domain of social support assessed, with statistically significant associations reported most commonly for practical support (demonstrated in both Das-Munshi et al., 2010 and Das-Munshi et al., 2012). However, despite plausible theory for its protective effect, the evidence gathered by this study for social support lying on the causal pathway is limited.

Arguably, the pathway for which the weakest evidence was found in this review is the 'social stress' pathway. This is largely due to the wide range of measures employed in this study group. Based on the included studies it is not clear if or how 'social stress' operates between ethnic density and mental health. Indeed, a focus instead on informal social control may help to advance our understanding of the role of acute forms of social stress, such as violence or property damage, in the association between ethnic density and mental health.

Place-based belonging and identity was commonly discussed as a pathway and featured strongly in qualitative work (Bécares and Nazroo, 2013; Wainwright et al., 2019), but it was not tested directly in any of the included quantitative studies. Although, it is often said that measures of social cohesion include aspects of belonging, the role of belonging itself in the ethnic density effect remains unclear.

Migration status and English language competency were regularly mentioned within the quantitative studies and were often included either as a control variables or as possible effect modifiers. The findings of these studies which included measures of migrant status or language were inconsistent and complex. Broadly, the evidence reported in these studies appeared to support contradicting hypotheses. Evidence reported in some studies implied that 'acculturation' was protective for mental health (Halpern and Nazroo, 2000; Yan et al., 2019). However, one study presented a more complex picture, reporting results from testing different aspects of migration and language which simultaneously implied protective and detrimental effects of 'acculturation' (Dorsett et al., 2019). The mechanisms behind the potential protective and detrimental effects of migration status and English language competency remain unclear. However, recent advances in understanding the so-called 'integration paradox' (Nandi et al., 2020; Steinmann, 2019), whereby immigrants become more likely to report racism the longer they spend in a country, may help to explain the detrimental

effects observed. Contrastingly, it is likely that 'acculturation', measured via English language proficiency, is indicative of better access to services and is also perhaps a proxy for education and social capital levels upon arrival. In future research, clearer explanations of the hypotheses being tested when these measures are employed are required in order to advance our knowledge of the role of these factors in the ethnic density effect.

Qualitative pathway evidence

The qualitative studies identified by this review provided more detail and greater theorisation of many of the pathways assessed in the quantitative studies. However, they also highlighted numerous aspects warranting attention that were largely absent from the quantitative studies, including: population stability and its role in undermining place-based attachment (Bécares et al., 2013), the specific role of the family in providing practical and emotional support (Campbell and McLean, 2002; Ochieng, 2011), and the 'double-stigma' of community discrimination based on a mental health diagnosis and of external racism (Wainwright et al., 2019; Schofield et al., 2019). In addition, these studies typically discussed racism from a more structural perspective, in comparison to the largely interpersonal focus taken by the quantitative studies.

3.10.3 Limitations: Evidence base available for review

The only studies to employ a longitudinal approach were those assessing young people. It is therefore not possible to determine if the lack of effect found was a result of the longitudinal approach or a focus on young people. As described previously, several of the hypothesised pathways are likely to be less relevant to young people, and it is arguable that other spatial scales may be more relevant to assessing the effect in young people. It has also been argued that some effects observed at the neighbourhood level are cumulative over time (Galster, 2012; Musterd et al., 2012) and that the effects of racism may also be cumulative across the life course (Wallace et al., 2016). In addition, there may be a lag in the effects of ethnic density on mental health which was not possible to assess in the studies on adult populations, which largely measured ethnic density at the same time point as mental health. Therefore, future longitudinal analyses may allow for the true magnitude of these cumulative effects to be observed.

Just ten of the included quantitative studies theoretically justified their choice of geographical scale used to measure ethnic density. Most commonly, the choice of scale was justified by data availability only. Similarly, a clear conceptualisation of the pathways and theorisation of how they operated was also uncommon. This made summarising the pathways theorised and tested within the studies challenging, as theorised pathways were often mentioned in list form, with little if any elaboration,

and tested pathways were often included with scant preceding justification or theory. Relatedly, in some instances the measurement of the pathways were poor, such as in the use of proxy measures for social capital by some studies (Kirkbride et al., 2007; Kirkbride et al., 2014).

Finally, the most recent data used within these studies was from approximately 2013, despite many of the included studies being much more recently published. The racialisation of ethnic identity and therefore, what it means to live in an area with many or few people from the same ethnic background, is temporally contingent (Omi and Winant, 2014). Consequently, it is arguable that ethnic density effects observed within the studies discussed in this review do not necessarily reflect current ethnic density effects. This limitation is largely a reflection of the lack of appropriate, recent data available for performing these analyses.

3.10.4 Limitations: systematic review methodology employed

There are also some limitations of the systematic review methodology which require some reflection. For example, it is worth noting that, whilst the country context is fixed within the included studies, the racialisation of different ethnic groups, their population growth, residential patterns, demographics and the policy context in relation to immigration and cohesion are not static. Therefore, as mentioned above, it is likely that the meaning and effect of ethnic density may vary over time. This is an important point for consideration as the data used in the included studies covers a period of approximately 32 years. Consequently, it is possible that temporal changes could explain some of the differences in effects observed, particularly across specific ethnic groups, and future reviews and studies should pay greater attention to this.

Some studies were excluded from this review which nevertheless may be useful for understanding how the ethnic density effect operates. Firstly, studies assessing the positive dimensions of mental health were not included in this review. Just one study identified by the search criteria employed a positive mental health measure (Knies et al., 2016). The authors reported that higher 'own-group' density was associated with better wellbeing for 'Black Africans' and for 'UK born Indians and Pakistanis'. Secondly, studies on young people which assessed school-level ethnic density, rather than neighbourhood density were not considered. A recent systematic review (DuPont-Reyes and Villatoro, 2019) demonstrated evidence for protective effects of school-based ethnic density on adolescent mental health (though importantly, all but one of these studies were US-based and the one UK-based study based found no effect). It is possible that school-level ethnic density may be a more relevant measure than neighbourhood-level for adolescent mental health and that this may explain the lack of effect found in the studies assessing young people included in this review.

3.10.5 Recommendations for future research

As the body of literature on the topic of ethnic density and its effects on mental health continues to grow, a focus on four key aspects is needed to make progress in understanding the potential causal effect of ethnic density on mental health.

Firstly, future research would benefit from greater use of methods which lend themselves to causal inference. For example, the use of longitudinal data and analysis methods which are designed to estimate complex theoretical models, with both mediation and moderation paths would be beneficial. Secondly, underpinning many of the issues identified in the included literature is a lack of data in appropriate volume or detail on minority ethnic groups. Despite people from minority ethnic backgrounds constituting a large proportion of the population in the UK, there remains a paucity of up-to-date data with a sufficiently large sample of these groups. Thirdly, to better understand the potential causal effects of ethnic density on mental health, greater theorisation of how ethnic density operates, as well as better conceptualisation of the pathways and a rationale for their inclusion in analyses is needed. Finally, greater consistency is required in the measurement of potential mediating pathways in order to improve comparability across studies, so that the presence or lack of consistency in findings related to these pathways can be identified.

3.11 Summary

This systematic review summarised the evidence available on the pathways associated with the 'ethnic density effect' which have been theorised and tested to date within UK based research. Overall, protective ethnic density effects were observed in most studies, with less consistency in the anxiety and depression study group. A wide range of pathways were hypothesised by the included studies, though detailed theorisation of their operation was lacking. Of the pathways assessed in the quantitative research, evidence for the racism pathway was the most consistent. In general, where finer ethnic group categories were used, more heterogeneity in the ethnic density effect and pathways tested was observed. These results highlight the need for better conceptualisation and operationalisation of the pathways in operation, as well as the need to use disaggregated ethnic categories, in order to better understand the ethnic density effect and the differences found across ethnic groups.

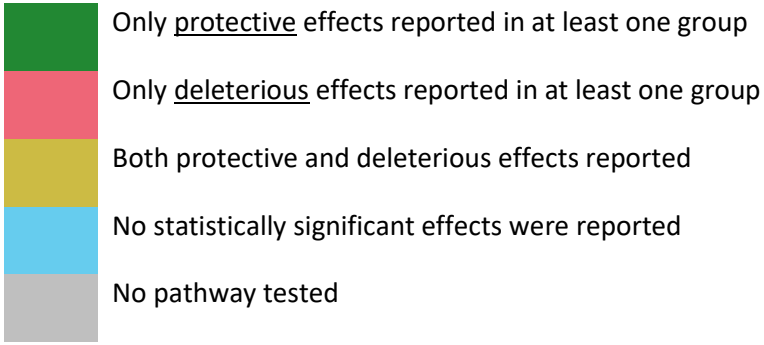
In the following chapters, this thesis aims to address this gap by carefully considering the key pathways identified, their measurement, and their operationalisation and by utilising appropriate data and methods to assess these complex pathways using panel data. In addition, based on the

differential findings in mental health outcomes and pathway effects across ethnic groups, the use of the most fine-grained ethnic groupings possible is prioritised. In the next chapter, the theoretical framework drawn from the results of this systematic review is presented.

3.12 Tabular summary of included studies

The colours indicate reported evidence of the type of statistically significant effect found (if any). Detrimental effects found for White British groups not included.[5]

Figure 3-4 - Systematic review study comparison table legend



[5] The terminology presented in the following tables is that of the author(s) of each paper and not that of the author of this review.

Table 3-2 – 'Severe' mental illness studies descriptive table

Authors	Mental health measure	Data (all cross-sectional)	Sample (Size and population- adult unless otherwise specified)	Area unit & ethnic density measure	Evidence reported for an ethnic density effect?	Pathway tested	Results	Covariates	Quality
Bécares, Nazroo, Stafford, 2009	Psychosis Screening Questionnaire	FNS	7,257 participants (White 2980, Caribbean 1215, Indian 1278, Pakistani 1190, Bangladeshi 594)	Ward Sub-group, own-group density	Protective associations described between PSQ and ethnic density for all groups except the Pakistani group.	**1. Racism**	1. Detrimental effect on mental health with increasing racism. Protective association between increasing ethnic density and reduced racism. Interaction term between racism and ethnic density not significant.	1. Sex, age, individual socioeconomic position, area deprivation, racism * ethnic density	High
Bécares L, Das-Munshi, 2013	Psychosis Screening Questionnaire	EMPIRIC & Citizenship Survey	EMPIRIC- 4,281 participants (Indian 643, Pakistani 724, Bangladeshi 650, Black Caribbean 694, White Irish 733, White British 835) Citizenship Survey- 23,205 participants (Indian 557, Pakistani 311, Bangladeshi 122, Black Caribbean 240, White Irish	MSOA Sub-groups, own-group ethnic density	Decrease in own-group ethnic density associated with increased reporting of psychotic symptomatology for the Indian group only	n/a			High

			437, White British 23,000)						
Boydell, Van Os, McKenzie, Allardyce, Goel, McCreadie, Murray, 2001	GP case records (Research Diagnostic Criteria schizophrenia)	Camberwell Borough patients who had contact with mental health services 1988-97	222 Cases (126 non-White, 96 White)	Ward Aggregate groups, overall minority ethnic density	Evidence of a dose response relationship between increasing minority ethnic density and decreasing incidence of schizophrenia for non-White participants	n/a			Medium
Cochrane, Sukhwant Sing, 1988	GP case records (Incidence of Schizophrenia- "HMRI (psych.l/P) Form completed at admission for all patients admitted to mental hospitals in England in 1981.")	Admissions from the mental health enquiry	484 incident admissions cases, 2,928 admissions in total. All cases: Irish Republic 332, India 166, Caribbean 494, Pakistan and Bangladesh 126	Regional Health Authority (RHA), England Sub-groups, unclear – possible own-group density	At the RHA level, protective association between ethnic density and schizophrenia incidence for Irish men only	n/a			Low
Das-Munshi, Bécares, Boydell, Dewey, Morgan, Stansfeld, Prince, 2012	Psychosis Screening Questionnaire	EMPIRIC	4,281 participants (White British 837, Irish 733, Black Caribbean 694, Bangladeshi 650, Indian 643, Pakistani 724)	MSOA Sub-groups & aggregate group, own-group ethnic density	Increase in the odds of reporting psychotic symptoms with a decrease in own-group ethnic density for the combined ethnic group and Indian ethnic group	**1. Racism** **2. Social support** **3. Social stress** **4. Migration & language**	1. Higher odds of schizophrenia with increasing interpersonal racism. Lower density associated with increased work-based racism for the	1. Age, gender, education, occupational social class, marital status, area level deprivation,	High

							combined minority ethnic group 2. Significant interactions for social support by ethnic density. Higher practical support protective in the combined minority ethnic model 3. A positive association found between one or more chronic strains and reporting psychotic experiences after controlling for ethnic density. Lower ethnic density associated with fewer housing problems 4. No significant interaction reported between 'generational status' and mental health.	(plus pathways) 2. As above 3. As above 4. As above	
Halpern, Nazroo, 2000	Psychosis Screening Questionnaire	FNSEM	8,063 participants (White 2867, Caribbean 1205, Indian 1273, African Asian 728, Pakistani 1185, Bangladeshi 591, Chinese 214)	Ward Sub-groups and aggregate group, own-group density	Protective association reported between own-group ethnic density and symptom levels for Indian, Caribbean, Bangladeshi groups	**1. Social support** **2. Social stress** **3. Migration & language**	1. Positive association between increasing density and social support, and increasing social support and better mental health	1. age, sex, hardship, migration, language (assumption based on discussion by the authors as	Medium-low

							2. Lower levels of property damage reported in higher density areas, though the authors reported no significant association for attack 3. Those who were less fluent on average reported more symptoms. Those who migrated at an older age on average reported fewer psychiatric symptoms	the model is not presented) 2. as above 3. as above	
Kirkbride, Morgan, Fearon, Dazzan, Murray, Jones, 2007	Schedules for Clinical Assessment in Neuro-psychiatry and a "modified Personal and Psychiatric History Schedule"	AESOP	228 cases (148 cases of Schizophrenia, 80 cases of non-affective psychoses). White 55 and Black and Minority Ethnic 163	CAS Wards Sub-groups & aggregate group, overall minority ethnic density	Evidence of an increased risk of schizophrenia at the lowest level of overall minority ethnic density for the 'BME' group in comparison to the White British group	**1. Social capital & cohesion**	1. Voter turnout associated with a decrease in Schizophrenia. However, ethnic density was not statistically significant in this model and was therefore removed. Voter turnout was also associated with a decrease in incidence of other non-affective psychoses, this time independent of ethnic density.	1. sex, age, ethnicity, area deprivation, population density, ethnic fragmentation, voter turnout	Medium-high

Kirkbride, Boydell, Ploubidis, Morgan, Dazzan, McKenzie, Murray, Jones, 2008	Schedules for Clinical Assessment in Neuro-psychiatry, incidence of ICD-10 F20 schizophrenia	AESOP, social capital postal survey	4231 responses to the cohesion survey (White British 3073, Black Caribbean 344, Black African 295, Asian 122, Chinese 28, other 223) 148 cases of Schizophrenia over 565 576 person years at risk. (Population at risk: White British 212 535, Black Caribbean 40 677, Black African 36 978, Asian 13 198, Chinese 4325, other 14178)	Ward Aggregate group, overall minority ethnic density	Evidence of decreasing risk of schizophrenia with higher levels of overall minority ethnic density for the 'BME' group	**1. Social capital & cohesion** **2. Social stress**	1. A U-shaped association was reported between social cohesion and Schizophrenia in a model containing ethnic density. 2. No significant evidence for the role of social disorganisation reported	1. Sex, age, area deprivation, population density, ethnic fragmentation, ethnicity * ethnic density, social cohesion, social stress 2. as above	Medium
Kirkbride, Jones, Ullrich, Coid, 2014	Schedules for Clinical Assessment in Neuropsychiatry (both nonaffective and affective psychoses)	ELFEP	484 First Episode Psychosis (over 1.6m person years at risk) (313 with nonaffective psychosis and 114 with affective psychosis). White British 68, non-British white 38, black Caribbean 55, black African	Ward Sub-groups, own-group ethnic density	Protective association between higher own-group ethnic density and psychosis risk for the Black African group only	**1. Social capital & cohesion**	1. No significant evidence of an association between voter turnout and nonaffective psychosis reported	1. n/a (not included in the final model and results of model testing pathway not presented)	Medium-high

			49, Bangladeshi 53 (other ethnic group sample sizes not stated)						
Schofield, Ashworth, Jones, 2011	GP read codes ("first diagnosis of a psychotic illness, defined as any non-organic psychosis and excluding drug-induced disorders")	Lambeth GP records 1996-2006	508 first cases (277 of which had their ethnicity coded: Black British 109 cases, White British 87 cases)	CAS Ward and LSOA Aggregate group, 'proportion of Black people'	Association between decreasing 'Black density' and rates of psychosis not as high in higher ethnic density areas	n/a			Medium-low
Schofield, Das-Munshi, Bécares, Morgan, Bhavsar, Hotopf, Hatch, 2016b	Psychosis Screening Questionnaire	SELCoH	1698 participants (Black 377, White British 1319)	LSOA Aggregate group, overall Black ethnic density	Association between decreasing 'Black ethnic density' and increasing odds of psychotic experiences for 'Black' participants reported	n/a			Medium-high

Table 3-3 - Anxiety and Depression studies descriptive table

Authors	**Mental health measure**	**Data** cross sectional unless otherwise stated: (L)= longitudinal (MM)= Mixed Method	**Sample** (Size and population- adult unless otherwise specified)	**Area unit & ethic density measure**	**Evidence reported for an ethnic density effect?**	**Pathway tested**	**Results**	**Covariates**	**Quality**
Astell-Burt, Maynard, Lenguerrand, Harding, 2012	Total Difficulties Score (TDS)	DASH (L)	3,409 participants (White 873, Indian 419, Pakistani and Bangladeshi 446, Black and Caribbean 779, Nigerian and Ghanaian 505, Other African 387). **Young people (aged 11-16)**	Output Area, School Sub-groups, Own-group density	No significant association between own-group ethnic density and TDS reported	**1. Racism**	Association between increased racism and poorer TDS scores across all ethnic groups reported	Racism, age, gender, age * gender, migrant generational status, family type, socio-economic circumstance, parental care, parental control and family activities, area deprivation	High
Bécares, Nazroo, 2013	GHQ-12	HSE (MM)	4,940 survey respondents (Caribbean 1067, Black African 859, Indian 1184, Pakistani 941, Bangladeshi 889)	MSOA Sub-group, own-group ethnic density	A protective effect of ethnic density on GHQ-12 reported for the Indian group only. A detrimental effect reported for the Bangladeshi group only.	**1. Social capital & cohesion**	1. Area level social capital was associated with own-group ethnic density for all ethnic groups, positive for Indian and Pakistani groups and negative for Black	Sex, age, marital status, nativity, social class, number of years in the neighbourhood, area deprivation, individual and area level social capital	High

							Caribbean, Black African and Bangladeshi groups. No significant evidence of a mediation effect reported.		
Bécares, Das-Munshi, 2013	CIS-R	EMPIRIC & Citizenship Survey	EMPIRIC- 4,281 participants (Indian 643, Pakistani 724, Bangladeshi 650, Black Caribbean 694, White Irish 733, White British 835) Citizenship Survey- 23,205 participants (Indian 557, Pakistani 311, Bangladeshi 122, Black Caribbean 240, White Irish 437, White British 23,000)	MSOA Sub-group, own-group ethnic density	A decrease in own group density reported to be associated with increased odds of common mental disorder for the Bangladeshi and White Irish groups.	n/a			High
Das-Munshi, Bécares, Dewey, Stansfeld, Prince, 2010	CIS-R	EMPIRIC	4,281 participants (White British 835, Irish 733, Black Caribbean 691, Indian 648, Bangladeshi 650, Pakistani 724)	MSOA Sub- groups, own-group ethnic density	Association reported between increasing ethnic density and decreasing risk of common mental disorders for all minority ethnic groups combined, for the Bangladeshi group and for the Irish group separately.	**1. Racism** **2. Social support**	1. Higher own-group ethnic density was associated with lower reporting of racist experiences for the Bangladeshi group and the opposite reported for work-based racism for the Caribbean group. No statistically	Area level deprivation, age, sex, marital status, education, social class, ethnicity, racism, social support, 2. as above	High

							significant evidence was reported of interactive effects between racism and ethnic density. 2. The authors reported mixed results, with higher practical support associated with higher density for the Bangladeshi and overall minority ethnic groups only and an association with higher numbers of close friends reported for the Bangladeshi group only. However, based on sequential multilevel models, the authors report no statistically significant evidence of a mediating effect.		
Dorsett, Rienzo, Weale, 2019	GHQ-12	UKHLS	30,320 participants (White British 26195, Indian 1161, Pakistani 924, Bangladeshi 641,	Local Authority District Sub-groups combined	A detrimental association between increasing density and mental health was reported for the	**1. Migration & language**	Interactive effect of 'migrant generation' with overall minority ethnic density reported. In	Density index * combined migration status with ethnicity, concentration index * combined	Medium

			Black Caribbean 624, Black African 775)	with migration, own-group ethnic density & combined minority ethnic group density	'White native' group and for the 'first generation established White' group. The authors also reported evidence of an association between higher overall minority density lower anxiety and depression for recent first-generation migrants (both White and non-White) and for second generation non-White.		addition, having a parent from a non-English speaking country was reported to be protective and age at migration and number of years resident in the UK to be detrimental.	migration status with ethnicity, years resident in the UK, age arrived in UK, sending country, arrived from non-English speaking, arrived as a child not speaking English, not speaking English in childhood, either parent arrived from a non-English speaking country, missing variables indicators, age, age squared, gender, working dummy variable, level of education, marital status, number of children, household income, concentration index * either parent from a non-English-speaking country.	

Du Preez, Conroy, Pawlby, Moran, Pariante, 2016	PHQ-12, SAPAS19	Early Infant Care Study	2262 participants (BAME 1222, White 1040), **Mothers**	LSOA aggregate group, own-group and overall ethnic density	No evidence of a statistically significant association reported between overall minority ethnic density and screening positive for post-natal depression for any minority ethnic group.	n/a			Medium
Halpern, Nazroo, 2000	CIS-R	FNSEM	8,063 participants (White 2867, Caribbean 1205, Indian 1273, African Asian 728, Pakistani 1185, Bangladeshi 591, Chinese 214)	Ward Sub-groups and aggregate group, own-group density	Higher own-group ethnic density associated with lower neurotic symptom levels, for the overall minority ethnic group and for the Indian group.	**1. Social stress** **2. social support**	1. For all of the included ethnic groups, property damage levels were reported to be lower in higher density areas 2. The authors reported a positive association between ethnic density and social support (though further detail of the findings and model are not reported)	1. age, sex, hardship, migration, language (assumption as the model is not presented) 2. as above	Medium-low
Jonsson, Vartanova, Södergren, 2018	TDS	UKHLS (L)	5513 participants, (White British 4918, Welsh 224, other Whites 174, BAMEs 1986), **Young people (age 10-15)**	MSOA Aggregate group, own-group ethnic density	No statistically significant evidence of an association reported between ethnic density and TDS in the fully	n/a			High

					adjusted model for any ethnic group.				
Jun, Jivraj, Taylor, 2020	TDS	UKHLS	4,145 participants, (Minority ethnic 732, White British 3413), **Young people (age 10-15)**	LSOA Aggregate group, own-group ethnic density	No statistically significant evidence of an association between ethnic density and TDS was reported for any of the minority ethnic groups included.	**1. Migration & language**	1. A protective effect was reported for both parents being immigrants, compared with both parents being native	Diversity index, dummy variable for ethnicity, Ethnic minority youth * co-ethnic density, Ethnic minority youth * diversity index, Neighbourhood deprivation * co-ethnic density, Neighbourhood deprivation * diversity index, age, sex, highest qualification, gross household income, variables measuring parental behaviour (x3)	High
Pickett, Shaw, Atkin, Kiernan, Wilkinson, 2009	Maternal depression ("whether or not a mother had felt low or sad for a period of two or more weeks	Millennium cohort Study	2,318 (Black African 367, Black Caribbean 252, Bangladeshi 369, Indian 462, Pakistani 868), **Mothers**	MSOA, LSOA Sub-groups, own-group density	Higher ethnic density associated with lower odds of reporting having ever been depressed at the 5-30% level for the Indian group, and at the 30-50% for the Pakistani group compared to a density of 0-5%. No	**1. Migration & language**	1. No statistically significant evidence of an interaction was reported between mother's nativity or language and ethnic density for depression	Ethnicity, age, parity, education, marital status, social class, receiving welfare or benefits, area deprivation	Medium-high

	since the baby was born (termed post-natal depression for this study)," "whether or not she had ever been told by a doctor that she was depressed ”				evidence of a statistically significant association reported for post-natal depression.				
Schofield, Das-Munshi, Bécares, Morgan, Bhavsar, Hotopf, Hatch, 2016b	CIS-R	SELCoH	1,698 (Black 377, White British 1319)	LSOA Aggregate group, overall Black ethnic density	No statistically significant evidence of an association reported between ethnic density and common mental disorder for any ethnic group.	n/a			Medium-high
Schofield, Das-Munshi, Mathur, Congdon, Hull, 2016a	Depression diagnosis in the past year from QOF depression read codes	GP Health Records for Lambeth, Hackney, Tower Hamlets and Newham 2013	410541 patient health records (White British 161720, Indian 45070, Pakistani 28780, Bangladeshi 83030, Caribbean 31667, African 60274 patient records)	LSOA Sub-groups, own-group ethnic density	Evidence of a protective effect of own-group density on depression diagnosis for the Pakistani, Indian, African and Bangladeshi groups reported. However, the authors also	**1. Migration & language**	1. No statistically significant evidence of the role of English as the first language as a pathway was reported	Age, gender, area deprivation	Medium-high

					reported a detrimental effect for the Black Caribbean group.				
Shields, Wailoo, 2002	Index of unhappiness (derived from 6 questions relating to psychological health)	FNSEM	1,824 (861 White, 224 Black Caribbean and 739 South Asian men), **Male adults**	Ward Sub-groups, own-ethnic density	Some evidence of a protective association between own-group density and unhappiness for South Asian men but not for Black Caribbean men.	**1. Racism** **2. Social stress** **3. Migration & language**	1. In a model including own-group ethnic density, an association between increased fear of harassment and increased unhappiness, was reported for the South Asian group only. 2. In the same model, being attacked was associated with increasing unhappiness for all ethnic groups. 3. In the same model, neither being born abroad, nor English language fluency was associated with unhappiness.	1.Age, age-squared, marital status, ethnic group, number of children, caring responsibilities outside of household, long-term illness, currently on prescribed medication, limited physical activity, had an accident, been attacked or burgled in the last 12 months, education, employment status, household income, rural, happiness with the area of residence, fear of harassment, English language fluency, born abroad 2. as above 3. as above	Medium-high

Yan, Wang, Zhou, Wang, Gong, 2019	GHQ-12	UKHLS	3,806 (Pakistani 891, Bangladeshi 541, Indian 1188, Black Caribbean 723, Black African 783)	LSOA Sub-groups, own-group density	Evidence of a detrimental association between higher own-group ethnic density and mental health for the Black Caribbean and Black African, Pakistani and Bangladeshi groups.	**1. Migration & language**	1. An interaction of generation with ethnic density was reported, where second generation Pakistani, Bangladeshi and Indian individuals had lower odds of having a potential mental health problem than the first generation.	Generation, generation * share of co-ethnics, gender, age, age^2, partnership, log of household income, log of duration of stay, neighbourhood deprivation	Medium

Table 3-4 - Suicide, suicidal ideation and self-harm studies descriptive table

Authors	**Mental health measure**	**Data** cross sectional unless otherwise stated	**Sample size**	**Area unit**	**Evidence reported for an ethnic density effect?**	**Pathway tested**	**Results**	**Covariates**	**Study quality**
Neeleman, Wilson-Jones, Wessely, 2001	Deliberate self-harm (attendance at A&E for DSH)	Lewisham and King's hospital attendance 1994-1997	1643 cases ('White' 1328, 'Non-White' 315)	Ward Sub-group & aggregate group, own-group density	For the 'non-White' group, the authors reported the relative risk of DSH to be lower at the highest centiles of density. The results were more varied for the Asian and Afro-Caribbean groups between both locations studied. The authors reported that a curvilinear model was a better fit to the data than the linear model for both the Asian and Afro-Caribbean ethnic groups.	n/a			Medium
Schofield, Das-Munshi, Bécares, Morgan, Bhavsar, Hotopf, Hatch, 2016b	Parasuicide ("Have you ever made an attempt to take your life, by taking an overdose of tablets or in some other way?")	SELCoH	1696 (143 Caribbean, 234 African, White British 1319)	LSOA Aggregate group, overall Black ethnic density	Evidence of an association between Black ethnic density and more reporting of parasuicide for both Caribbean and African groups combined was reported. The authors reported this effect to only retain significance for the Black Caribbean group when both groups were analysed separately and only when	n/a			Medium-high

					the overall Black density was used, rather than Black Caribbean density.				
Neeleman, Wessely, 1999	Suicide (unnatural deaths of study area residents obtained via local coroners and the Office for National Statistics)	South London Coroners Records 1991-1993	329 suicides (sample size by ethnic group not reported)	Ward Sub-group & aggregate group, own-group density	Higher minority ethnic density protective for suicide rates for the minority ethnic sample, with the opposite reported for the White group with increasing minority density.	n/a			Medium
Bécares, Nazroo, Jackson, Heuvelman, 2012b	Suicidal ideation ("Have you ever thought of taking your life, even if you would not really do it?")	EMPIRIC	661 participants -Caribbean only	MSOA Caribbean only, own-groups density	No statistically significant evidence of an association identified between ethnic density and suicidal ideation for the 'Caribbean English' group.	**1. Racism**	A protective association was reported between higher 'Black' ethnic density and having been refused a job for people identifying as Caribbean and a in the opposite direction for Caribbean ethnic density.	sex, age, marital status, generation, household income, education, employment status, area deprivation (additionally adjusted for 'Black' or 'Caribbean' density in alternate models)	High
Bécares, Das-Munshi, 2013	Suicidal ideation ("Have you ever thought of taking your life, even if	EMPIRIC & Citizenship survey	4,281 participants (Indian 648, Pakistani	MSOA	The authors reported statistically significant evidence of a protective association between own-	n/a			High

	you would not really do it?")		724, Bangladeshi 650, Black Caribbean 691, White Irish 733, White British 835). (EMPIRIC)	Sub-groups, own-group ethnic density	group ethnic density and suicidal ideation for the Bangladeshi group only.				

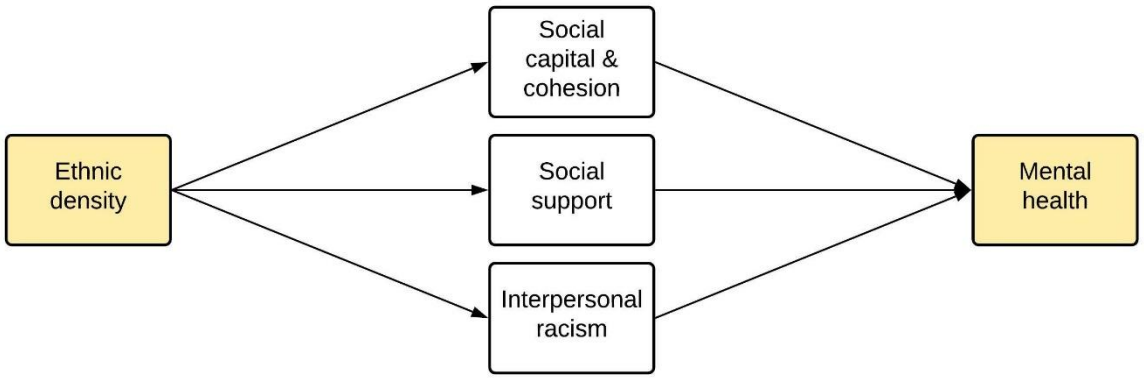
4 Chapter 4: Theoretical framework

The results of the systematic review, along with previous work proposing other related, relevant theoretical frameworks (Halpern, 1993; Bécares, 2009; Kramer and Hogue, 2009; Landrine and Corral, 2009), were drawn upon to create a theoretical framework for the ethnic density effect. The broad, overarching theoretical approach employed in the creation of the theoretical framework is one of a largely psychosocial understanding of the social determinants of health (Krieger, 2011; Marmot and Wilkinson, 2005). Figure 4.1 below displays the theoretical model proposed which I aim to empirically assess in this thesis. Three indirect pathways are proposed. These are as follows:

1. Social capital and cohesion
2. Social support
3. Racism

Though the included studies in the systematic review also frequently assessed 'social stress', the evidence base for this pathway was arguably the weakest. The operation of the 'social stress' pathway was poorly theorised and variously conceptualised and measured, resulting in a complex and unclear evidence base. For this reason, this pathway was excluded from the theoretical framework presented here. In addition, the more complex factors which may play a role in the operation of these pathways such as deprivation and migration, language and 'acculturation' are not presented here. These factors are thought to exert different effects on each of the proposed indirect paths and, for clarity, are not presented in the theoretical framework. However, the role of these other factors is discussed later in the thesis.

Figure 4-1 - Simplified theoretical framework



n.b. the above is a theoretical model only. The structural model employed in the quantitative analyses used to test this framework (which includes confounders and additional structural paths) is presented in Chapter 8.

4.1 Theoretical framework description

It is not hypothesised that ethnic density will exert a direct effect on mental health. Instead, as depicted in Figure 4.1, the effect of ethnic density is hypothesised to be mediated by social capital and cohesion, social support and interpersonal racism. The processes thought to operate behind each of these mediators are complex and not always direct in nature. In the following, the theories behind the operation of each of the proposed mediators in the relationship between ethnic density and mental health are described.

4.2 Social support

Direct effects

In the conceptual framework, ethnic density is proposed to determine the level of social support, which in turn influences mental health. Social support is argued to be beneficial for mental health directly via the provision of informational support, the augmentation of feelings of self-esteem, identity and via a general increase in positive affect (Cohen, 1988). In addition, in theories of cultural maintenance (see Berry, 1997) it is proposed that the maintenance of culture and support among group members may be beneficial for health, particularly in mitigating the stressors involved with integration. Recent work provides evidence of the protective effects of the maintenance of social ties with members of the same ethnic group (Luthra et al., 2020).

Indirect effects: The buffering hypothesis

It is also thought that the social support pathway has indirect effects, drawing upon the "stress buffering hypothesis" (Cohen and Wills, 1985; Cohen, 1988). This theory argues that the effects of racism are lessened via social support provided. In addition to the pathways between social support and health listed above, it is argued that social support alters the appraisal of stressful events, reducing the affective reaction to the event (Cohen, 1988). In addition, processes relating to "internalized oppression" (Krieger and Sidney, 1996) are thought to be in operation. It is argued that racism is less likely to come to be internalised (seen as a reflection of an individual's inherent flaw) and to be considered justifiable by the victim. Relatedly, the discussion and validation of racist experiences with others from a similar ethnic background is also said to buffer the impact of racism on mental health (Bécares et al., 2009). Existing studies provide some evidence that social support may moderate the association between ethnic density and mental health (Das-Munshi et al., 2012), though this has been inconsistent (Das-Munshi et al., 2010). However, the evidence resulting from

the systematic review on this indirect pathway was not sufficiently clear to justify its inclusion in the theoretical framework presented here.

4.3 Racism

In the conceptual framework, ethnic density levels are proposed to determine the likelihood of encountering racism, thereby impacting mental health. The theory underpinning this pathway is that of informal social control, which is said to be greater in areas where residents are similar. This informal social control establishes social norms, regulating the behaviours of a group (Sampson et al., 1997). Therefore, it is suggested that, as ethnic density increases, informal social control and associated group norms relating to racism are established, leading to a reduction in racist encounters (Bécares, 2009). Existing studies assessing racism report weaker associations between racism and mental health in higher density areas (Bécares, et al., 2009; Das-Munshi et al., 2010).

4.4 Social Cohesion

The social cohesion concept itself is arguably the most complex included within the framework and the processes underpinning its effects are the least clear. As argued by Kawachi and Berkman, "a cohesive society is also one that is richly endowed with stocks of social capital" (Kawachi and Berkman, 2000, p.175) and is said to be a group-level attribute (Kawachi et al., 2008). A cohesive community is also thought to foster social capital, including a sense of community connectedness, trust, belonging and identity, collective action and civic involvement (Putnam, 1992). In this thesis, social cohesion is hypothesised to impact mental health primarily via greater social capital, an increased sense of belonging and greater influence over the decisions made within that area (Carpiano, 2008). Civic involvement is thought to be relevant to mental health via the facilitation of availability of and access to culturally appropriate services, including health services (Kawachi and Berkman, 2000). However, the more direct effects of social cohesion on mental health, via belonging, are of primary interest in this thesis and the indirect process, through greater civic and political participation, is not depicted in the theoretical framework.

4.5 Summary

This chapter presented the theoretical framework drawn from the results of the systematic review which will be used to guide the following empirical analyses included in this thesis. In the following chapter, the dataset, sample characteristics and variables which will be used to test this theoretical framework are presented.

5 Chapter 5: An empirical investigation of ethnic density and mental health: data selection, descriptive characteristics, and basic associations

This chapter introduces the main datasets employed (Understanding Society Wave 3 and 2011 Census data) to assess the ethnic density effect and the role of the key pathways identified by the systematic review. It describes the main sources of data and provides a detailed overview of these datasets.

The findings of the systematic review (particularly those relating to the pathways tested) informed the selection of the dataset, variables and area unit used in the following analyses. In selecting a dataset for individual-level data, I prioritised the available sample size for the largest minority ethnic groups in England and the range of topics available in the variables included in the survey. Based on these factors, I chose to use the panel study Understanding Society (University of Essex 2021), also known as the UK Household Longitudinal Study and referred to henceforth as UKHLS (the ethics statement for the UKHLS data is included in the Appendix, section 10.6). Further detail on the role of the systematic review findings in guiding the analyses included in this thesis is detailed in Chapter 6.

5.1 UKHLS: survey introduction and data access

Data from the panel study UKHLS[6] were used in the quantitative analyses performed in the following chapters. The survey began in 2009 and is available to download from the UK Data Service (UKDS). The UKHLS is a large and representative longitudinal survey of 26,000 households which includes the remaining participants from the British Household Panel Survey (BHPS) (which ended in 2008) merged into the start of the new study in 2010 (Understanding Society, 2021a). It is possible to link the UKHLS data to area-level data by using the census output area identifiers provided by the UKDS.

[6] Data acknowledgement statement: Understanding Society is an initiative funded by the Economic and Social Research Council and various Government Departments, with scientific leadership by the Institute for Social and Economic Research, University of Essex, and survey delivery by NatCen Social Research and Kantar Public. The research data are distributed by the UK Data Service.

Special license requirements and safeguarding steps

An application was submitted to the UKDS to download Waves 1-8, along with area-level identifiers (both LSOA and MSOA identifiers were requested). This application was made via the UKDS online form and underwent review through the UKDS application system. A special license was required for the use of these datasets due to the potential risk of identifying individuals while using the area-level identifiers (access granted 14/11/2019, Project id: 181008). In order to protect these data and participant anonymity, I put in place several measures which included: storing the data on a passphrase protected, encrypted laptop which was stored and used in a locked room within the university, and agreeing to securely delete all data at the end of the time frame for which approval for its use was sought. The UKDS granted special permission to allow the special license data to be accessed from home, via remote desktop and using the University's secure VPN, during the Covid-19 pandemic (permission granted on 02/04/2020).

Survey waves used for this project

This project uses Wave 3 data (data collection period January 1st 2011 to 30th June 2013) of the UKHLS (University of Essex, 2021). This wave was selected based upon variable availability, which covered a range of topics including neighbourhood cohesion, attitudes toward the neighbourhood and racism questions. Moreover, this wave is temporally most proximate to the 2011 census (which is important for data linkage to ethnic density measures from the 2011 census discussed below in section 5.5). In addition, earlier waves of the survey are likely to have smaller loss to follow-up than later waves for the ethnic minority boost sample (this hypothesis was confirmed via analysis of the sample sizes in each of the survey waves prior to commencing the present analysis). Just one wave was chosen and assessed in a cross-sectional approach based on the decision to prioritise analysing ethnic groups in the smallest aggregations possible. Longitudinal analysis, requiring repeat engagement with the survey across waves by the same participants, reduced the sample size to such a degree that disaggregated analysis would not have been possible.

5.2 Sampling strategy in UK Household Longitudinal Study and its component sub samples

The UKHLS is comprised of the General Population Sample (GPS), the Ethnic Minority Boost sample (EMB), the General Population Sample (GPS), the General Population Comparison Sample (GPCS) (a subset of the GPS sample) and sample members from the old British Household Panel Survey (ex-

BHPS) (Lynn, 2009). Members of the EMB and GPCS are asked an additional survey of specific questions not asked to the GPS, called the 'extra five minutes' survey, which contains question topics specific to minority ethnic groups. In this study I analyse survey participants who responded to this 'extra five minutes' survey.

The General Population Sample (GPS)

The sampling strategy of the General Population Sample (GPS) of UKHLS is complex and multi-stage, where individuals are sampled from households, which are sampled from postcodes. The sampling strategy is described in full by Lynn (Lynn, 2009). The GPS is comprised of samples from England, Scotland, Wales and Northern Ireland and uses "a proportionately stratified, equal probability (clustered) sample of residential addresses" (Lynn, 2009, p.2), excluding Northern Ireland where this is un-clustered. Firstly, postal sectors were defined so that sectors smaller than 500 "delivery points" were grouped with the nearest sector. Following this, stratification by region was performed, in which postal sectors were divided into 12 regions. Each region was then stratified into three strata by occupation, based on responses to the 2001 census. These were grouped into three equal sized groups by population density which were then sorted again by minority ethnic density. Finally, from these strata 2,640 areas (referred to by UKHLS as Primary Sampling Units or 'PSU's) were selected using systematic random sampling (SRS), with 18 Postcode Address Files selected from each (also using SRS), resulting in 47,520 addresses in total (excluding Northern Ireland which had a different selection process not described here) (Lynn, 2009).

The General Population Comparison Sample (GPCS)

The GPCS members were selected by random sample of the GPS. For 40% of the postal sectors covered by the GPS, one household from each was included in the GPCS sample (Understanding Society, 2021a) to receive the 'extra five minutes' additional survey.

The Ethnic Minority Boost sample (EMB)

In addition to the main General Population Sample (GPS), a minority ethnic boost sample was also included for England, Scotland and Wales (Northern Ireland is not included). The aim of this sample was to achieve 1,000 responses from each of the largest minority ethnic groups: Indian, Pakistani, Bangladeshi, Caribbean and African (McFall et al., 2019). The sampling procedure for the boost sample recruited participants by selecting postal areas with high proportions of minority ethnic groups, identifying 3,145 areas in total. These were then divided into four strata by the expected number of minority ethnic households to be identified (shown below in Table 5.1). All sectors in

strata 1 were included (where three or more households were expected to be identified). The other three strata were sub-sampled at differing rates. This resulted in a total of 771 sectors selected, with 758 in England and with 15 to 103 addresses selected per sector based on target numbers and efficiency (McFall et al., 2019; Berthoud et al., 2009). Initial screening questions were carried out to identify if any members of a minority ethnic group lived in the house. Further information on the sampling design of the Ethnic Minority Boost sample is available from (Berthoud et al., 2009). The total sample size of Ethnic Minority Boost participants in Wave 1 was 7,320.

Table 5-1 - EMB sampling strata

Strata	Predicted household yield	Sub-sampling rate
4	0	1 in 16
3	1	1 in 8
2	2	1 in 4
1	3+	All sampled

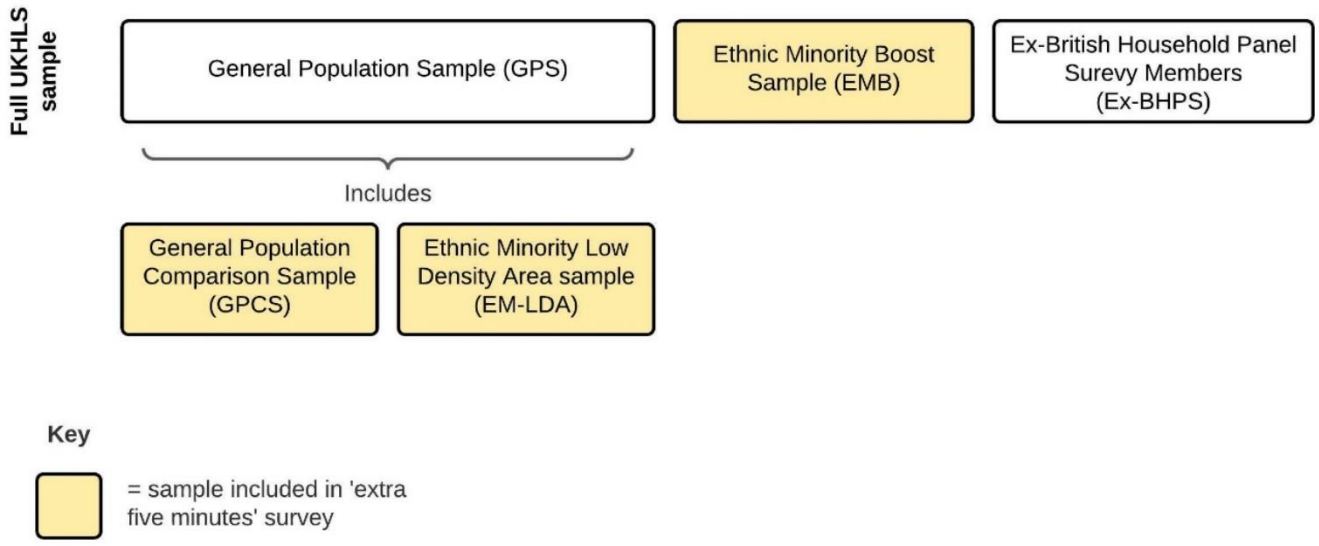
The 'extra five minutes' sample

As explained briefly above, the 'extra five minutes' survey is given to a sub-group of study participants made up from three other samples. This sample includes the EMB sample, the General Population Comparison Sample (GPCS) and the Ethnic Minority in Low Ethnic Minority Density Area sample (EM-LDA). The GPCS is included in order to provide a White British/English/Scottish/Welsh comparative group, who are also asked the 'extra five minutes' questions. The final component, the EM-LDA, is comprised of participants from minority ethnic backgrounds identified by the GPS (in areas that were not identified for the boost sample due to their low density of minority ethnic groups). In other words, the EM-LDA is not a separate sample element. However, respondents identified by the GPS who happened to be of minority ethnic background were flagged as EM-LDA and subsequently given the 'extra five minutes' survey. Figure 5.1 shows a graphical depiction of the samples which constitute the full UKHLS sample and those which are given the additional 'extra five minutes' questionnaire. Further information on the 'extra five minutes' sample is available from (McFall et al., 2019). The sample size of the 'extra five minutes' sample in Wave 1 was 8,161.

The purpose of the 'extra five minutes' sample is to allow questions to be asked which are specific to ethnicity-based research. Like the main survey, some of the questions posed in this module are constant across waves, while others rotate in and out. In particular, this additional question module provides the opportunity to assess important issues such as racism and discrimination. In addition, a

key benefit of using this survey is the large sample of minority ethnic groups which are sampled repeatedly across time

Figure 5-1 - Graphical depiction of the sub-samples which are given the additional 'extra five minutes' questionnaire



Data collection for all samples

Data collection for each wave of the survey is conducted over a period of 24 months, although the UKDS team aim to interview each participant at 12-month intervals. Interviews are conducted predominantly face to face, with a small number conducted over the phone. From Wave 8 onward, a large proportion (approximately 40%) of the sample completed online interviews (Understanding Society, 2021a). The survey itself is comprised of a household element, answered by one household member on behalf of the rest of the residents (covering questions such as household income), and a mainstage element which includes a self-completion module (completed by the participant on a laptop from Wave 3 onward) (Understanding Society, 2021a, p.33).

5.3 Data representativeness and sampling design

The GPS sample of the UKHLS is generally understood to be representative of the 2011 population (Lynn, 2011). However, it has been noted that in comparison to the 2011 census, there is a small underrepresentation of people from greater London, men, and also people with a "severely limiting long term illness" (Lynn and Borkowska, 2018). The authors of a working paper on sample

representativeness found attrition rates to be much higher in the UKHLS survey, with 52% of the sample remaining after six years, in comparison to its predecessor, the BHPS with 78% of the original sample participating after six years (Lynn and Borkowska, 2018, p.7). Importantly though, they noted that there was not a strong association between health and attrition from the survey (Lynn and Borkowska, 2018).

The EMB sample is designed so that it provides representation of the biggest five minority ethnic groups in Britain. However, the EMB sample suffers from high attrition, so that by Wave 3 (the wave used in the analysis included in this thesis) only 48.73% of the original sample remained. In addition to this, the 'extra five minutes' sample also has a large proportion of non-response to the self-completion element of the survey, though the proportion of non-response mirrors that for the full Wave 3 sample including the GPS (approximately 18% in both). It is important to consider these limitations when interpreting analysis results as, although currently UKHLS provides the most comprehensive coverage of minority ethnic groups in England, it is not necessarily representative of these groups.

5.4 Area unit chosen to study the ethnic density effect

The focus of this thesis is the role of area-level ethnic density on individual mental health. It was therefore important to select the area-unit which most accurately represents the scale at which the 'ethnic density effect' is thought to operate. Theory on the pathways behind the ethnic density effect derived from the theoretical framework produced from the results of Chapter 3 was studied in order to provide further justification for the most appropriate scale. Many of these pathways refer to neighbourhood level constructs, such as social cohesion and informal social control, suggesting smaller area units may be more appropriate for studying these underlying pathways. Census data and UKHLS data are available at three different spatial units: Middle Super Output Area (MSOA), Lower Super Output Area (LSOA), and Output Area (OA). These units have average populations of 7,787 for MSOAs, 1,614 for LSOAs and 309 for OAs in the 2011 census (ONS, 2012). The number of each of these area units at Wave 1 and Wave 3 compared with the total number in England are shown below in Table 5.2. However, it should be noted that the area unit choice was in part made with data volume and data availability in mind. For some of the area-level measures from linked datasets, the smallest unit available was LSOA. In addition, due to the sampling design of the EMB sample, the average sample size per area unit was small, and decreased further with increasingly smaller unit sizes (shown in Table 5.3). Therefore, balancing a priority for small area unit size guided

by exiting research and theory with data volume and availability, LSOA unit size was chosen for this thesis.

Table 5-2 - Total number of LSOAs and MSOAs in England and in the UKHLS dataset

	England	UKHLS dataset w1	UKHLS dataset Wave 3
LSOA	32,844	12,874	12,899
MSOA	6,791	4,563	5,256

Table 5-3 - Average number of participants and households per LSOA and MSOA

	2011 household average for England	2011 individual average for England	UKHLS participating households at w1	UKHLS participating individuals at w1
LSOA	699.55 (SD 146.37)	1614.07 (SD 301.29)	2.69 (SD 1.60)	5.04 (SD 3.37)
MSOA	3383.31 (SD 731.22)	7806.28 (SD 1603.72)	7.98 (SD 4.33)	14.25 (SD 8.54)

5.5 Linked data

Census data

LSOA identifiers from the UKDS were used to link the data to area-level census data. 2011 census data on the proportions of ethnic groups within LSOAs were used to calculate ethnic density data for each disaggregated ethnic group, for overall minority ethnic density and for Black and South Asian density. These data are freely available from the Nomis website (Nomis, 2021).

Deprivation data

The English Indices of Deprivation (EID) from 2015 were chosen as the measure of area deprivation for these analyses. It could be argued that the most temporally proximate deprivation measure would have been the previous measure from 2010. However, the 2010 EID measure uses data from 2008 (Ministry of Housing, Communities and Local Government, 2011) whereas the 2015 measure uses data mostly from 2012-2013 as well as some data from the 2011 census (Ministry of Housing, Communities and Local Government, 2015). Therefore, the 2015 EID measure was deemed to be a better temporal fit to the 2011 census data used for the ethnic density measures and the UKHLS Wave 3 data (2011-2013). The composition of this measure is described in greater detail in section 5.11.4.

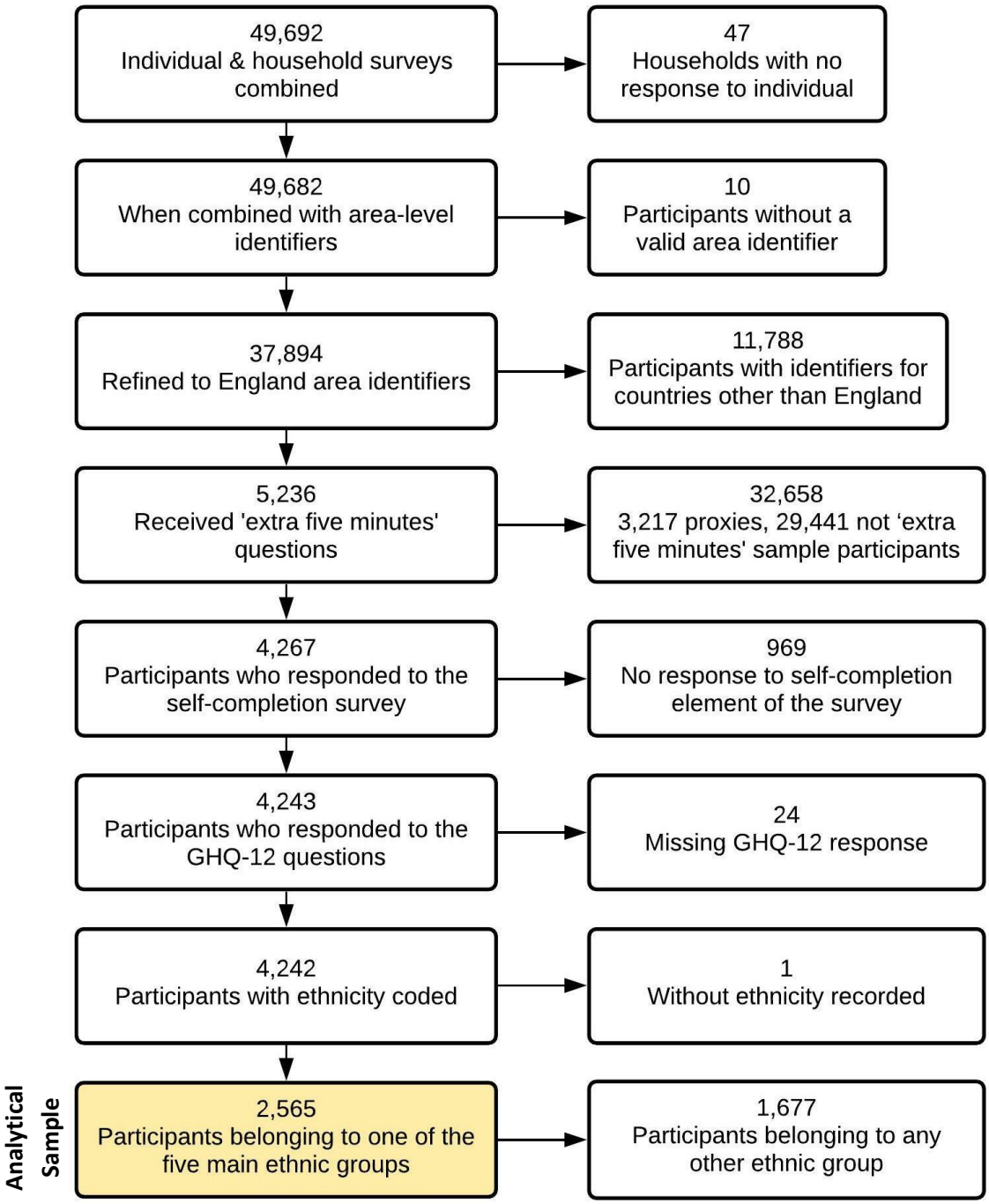
5.6 Descriptive statistics of the analytic sample

In the following, I introduce the analytical sample used in the subsequent analyses in this thesis, beginning with a diagram showing the process of exclusion to reach this final sample and followed by a comparison with those excluded from analyses. I follow this by introducing the key measures and covariates employed in the subsequent analyses. Finally, I present the results of the preliminary analyses conducted of adjusted associations between the ethnic density and mental health measures.

5.7 Sample size flow chart

In Figure 5.2 the process of inclusion of study participants from Wave 3 is shown, based on the 'extra five minutes' sub-sample, the availability of area identifiers, response to the self-report questionnaire and response to ethnicity and mental health questions. The final size of the analytical sample used in the Structural Equation Modelling performed in Chapters 7 and 8 (participants belonging to one of the five main ethnic groups) is shown (n= 2,565).

Figure 5-2 - Sample size flow chart



5.8 Analytic sample

The analytical sample (n= 2,565) used in the thesis is refined to the five main minority ethnic groups represented by the 'extra five minutes' sample (with 'other', 'mixed' and White British ethnic categories excluded). Table 5.4 shows the characteristics of the final analytical sample used for subsequent analyses.

Table 5-4 - Descriptive characteristics of the analytic sample

Variable		Number/mean (%/SD)
Sample total		2,565
Sex	Male	1,170 (45.61%)
	Female	1,395 (54.39%)
Age group	16-20	352 (13.72%)
	21-30	522 (20.35%)
	31-40	634 (24.72%)
	41-50	539 (21.01%)
	51-60	293 (11.42%)
	61+	225 (8.77%)
Ethnic categories	Indian	653 (25.46%)
	Pakistani	570 (22.22%)
	Bangladeshi	394 (15.36%)
	Black Caribbean	459 (17.89%)
	Black African	489 (19.09%)
Highest qualification	Missing	8 (0.31%)
	Degree level or higher	1,029 (40.12%)
	A or AS level or equivalent	402 (15.67%)
	GCSE, equivalent or other school certification	657 (25.61%)
	None of the above	469 (18.28%)
Marital status	Single, never married	902 (35.17%)
	Married/in a civil partnership	1,339 (52.20%)
	Legally separated or living separately	202 (7.88%)
	Widowed/surviving civil partner	57 (2.22%)
	Living as a couple (cohabiting?)	67 (2.53%)
Household income (£ month before interview)	£-505.00 - £43903.27	3576.53 (SD 2713.93)
Born in the UK	Missing	15 (0.58%)
	Not born in UK	1,550 (60.43%)
	England/Scotland/Wales/NI	1,000 (38.99%)
Long standing illness or disability	Missing	2 (0.08%)
	Yes	521 (20.31%)
	No	2,042 (79.61%)
Household type	Living alone	232 (9.04%)
	Single parent	208 (8.11%)
	Couple without children	202 (7.88%)
	Couple with children	779 (30.37%)

Variable		Number/mean (%/SD)
	More than one adult, without children	416 (16.22%)
	More than one adult, one or more children	728 (28.38%)
Tenure	Missing	15 (0.58%)
	Owned outright	407 (15.87%)
	Owned with mortgage	977 (38.09%)
	Social rent (local authority or housing association)	748 (29.16%)
	Privately rented	386 (15.05%)
	Other	32 (1.25%)
Would like to move in the next year	Don't know	10 (0.39%)
	Prefers to stay	1,550 (60.43%)
	Would like to move	1,005 (39.18%)
Area type	Urban	2,542 (99.10%)
	Rural	23 (0.90%)
Low density area for minorities	No	2,081 (95.46%)
	Yes	99 (4.54%)

The analytic sample presented in Table 5.4 shows the final sample refined to participants belonging to one of the five largest minority ethnic groups represented by the survey. The sample is comprised of a slightly larger proportion of women to men and contains a greater proportion of people from the age 31-40 group then the rest of the other age brackets. The largest ethnic group in the sample is the Indian group (25.46%) and the smallest is the Bangladeshi group (15.36%). In general, the sample is well educated to degree level or higher (40.12%) and over half of the sample are married or in a civil partnership (52.20%). More than half of the sample were not born in the UK (60.43%). A substantial proportion of the sample reported having a long-standing illness or disability (20.31%), although this is lower than the average for the full survey sample (at approximately 35% for the full survey sample). Couples with children made the largest category of household type (30.37%) and owning a house with a mortgage was the largest category of tenure for the sample (38.09%). The majority of the sample indicated that they would like to stay in their current area (60.43%) and the sample was almost entirely drawn from urban areas (99.10%) and areas of higher ethnic density (95.46%).

The analytic sample contains only respondents with valid GHQ-12 scores belonging to one of the five ethnic groups of focus within the 'extra five minutes' survey. As the proportion of the sample with missing responses to the self-report survey (and as a result, the GHQ-12 questions) was high, the following section (5.9) describes the 'extra five minutes' sample with missing or invalid responses to the GHQ-12 element of the survey and compares it to the sample participants with valid responses to GHQ-12.

5.9 Missing data

A substantial proportion of the 'extra five minutes' sample at Wave 3 had missing responses to the main outcome variable (GHQ-12), with 966 coded as inapplicable (18.45%) and 24 coded as missing (0.46%) (see sample size flow chart in Figure 5.2). Further investigation revealed that participants with responses coded as 'not applicable' or 'missing' were coded as such mostly due to failing to complete the self-completion element of the survey (meaning that the participant failed to fill out any questions in this element of the survey, rather than just the questions relating to mental health). The total number of participants who failed to fill in the self-completion survey was 969 (18.51%). This survey element is completed individually, and in Wave 3 this was completed via Computer-Assisted Self Interviewing (CASI) (Scott and Jessop, 2013). Non-response to this element meant that, although basic descriptive information was available for these participants, collected via the interviewer-administered portion of the survey, responses to more personal questions such as those relating to mental health and the perception of the neighbourhood were not available.

The proportion of the sample with missing responses to the self-completion questionnaire and therefore, the GHQ-12 measure, was deemed too large to proceed with performing a complete case analysis without further consideration and treatment of the missing data and its impact on analysis. A table comparing the average scores and percentages of key covariates between the samples with missing and non-missing GHQ-12 of those who received the 'extra five minutes' survey is presented below in Table 5.5. As the missing information related to the outcome variable, imputation was not a viable option and listwise deletion was instead used to remove these participants. The implications of excluding the sample with missing information on the outcome variable are discussed below.

Table 5-5 - Descriptive table of the sample receiving the 'extra five minutes' survey, comparing those with missing responses to the GHQ-12 measure to those with a valid response

Variable		Missing Number/ mean (%/SD)	Non-Missing Number/ mean (%/SD)	Diff. % (non missing-missing)	Diff. tests (x^2 unless stated)[7]
Sample total (% of entire sample)		969 (18.51)	4,267 (81.49)		
Sex	Male	406 (41.90)	1,937 (45.39)	3.49	P<0.05
	Female	563 (58.10)	2,330 (54.61)	-3.49	
Age	16-20	57 (5.88)	516 (12.09)	6.21	P<0.001
	21-30	141 (14.55)	816 (19.12)	4.57	
	31-40	226 (23.32)	1,019 (23.88)	0.56	
	41-50	218 (22.50)	912 (21.37)	-1.13	
	51-60	136 (14.04)	518 (12.14)	-1.90	
	61+	191 (19.71)	486 (11.39)	-8.32	
Ethnic group analysis categories	White British/E/W/S/NI	66 (6.81)	725 (16.99)	10.18	P<0.001
	Indian	178 (18.37)	660 (15.47)	-2.90	
	Pakistani	178 (18.37)	574 (13.45)	-4.92	
	Bangladeshi	208 (21.47)	398 (9.33)	-12.14	
	Black Caribbean	84 (8.67)	613 (14.37)	5.7	
	Black African	113 (11.66)	491 (11.51)	-0.15	
	All other groups	142 (14.65)	806 (18.89)	4.24	
Highest qualification	Missing	2 (0.20)	10 (0.24)	0.04	P<0.001
	Degree level or higher	232 (23.94)	1,812 (42.47)	18.53	
	A or AS level or equivalent	107 (11.04)	628 (14.72)	3.68	
	GCSE/equivalent/other school certification	222 (22.91)	1,084 (25.40)	2.49	
	None of the above	406 (41.91)	733 (17.18)	-24.73	
Marital status	Missing	1 (0.10)	0 (0.00)	-0.10	P<0.001
	Single, never married	195 (20.12)	1,400 (32.81)	12.69	
	Married/in a civil partnership	634 (65.43)	2,193 (51.39)	-14.04	
	Legally separated or living separately	70 (7.22)	326 (7.64)	0.42	
	Widowed/surviving civil partner	52 (5.37)	109 (2.55)	-2.82	
	Living as a couple (cohabiting?)	17 (1.75)	239 (5.60)	3.85	
Household income (£ month before interview)	£0.17 - £43903.27	3287.76 (SD 2763.31)	3694.31 (SD 2762.88)	406.55	T-test P<0.001
Born in the UK	Missing/n/a/don't know	1 (0.10)	29 (0.68)	0.58	P<0.001
	England/Scotland/Wales/NI	241 (24.87)	2,058 (48.23)	-23.94	

[7] Chi square test performed with the missing category removed where applicable due to small cell sizes rendering the test unreliable. Statistical significance of these tests may be the result of a large difference in just one category.

Variable		Missing Number/ mean (%/SD)	Non-Missing Number/ mean (%/SD)	Diff. % (non missing-missing)	Diff. tests (x^2 unless stated)[7]
	Not born in UK	727 (75.03)	2,180 (51.09)	23.36	
Long standing illness or disability	Missing	6 (0.62)	2 (0.05)	-0.57	P<0.01
	Yes	274 (28.28)	1,011 (23.69)	-4.59	
	No	689 (71.10)	3,254 (75.31)	4.21	
Household type	Living alone	78 (8.05)	449 (10.52)	2.47	P<0.01
	Single parent	56 (5.78)	302 (7.08)	1.30	
	Couple without children	104 (10.73)	549 (12.87)	2.14	
	Couple with children	290 (29.93)	1,305 (30.58)	0.65	
	Adults >1, no children	174 (17.96)	687 (16.10)	-1.86	
	Adults >1, 1+ children	267 (27.55)	975 (22.85)	-4.75	
Tenure	Missing	10 (1.03)	20 (0.47)	-0.56	P<0.001
	Owned outright	199 (20.54)	771 (18.07)	-2.47	
	Owned with mortgage	294 (30.34)	1,681 (39.40)	9.06	
	Social rent	299 (30.86)	1,086 (25.45)	-5.41	
	Privately rented	145 (14.96)	658 (15.42)	0.46	
	Other	22 (2.27)	51 (1.39)	-0.88	
Would like to move in the next year	Don't know	6 (0.62)	14 (0.33)	-0.29	P<0.001
	Prefers to stay	656 (67.70)	2,536 (59.43)	-8.27	
	Would like to move	307 (31.68)	1,717 (40.24)	8.56	
Area type	Urban	947 (97.73)	4,048 (94.87)	-2.86	P<0.001
	Rural	22 (2.27)	219 (5.13)	2.86	
Area deprivation score (LSOA)		3138.36 (SD 3138.36)	2669.19 (SD 1400.46)	-469.17	T-test P<0.001

Of the entire sample which received the 'extra five minutes' questions (n=5,236), 18.51% did not have a valid response to the GHQ-12 questions. The missing sample contained a greater proportion of women (58.10% compared with 54.61%), a greater proportion of people from the oldest age group (61+) (19.88% compared with 12.09%) and a smaller proportion of people in the youngest age category than in the non-missing sample (5.76% compared with 12.15%). The missing sample contained a smaller proportion of people from the White British ethnic group (6.81% compared to 16.99%). In general, in the missing sample contained a larger proportion of the other ethnic groups included except in the case of the Black Caribbean group (8.67% compared with 14.37%) and in the case of the 'other' group (14.65% compared with 18.89%). The missing sample was made up of a greater proportion of people without any of the qualifications listed (41.91% compared with 17.18%) and contained a slightly greater proportion of participants who were married (65.43% compared with 51.39%) and a slightly smaller proportion of participants who were single (20.12% compared to 32.81%). The missing sample had a lower average household income by £406.55, had higher average area-level deprivation scores (by a difference of 469.17) and contained a smaller proportion of

people who wanted to move compared with the non-missing sample (31.68% compared with 40.24%). The missing sample also contained a much greater proportion of people not born in the UK compared with the non-missing sample (75.35% of the missing sample compared with 50.89% of the included sample).

Tests of difference (x^2 and independent sample t-tests) comparing the missing and non-missing sample members were all significant to p< 0.05 or above. In summary, comparison of the samples suggests that the missing sample were more likely to be older, married, to have no qualifications, a lower average household income, to be from a more deprived area, to have not been born in the UK and were in general more likely to be from a minority ethnic group. Therefore, the final analytical sample is biased towards the better educated, wealthier, single, younger and to those born in the UK. It is important to consider the findings of the following chapters in light of this.

5.10 Weighting strategy and representativeness of the analytic sample

Due to the complex sampling strategy used for this survey, sampling weights are provided by UKHLS and should be applied in analyses in order to account for unequal selection probabilities and non-response which can result in the data missing not at random (MNAR). The weights provided are specific to the UKHLS (full or sub-) sample used in analyses and also to the cross-sectional or longitudinal use of the data. The primary reason for the use of weights is not only to correct for the sampling strategy and data clustering, but to render the data representative of the population of the UK.

Although specialised weights were available with the UKHLS data for the 'extra five minutes' sample, the weight contained a large number of zero-weights (n=858) which appeared to be a result of the way the weights had been calculated, rather than due to the data provided by the survey respondent[8] (effectively excluding these participants from any analyses). Application of the weight resulted in a reduction in sample size in the already limited ethnic group-specific sample sizes. Alternative possibilities were tested, including working forward from a Wave 1 weight provided for the sample. However, ultimately, no alternative options were found which did not result in the loss of a similar or larger proportion of participants. In addition, due to the complex type of SEM ultimately applied to the data, it was ultimately not possible to include any sampling weights in the final MG-MSEM analysis. Importantly, the aim of this research was to elucidate possible causal

[8] Based on communication with UKHLS User Support (Kaminska, 2021)

pathways between ethnic density and mental health for minority ethnic groups, rather than to provide descriptive statistics which are representative of these ethnic groups in England. These reasons led to the decision not to include weights in any of the analyses presented in this thesis.

Proceeding with the following analyses without the application of the survey weights means that the results presented are not generalisable to the population of minority ethnic groups in England. In particular, and as is described in further detail in section 5.9, the sample is skewed toward people from minority ethnic backgrounds living in high ethnic density areas. Inferences made based upon the findings of the following analyses relate specifically to the sample employed (a detailed, ethnic group-specific description of which is provided later in this chapter in section 5.12, Table 5.11) and should not be thought of as representative of the population of these five minority ethnic groups in England. Though representation from low density areas is very low, there remains considerable variation in ethnic density across all five ethnic groups (demonstrated and discussed later in this section in Figure 5.4). Despite its lack of representativeness, the analytical sample provides an opportunity to test a theoretical model of the effect of ethnic density on mental health for fine grained minority ethnic groups; the focus of this thesis.

5.11 Included variables and their operationalisation

The following variables were selected for inclusion based upon a priori knowledge of the determinants of mental health, ethnic density, and confounders of the association between mental health and ethnic density. Individual-level measures are presented first (including the dependent variable, covariates and hypothesised mediators), followed by area measures employed. The measurement of these variables is described below, followed by descriptive statistics for the sample as a whole and by ethnic group.

5.11.1 Individual level variables

Outcome variable: GHQ-12

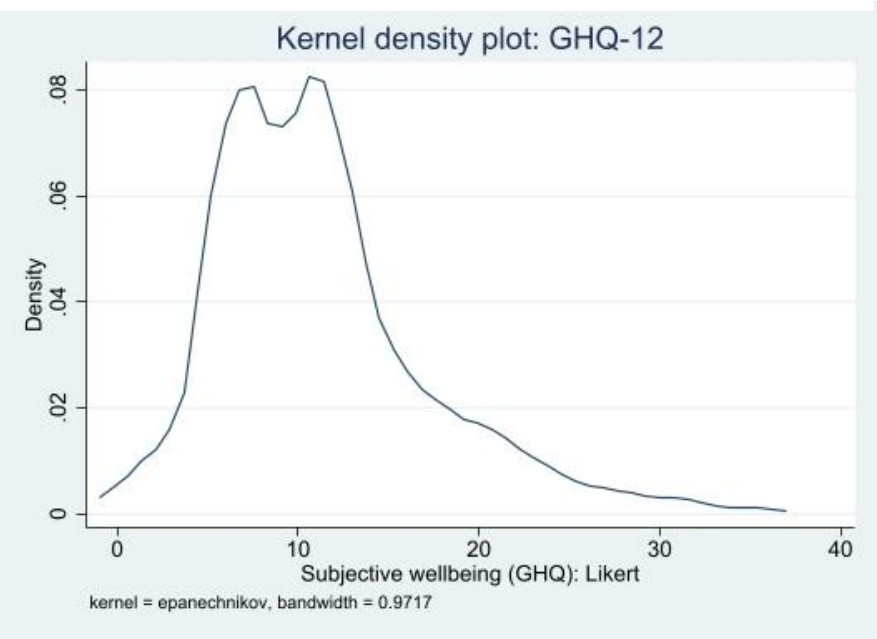
The General Health Questionnaire 12 is a questionnaire which is self-administered by the study participant to assess non-psychotic mental illness (Goldberg and Williams, 1988) in the self-completion module of the UKHLS questionnaire. The questions which comprise the instrument are detailed below in Table 5.6.

Table 5-6 - GHQ-12 component questions and Likert responses (Goldberg and Williams, 1988)

	Have you recently…	
1	been able to concentrate on whatever you're doing?	Better than usual Same as usual Less than usual Much less than usual
2	lost much sleep over worry?	Not at all No more than usual Rather more than usual Much more than usual
3	felt that you were playing a useful part in things?	More than usual Same as usual Less so than usual Much less than usual
4	felt capable of making decisions about things?	More so than usual Same as usual Less so than usual Much less capable
5	felt constantly under strain?	Not at all No more than usual Rather more than usual Much more than usual
6	felt you couldn't overcome your difficulties?	Not at all No more than usual Rather more than usual Much more than usual
7	been able to enjoy your normal day-to-day activities?	More than usual Same as usual Less so that usual Much less than usual
8	been able to face up to problems?	More so than usual Same as usual Less able than usual Much less able
9	been feeling unhappy or depressed?	Not at all No more than usual Rather more than usual Much more than usual
10	been losing confidence in yourself?	Not at all No more than usual Rather more than usual Much more than usual
11	been thinking of yourself as a worthless person?	Not at all No more than usual Rather more than usual Much more than usual
12	been feeling reasonably happy, all things considered?	More so than usual About the same as usual Less so than usual

Responses to the individual questions are in a Likert format, ranging from one to four. Here, the 12-item measure was recoded into one scale, by summing the scores of each question (recoded to range from zero to three) together to form a scale running from zero to 36, with zero being the least distressed and 36 the most (Understanding Society, 2021b). Other ways of operationalising the measure are possible, for example transforming the scale into a binary or using a threshold indicate probable mental disorder (Goldberg at al., 1997) or based on separate underlying constructs (Dorsett et al., 2019). However, recent research suggests that GHQ-12 is unidimensional in nature (Gnambs and staufenbiel, 2018). Based on this and the complex analyses performed later it was decided that operationalising the measure in a continuous form would both be most appropriate and would allow as much information to be retained as possible. Employing the measure in a continuous form follows the practice employed by other studies (for recent examples see: Li and Wang, 2021; Aksoy et al., 2021; Chum et al., 2020). The average GHQ-12 score for the whole analytical sample was 11.29. The below plot shows the distribution of GHQ-12 for the whole sample.

Figure 5-3 - GHQ-12 Kernel density plot



Individual level covariates

The individual level covariates included in the following analyses are: age, sex, highest qualification, marital status, whether the participant was born in the UK, household income and ethnicity (see Table 5.9 for a summary of the variable type and range or categories of each of these variables). Justification for the inclusion of these covariates is provided below.

Firstly, existing research suggests mental health varies by age (Weich et al., 2011; McManus et al., 2016) and it is also likely that age affects residential patterns and therefore also ethnic density. Sex is also included as a covariate due to differences in mental health by sex which have been observed (Eid et al., 2019). In addition, marital status is known to be associated with mental health outcomes and its association with depression in particular has been demonstrated across a number of contexts (Bulloch et al., 2017; LaPierre, 2009). Whether or not the participant was born in the UK was operationalised as a binary variable and was used as an indicator of migration status and termed 'nativity'. Migration status has been shown to modify the associations observed between ethnic density and mental health (Dorsett et al., 2018). Household income (equivalised using the modified OECD equivalence scale to take account of household composition according to the guidance provided by the UKHLS (Understanding Society 2021a)) was used to control for the financial circumstances of the participant which are likely to be associated with both ethnic density and mental health. Finally, self-defined ethnicity, grouped into census categories for the five main ethnic groups represented by the 'extra five minutes' sample, is included to assess possible differences in the association between ethnic density and mental health. Evidence suggests that mental health differs by ethnic group (McManus et al., 2016; Karlsen et al., 2005) and, as demonstrated in Chapter 3, that the ethnic density effect itself may differ across ethnic groups. The measure of ethnicity is described in greater detail below.

5.11.2 Ethnicity

The questions relating to self-ascribed ethnicity included in the UKHLS are the same as those in the 2011 census. Participants are asked to select the category which best represents their ethnic group. Ethnic groups were aggregated in broader groups in some instances. The aggregation of groups was based upon common practices in UK based research and was only used for the 'mixed' and 'other' groups in preliminary analyses. The five main ethnic groups represented within the 'extra five minutes' sample were not grouped into larger categories in order to most accurately represent these groups. These five groups are: Indian, Pakistani, Bangladeshi, Black Caribbean and Black African.

It is worth highlighting that, as discussed in depth in the narrative review in Chapter 1, participants who self-identify with each of these census categories are not a homogenous group. These categories are operationalised here with the intention of analysing individuals who are as similar as possible in terms of ethnic backgrounds. The table below (Table 5.7) shows how ethnic groups were aggregated in this study.

Table 5-7 - 2011 Census ethnic group categories and ethnic group categories used in analyses

Census ethnic group	Main analysis groups
White Brit/Welsh/Eng/Scot/NI	White Brit/Welsh/Eng/Scot/NI
Irish	Other
Any other White	Other
White and Black Caribbean	Mixed
White and Black African	Mixed
White and Asian	Mixed
Any other mixed background	Mixed
Indian	Indian
Pakistani	Pakistani
Bangladeshi	Bangladeshi
Chinese	Other
Any other Asian background	Other
Black Caribbean	Black Caribbean
Black African	Black African
Any other Black background	Other
Arab	Other
Any other ethnic group	Other

5.11.3 Pathway measures

Several measures were thought to operate as mediating variables. The hypothesised mediators empirically assessed in this thesis via inclusion in indirect paths, are based upon the theoretical framework presented in Chapter 4, informed by the findings of the systematic review presented in Chapter 3. The measurement of each of these measures is described below.

Social cohesion

A shortened version of Buckner's Cohesion Scale (Buckner, 1988) is included in Wave 3 of the UKHLS. According to personal communication with the team at UKHLS (Auty, 2018), the reduced number of items from the longer scale were selected for inclusion based on those with the highest correlation with the main factor demonstrated in a study conducted by the original author of the scale (Buckner, 1988). The team at UKHLS provide an overall score for the scale which they computed via coding the responses to the questions in reverse and then calculating the mean, resulting in a scale which

ranges from one to five, with five indicating the highest cohesion (Understanding Society, 2021b). Detailed below (Table 5.8) are the questions and associated dimensions of social cohesion as determined by Buckner (1988). This measure is operationalised as a latent variable in the Structural Equation Modelling based analyses introduced later in the thesis (using individual questions and related responses rather than a composite scale) and is discussed in depth in Chapter 7.

Table 5-8 - Buckner's Neighbourhood Cohesion Scale included in UKHLS and associated dimensions

Buckner's Neighbourhood Cohesion Scale Question	Dimension of cohesion
I feel like I belong to this neighbourhood	Sense of community
The friendships and associations I have with other people in my neighbourhood mean a lot to me	Sense of community
I would be willing to work together with others on something to improve my neighbourhood	Sense of community
I think of myself as similar to the people that live in this neighbourhood	Sense of community
If I needed advice about something, I could go to someone in my neighbourhood	Neighbouring
I borrow things and exchange favours with my neighbours.	Neighbouring
I regularly stop and talk with people in my neighbourhood	Neighbouring
I plan to remain a resident of this neighbourhood for a number of years	Attraction to neighbourhood

Racism

In Wave 3 of the UKHLS, several questions were included relating to discrimination and harassment. The questions captured both context and perceived reason for the harassment experienced. In this thesis, based on the available questions on the topic, racism was operationalised to reflect reports of physical attack or verbal insult in a public place (including: at school, at college/university, at work, on public transport, at or near a bus or train station, in a shopping centre, in a cinema or café, at a pub, disco or club, in a car park or outside in the street). Experiences of discrimination were coded as racism where the interviewee attributed the experience to one of the following: ethnicity, nationality, religion, language or accent.

The exact question wording is detailed below:

Attack

- "In the last 12 months, have you been physically attacked in any of these places? If so, which ones?"
- "Were you physically attacked … for any of these reasons? If so, which ones?"

Insult

- "In the last 12 months, have you been insulted, called names, threatened or shouted at, in any of these places? If so, which ones?"
- "Were you insulted, called names, threatened or shouted at … for any of these reasons? If so, which ones?"

Affirmative responses to one or more of these questions, combined with a public place and racism-based attribution of the event were coded into a binary variable. Descriptive statistics relating to these hypothesised mediating variables are presented in Chapter 6. Despite the large sample size of people from a minority ethnic background, the number of participants indicating that they had experienced racism in the past year was relatively small (reported by 7.88% of the whole analytical sample). It is for this reason that the two types of racist experience were combined into one measure in this instance. A question related to work-based discrimination is also included in the UKHLS 'extra five minutes' survey. However, responses indicating an experience of work-based racism were too infrequent to operationalise it as a separate measure of racism. In addition, combining this measure with measures which captured interpersonal racism was decided against, as they capture two distinct forms of racism. The merits and challenges of measuring racism in the way it is employed here are discussed in more detail in Chapter 9.

Measures of social support

Close number of friends

UKHLS includes a measure of social support which asks "How many close friends would you say you have?". Responses to this question range from zero to 100.

Proportion of friends from the same ethnic group

In addition, UKHLS also includes a social support measure which asks participants to give the proportion of their close friends who are from the same ethnic group as their own: “And what about ethnic group. What proportion of your friends are of the same ethnic group as you?” with response options including ‘all the same’, ‘more than half’, ‘about half’ and ‘less than half’.

Table 5-9 - Summary of analytical sample individual level variables

Variable	Type	Range/categories
Outcome		
GHQ-12	Interval	0-36
Exposure		
Own-group density	Continuous	(varies by ethnic group- see section 5.13)
Minority ethnic density	Continuous	1.04-97.80
Mediating variables		
Social cohesion scale	Ordinal	1-5
Number of close friends	Continuous	0-100
Proportion of friends from same ethnic group	Ordinal	1-4
Racism	Binary	No Yes
Covariates: individual		
Age	Continuous	16-90
Sex	Binary	1.Male 2.Female
Ethnicity	Categorical	Indian Pakistani Bangladeshi Black Caribbean Black African
Household income[9]	Continuous	£-505.49 - 43903.27[10]
Highest Qualification	Categorical	1. Degree level or higher 2. A or AS level or equivalent 3. GCSE, equivalent or other school certification 4. None of the above
Marital status	Categorical	1. Single, never married 2. Married/in a civil partnership 3. Legally separated or living separately 4. Widowed/surviving civil partner 5. Living as a couple
Born in the UK	Binary	1. Yes 2. No
Wants to move home	Categorical	1. Don‘t know 2. Prefers to stay 3. Prefers to move

[9] An equivalised version of the household income data is employed in later analyses so that households of different sizes are comparable

[10] UKHLS allow respondents to report negative income if applicable for participants who are self-employed. One participant included in the analytical sample reported negative income. The next lowest income reported after this was zero.

5.11.4 Area-level measures

The following section describes in detail the area-level measures included in the analyses performed in this thesis, including the main variable of interest - ethnic density.

Ethnic density

The ethnic density data used in this thesis was derived from the 2011 census data, due to temporal proximity with the Wave 3 study data, for which the data collection period spanned from January 2011 to June 2013. Own-group ethnic density was calculated as the proportion of people of the total population from a specific ethnic group within each LSOA. This calculation was performed for each ethnic group available from the 2011 Census. Overall minority ethnic density was calculated as the proportion of people from any minority ethnic background within each LSOA. Finally, aggregations of ethnic groups into broader categories of Black (Caribbean and African) and South Asian (Indian, Pakistani, Bangladeshi) were also calculated for each LSOA. All measures of ethnic density were modelled by a 10% unit increase in this thesis in order to aid interpretation of the findings.

In the following analyses of association between ethnic density and mental health, three different types of ethnic density measures are used:

- 'Own-group density' is used in relation to a specific ethnic group
- 'South Asian Density' and 'Black Density' are both aggregate measures, combining the appropriate ethnic groups.
- Finally, overall combined minority ethnic density is a measure which incorporates all ethnic groups except those identifying as White British/English/Welsh/Scottish/Northern Irish.

Table 5.10 shows how the census ethnic group categories are combined to form these aggregate density measures.

Table 5-10 - Ethnic density measures

Census ethnic group	Aggregate group density	Combined minority ethnic density
White Brit/Welsh/Eng/Scot/NI	White British	White British
Irish	Other	Combined minority ethnic
Any other White	Other	Combined minority ethnic
White and Black Caribbean	Mixed	Combined minority ethnic
White and Black African	Mixed	Combined minority ethnic
White and Asian	Mixed	Combined minority ethnic
Any other mixed background	Mixed	Combined minority ethnic
Indian	South Asian	Combined minority ethnic
Pakistani	South Asian	Combined minority ethnic
Bangladeshi	South Asian	Combined minority ethnic
Chinese	Other	Combined minority ethnic
Any other Asian background	Other	Combined minority ethnic
Black Caribbean	Black	Combined minority ethnic
Black African	Black	Combined minority ethnic
Any other Black background	Black	Combined minority ethnic
Arab	Other	Combined minority ethnic
Any other ethnic group	Other	Combined minority ethnic

English indices of deprivation

The inclusion of a measure of deprivation in ethnic density analyses is important due to the correlation commonly observed between high deprivation and high levels of ethnic density (Bécares et al., 2009). The Indices of Multiple Deprivation were used in this analysis, specific to England, and henceforth referred to as the English Indices of Deprivation (EID). This measure of deprivation is comprehensive and is frequently used across the studies included within the systematic review element of the research.

The specific deprivation measure selected for this research was the 2015 English Indices of Multiple Deprivation (Ministry of Housing, Communities and Local Government, 2015). This measure was selected due to the nuances it is able to capture in area deprivation at the small scale of LSOA. The measure contains a number of domains including: income, employment, health and disability, education and training, crime, housing and services, and living environment (further information relating to these measures and the sources and weighted computation of the overall Indices of Multiple Deprivation rank and deciles can be found in the Communities and Local Government 2015 technical report and in Noble et al., 2006). The complexity and nuance of area deprivation is particularly important to capture for the analyses in this thesis due to the correlation between ethnic density and area deprivation. In capturing more of the effects of deprivation, the likelihood of

residual confounding is reduced, meaning the true effects of ethnic density are more likely to be observed. The EID measure was therefore preferable to other, less complex measures such as the Townsend index which captures just four elements, each from the census (unemployment, non-car ownership, non-home ownership and household overcrowding) (Townsend, 1987). Here, the 2015 EID is used as the data collection period (broadly covering 2011 to 2013) is temporally a better match to the 2011 ethnic density data than the 2010 EID measure (which employs data from a collection period of approximately 2007 to 2008). The data used to create the EID are derived mostly from measures from the tax year of 2012 to 2013, with some domains derived from 2011 census data (Ministry of Housing, Communities and Local Government, 2015). In addition, the 2015 EID utilises the same LSOA boundary areas as the 2011 census, meaning there is a perfect match between the ethnic density and deprivation measures in terms of spatial units.

As stated above, the Index of Multiple Deprivation is usually calculated to include area-level measures of health and disability. However, as the outcome of interest in this study is a measure of mental health, the decision to recalculate the measure without the health domain was taken, in order to avoid partially controlling for an element of the outcome data via the deprivation measure, following best practice suggested in existing literature (Adams and White 2006). The 2015 EID was therefore recalculated with a weight of 0 assigned to the health domain, using the recommended procedure outlined in Appendix B of the 2015 report (Ministry of Housing, Communities and Local Government 2015). The LSOA level EID measure employed in this study for the analytical sample has a score range of 146.99-7080.17 and a mean of 3006.02 (SD 1314.58), with higher scores indicating higher deprivation.

Having now introduced all of the key measures which will be used in the quantitative analyses employed in this thesis, in the following, descriptive statistics on each of these measures per minority ethnic group are presented and described.

5.12 Descriptive sample information by ethnic group

In this section, demographic and descriptive information relating to each ethnic group sample is presented and discussed in comparison with the other groups, beginning with the statistics for key characteristics presented in Table 5.11. Following this, descriptive information is provided on ethnic density and GHQ-12 variables, as well as a table showing the results of adjusted linear regressions between both measures for each ethnic group.

Table 5-11 - Comparison of the minority ethnic groups included in the analytical sample (N(%) or Mean (SD))

	Ethnic groups						
	Indian (653)	Pakistani (570)	Bangladeshi (394)	Caribbean (459)	African (489)	Analytical sample (2,565)	White British (724)
Sex							
Male	338 (51.76)	258 (45.26)	194 (49.24)	181 (39.43)	199 (40.70)	1,170 (45.61)	349 (48.20)
Female	315 (48.24)	312 (54.74)	200 (50.76)	278 (60.57)	290 (59.30)	1,395 (54.39)	375 (51.80)
Age							
16-20	60 (9.19)	97 (17.02)	87 (22.08)	34 (7.41)	74 (15.13)	352 (13.27)	51 (7.04)
21-30	116 (17.76)	157 (27.54)	107 (27.16)	48 (10.46)	94 (19.22)	522 (20.35)	93 (12.85)
31-40	187 (23.64)	140 (24.56)	112 (28.43)	66 (14.38)	129 (26.38)	634 (24.72)	129 (17.82)
41-50	132 (20.21)	99 (17.37)	60 (15.23)	135 (29.41)	113 (23.11)	539 (21.01)	158 (21.82)
51-60	83 (12.71)	48 (8.42)	18 (4.57)	95 (20.70)	49 (10.02)	293 (11.42)	119 (16.44)
61+	75 (11.49)	29 (5.09)	10 (2.54)	81 (17.65)	30 (6.13)	225 (8.77)	174 (24.03)
Highest Qualification							
Missing	1 (0.15)	2 (0.35)	2 (0.51)	1 (0.22)	2 (0.41)	8 (0.31)	n/a
Degree	326 (33.51)	191 (33.51)	106 (26.90)	162 (35.29)	244 (49.90)	1,029 (40.12)	294 (40.61)
A/AS/equivalent	98 (16.49)	94 (16.49)	79 (20.05)	49 (10.68)	82 (16.77)	402 (15.67)	88 (12.15)
GCSE/equivalent	137 (29.47)	168 (29.47)	121 (30.71)	140 (30.50)	91 (18.61)	657 (25.61)	216 (29.83)
None of above	91 (20.18)	115 (20.18)	86 (21.83)	107 (23.31)	70 (14.31)	469 (18.28)	126 (17.40)
Marital status							
Single	153 (23.43)	169 (29.65)	151 (28.32)	206 (44.88)	223 (45.60)	902 (35.17)	150 (20.72)

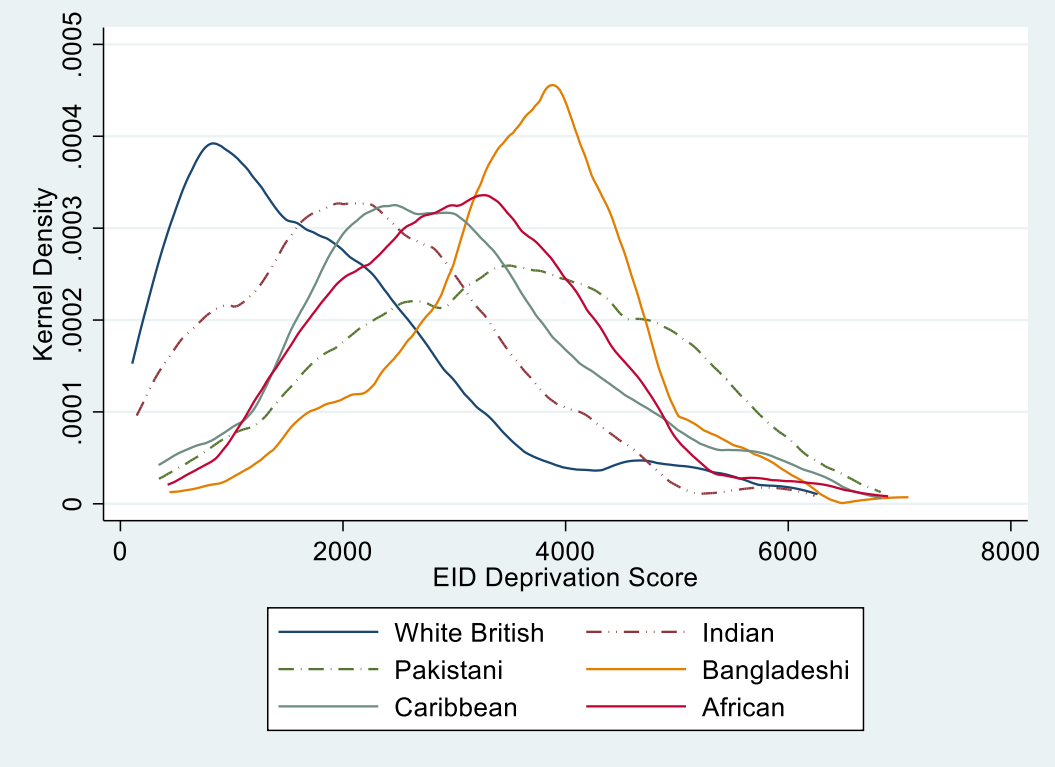
	Ethnic groups						
	Indian (653)	Pakistani (570)	Bangladeshi (394)	Caribbean (459)	African (489)	Analytical sample (2,565)	White British (724)
Married/CP	459 (70.29)	245 (60.53)	220 (55.84)	132 (28.76)	183 (37.42)	1,339 (52.20)	396 (54.70)
Separated	21 (3.22)	36 (6.32)	19 (4.82)	72 (15.69)	54 (11.04)	202 (7.88)	51 (7.04)
Widowed	11 (1.68)	14 (2.46)	3 (0.76)	18 (3.92)	11 (2.25)	57 (2.22)	31 (4.28)
Cohabiting	9 (1.38)	6 (1.05)	1 (0.25)	31 (6.75)	18 (3.68)	65 (2.53)	96 (13.26)
Household income (equiv.)	2001.24 (1371.92)	1185.43 (778.86)	1257.68 (834.88)	1701.14 (1186.49)	1642.13 (1347.19)	1583.57 (1189.99)	2081.39 (1432.33)
Born in the UK							
Missing	2 (0.31)	4 (0.70)	4 (1.02)	2 (0.44)	3 (0.61)	15 (0.58)	5 (0.69)
No	437 (66.92)	239 (50.70)	215 (54.57)	211 (45.97)	398 (81.39)	1,550 (60.43)	680 (93.92)
Yes	214 (32.77)	277 (48.60)	175 (44.42)	246 (53.59)	88 (18.00)	1,000 (38.99)	39 (5.39)
Prefers to move							
Missing	2 (0.31)	2 (0.35)	1 (0.25)	2 (0.44)	3 (0.61)	10 (0.39)	2 (0.28)
Stay	448 (68.61)	383 (67.19)	251 (63.71)	229 (49.89)	239 (48.88)	1,550 (60.43)	454 (62.71)
Move	203 (31.09)	185 (32.46)	142 (36.04)	228 (49.67)	247 (50.51)	1,005 (39.18)	268 (37.02)
Area deprivation (EID score LSOA)	2251.64 (1179.06)	3445.48 (1390.41)	3585.33 (1031.52)	2975.58 (1291.79)	3062.96 (1132.70)	3006.02 (1314.58)	1870.82 (1323.03)

Across the Indian, Pakistani, Bangladeshi, White British and combined groups, men and women comprised roughly half of the sample. However, the Black African and Black Caribbean groups had a larger proportion of women to men (roughly 60%). In terms of age, the proportion of the sample in the oldest age category was small (between 2.54% and 17.65%) for all ethnic groups. However, the Black Caribbean group appears more skewed towards the older age brackets than the other minority ethnic groups. The distribution of participants across the levels of qualification for each ethnic group was broadly similar, with the largest proportion of the sample in each ethnic group qualified at the degree level or higher, with the exception of the Bangladeshi group, for whom the largest proportion was found at the GCSE level (30.71%). The majority of the sample for each ethnic group were married, except for the Black Caribbean and Black African groups, for whom the largest proportion of the sample in each group was found in the 'single' group (44.88% and 45.60% respectively). Average household income from the month before the interview was largest for the Indian group, and lowest for the Black Caribbean group. All of the included ethnic groups had a larger proportion of sample members who were not born in the UK than those who were, except for the Black Caribbean group, with 53.59% of the sample born in the UK. The group with the largest proportion of participants not born in the UK was the Black African group (81.39%), followed by the Indian group (66.92%) with the Pakistani and Bangladeshi groups both having roughly half of the sample not born in the UK. Approximately 30% of the Indian and Pakistani groups indicated a preference to move, whereas approximately 50% of the Black Caribbean and Black African groups reported a preference to move. Area deprivation was on average highest for the Bangladeshi group (3585.33) and lowest for the Indian group (2251.64). Further detail on the distribution of deprivation scores by ethnic group is presented below in Figure 5.4. Descriptive statistics for ethnic density and mental health for each ethnic group are presented separately in Tables 5.12 and 5.15.

Deprivation

The distribution of deprivation per ethnic group is presented graphically in Figure 5.4, which shows that the distribution of deprivation scores across ethnic groups are broadly similar, peaking at around 2000 to 4000. However, the deprivation scores of the white British group are considerably more skewed to the left (less deprived) and the scores of the Bangladeshi group appears to be the most skewed to the right, with a peak above a deprivation score of 4000. The Pakistani group appears to have the most even distribution but is also more skewed towards higher deprivation scores.

Figure 5-4 - Kernel density plot showing the distribution of 2015 EID scores by ethnic group



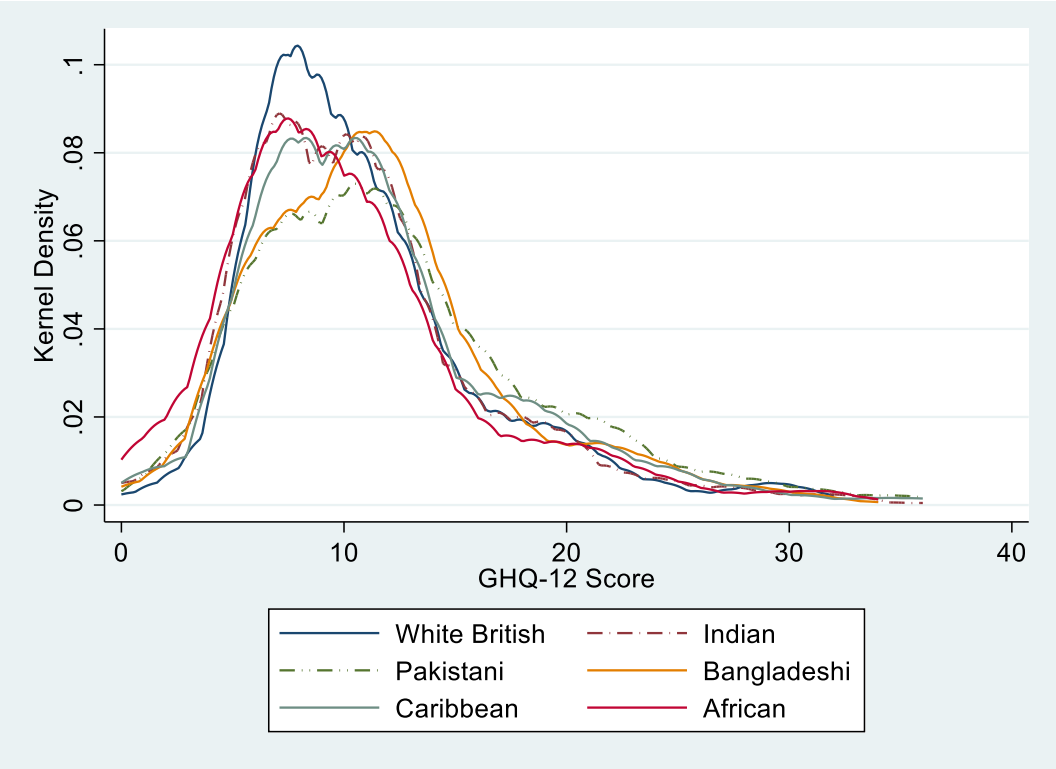
5.13 GHQ-12

As described previously, existing literature suggests that mental health varies across ethnic groups, as well as by gender and age. In order to investigate potential differences in mental health across these demographics in this sample, descriptive tables for each characteristic are presented and discussed below. Table 5.12 below shows that on average, the Pakistani group had the highest (worse) GHQ-12 scores of the minority ethnic groups, and the Black African group had the lowest (better) average score. The population average for the full UKHLS sample (with weights applied and sampling units and strata accounted for) at Wave 3 was 11.02, suggesting that the scores for the White British, Indian and Black African groups are below the national average. The distribution of these scores for each ethnic group are shown below in Figure 5.5.

Table 5-12 - Average GHQ-12 by ethnic group

Sample group n	GHQ-12 average score (SD)
Whole sample (inc. White British) 4,242	11.27 (5.84)
Analytic sample 2,565	11.29 (5.99)
White British 724	10.97 (5.39)
Indian 653	10.81 (5.64)
Pakistani 570	12.36 (6.51)
Bangladeshi 394	11.57 (5.68)
Black Caribbean 459	11.50 (5.91)
Black African 489	10.25 (5.93)

Figure 5-5 - Kernel density plot of GHQ-12 scores by ethnic group



Distributions of GHQ-12 scores by ethnic group were broadly similar, indicating a peak in GHQ-12 score at around 10, gradually sloping off to a similar extent across groups. However, as reflected by the means presented previously in Table 5.12 both the Pakistani and Bangladeshi groups peak slightly after 10. Due to the skewed distribution of GHQ-12 scores and ordinal nature of the data, a Kruskal-Wallis H test was performed to compare median GHQ-12 scores across the ethnic groups. The test showed statistically significant differences GHQ-12 between the ethnic groups (X^2 =47.378, d.f.= 7, p<0.001). However, Cronbach's alpha for the GHQ-12 measure for the whole sample was high (0.894) and remained high (above 0.8) when computed separately for each ethnic group.

Based on previous research indicating that mental health varies by sex and age (McManus et al., 2016), the following tables also provide a summary of the average GHQ-12 by both sex and age for each ethnic group.

Table 5-13 - Average GHQ-12 by sex and ethnicity

	Average GHQ-12 (SD) Men	Average GHQ-12 (SD) Women
Overall sample (inc. White British)	10.73 (5.57)	11.71 (6.02)
White British	10.50 (5.21)	11.40 (5.53)
Analytical sample	10.78 (5.65)	11.77 (6.11)
Indian	10.13 (5.03)	11.53 (6.16)
Pakistani	11.73 (6.54)	12.88 (6.46)
Bangladeshi	10.93 (5.42)	12.20 (5.86)
Black Caribbean	11.29 (5.74)	11.64 (6.03)
Black African	9.85 (5.84)	10.53 (5.98)

Table 5.13 above shows average GHQ-12 scores by sex for the whole sample, and across ethnic groups. In the overall sample and across all ethnic groups, women had on average higher GHQ-12 scores, indicating worse mental health. Men and women from the Black African ethnic group had the lowest average GHQ-12 scores and men and women from the Pakistani group had the highest average scores. A two-way ANOVA showed statistically significant differences in the means of GHQ-12 across both ethnic groups ($p<0.001$) and sex ($p<0.001$), but the interaction between ethnic group and sex was not statistically significant.

GHQ-12 and age

Table 5-14 - Average GHQ-12 score by age

Age category (n)	GHQ-12 average		
	Full sample (inc. White British) (SD)	Men (SD)	Women (SD)
16-20 (516)	10.66 (SD 6.00)	10.05 (SD 6.25)	11.14 (SD 6.09)
21-30 (813)	11.16 (SD 5.86)	10.40 (SD 5.75)	11.92 (SD 6.17)
31-40 (1013)	11.26 (SD 5.81)	10.73 (SD 5.68)	11.20 (SD 5.98)
41-50 (906)	11.60 (SD 5.86)	10.54 (SD 5.04)	12.23 (SD 6.29)
51-60 (514)	11.65 (SD 6.19)	11.35 (SD 6.03)	12.74 (SD 7.00)
61+ (480)	11.07 (SD 5.18)	12.02 (SD 5.84)	11.26 (SD 4.91)

In line with previous research showing non-linear associations between age and mental health in the UK (McManus et al., 2016), age was employed as a categorical variable here. Table 5.14 shows that the variation in GHQ-12 averages across age groups is small. However, GHQ-12 scores are on average lowest for the youngest age bracket (16-20), followed by the oldest age bracket (61+). Furthermore, it should be noted that both of these age brackets have smaller sample sizes than most of the other age brackets. Average GHQ-12 scores are highest for the 51-60 age bracket at 11.65.

The Kruskal-Wallis H test was performed in order to determine if differences in GHQ-12 between age groups were statistically different. The test showed statistically significant differences GHQ-12 between the ethnic groups (X^2 = 15.622, df.= 5, $p<0.01$). The final two columns present age differences in GHQ-12 by gender. Different patterns are seen across the age groups for both genders. As seen in the full sample, the worst (highest) average GHQ-12 scores are seen in the 51-60 age bracket for women. However, for men the highest average score is seen in the oldest age category.

5.14 Ethnic density

This section introduces descriptive information relating to the ethnic density measures included in this thesis, including overall minority ethnic density, own-group density, South Asian density and Black density.

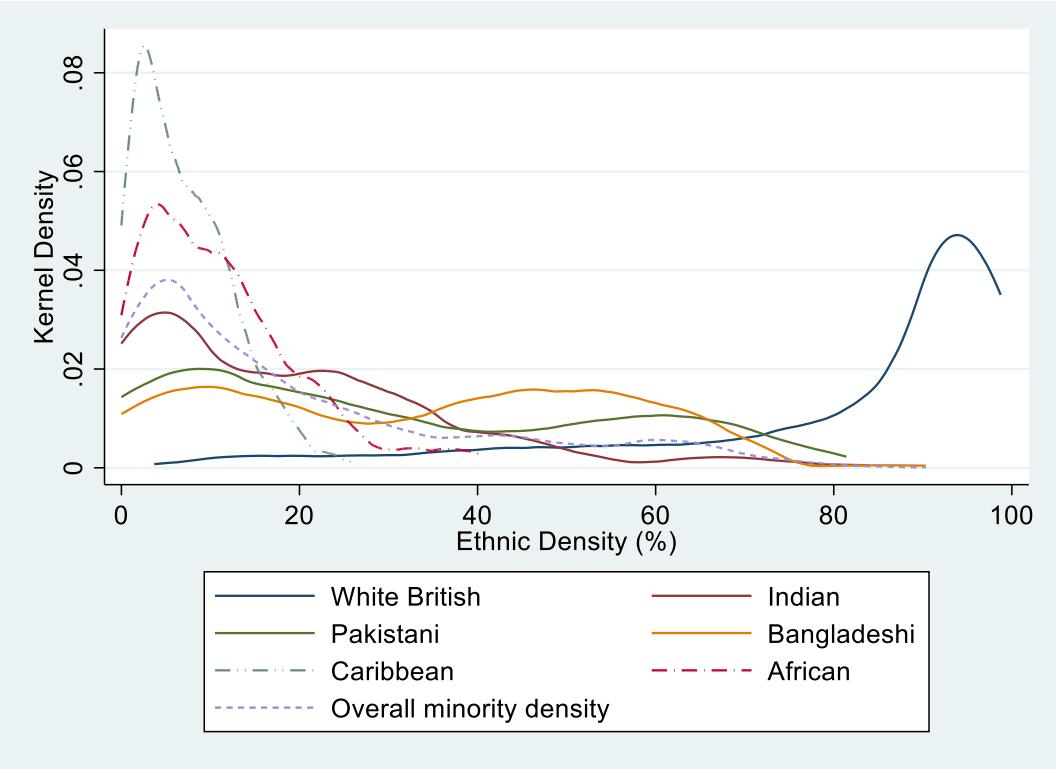
Table 5-15 - Own-group density by ethnic group at the LSOA level

Ethnic group	Own-group ethnic density of the sample population (UKHLS Wave 3 'extra five minutes' survey respondents)		Ethnic density of each ethnic group in the general population of England (Census 2011)	
	mean (SD)	Range	mean (SD)	Range
White British	80.49 (22.57)	3.70-98.75	80.74 (22.23)	0.63-99.72
Indian	18.63 (17.09)	0.00-84.06	2.50 (5.97)	0.00-85.54
Pakistani	29.69 (23.72)	0.00-81.43	1.92 (6.32)	0.00-84.97
Bangladeshi	33.05 (21.89)	0.00-90.35	0.76 (3.27)	0.00-90.35
Black Caribbean	7.01 (5.34)	0.00-26.51	1.06 (2.35)	0.00-27.80
Black African	11.03 (8.74)	0.00-40.33	1.73 (3.70)	0.00-48.38

Table 5.15 shows that the White British group (who received the 'extra five minutes' questions) had the highest average density (80.48), followed by the Bangladeshi group (33.05). The group with the lowest average density and smallest range of density values was the Black Caribbean group, with a mean density of 7.01 and a range of 0 to 26.51. The Black African group had the next lowest average density (11.03) but had a wider standard deviation, with a maximum of 40.33, than that of the Black Caribbean group. Further detail on the distribution of these ethnic density data for each ethnic group is shown below in Figure 5.6.

The second column of Table 5.15 shows the average densities of each ethnic group per LSOA in the general population of England, using data from the 2011 Census. This demonstrates that the densities in the general population for each ethnic group are much smaller than the densities of the LSOAs where participants live in the analytical sample (resulting from the sampling strategy, which overrepresents high density areas, discussed earlier in this chapter).

Figure 5-6 - Kernel density plot of own-group ethnic density by ethnic group



The kernel density plot in Figure 5.6 shows the distribution of own-group ethnic density for the analytical sample by ethnic group. There is heterogeneity in both range and distribution of own-group ethnic density for each ethnic group. The most similar distributions are those of the Black Caribbean and Black African ethnic groups, which are skewed towards low density levels. The Bangladeshi, Pakistani and Indian distributions are broadly similar in shape, though the distribution of values for the Bangladeshi group appears somewhat bimodal. The White British group is, as expected, highly skewed to towards high own-group density levels.

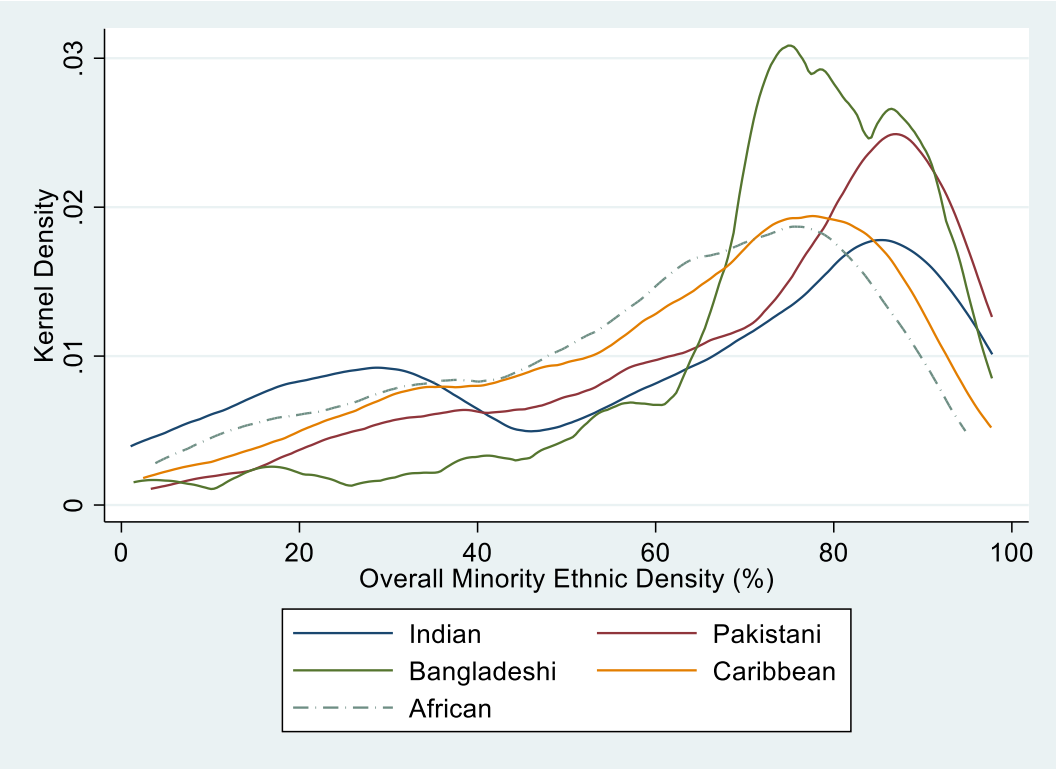
In the following I present descriptive statistics for overall minority ethnic density. Descriptive statistics for Black and South Asian ethnic density and for own-group density compared with overall minority density are available in the Appendix, section 10.8.

Table 5-16 - Overall minority ethnic density by ethnic groups

Ethnic group	Overall minority ethnic density	
	mean (SD)	Range
White British	19.51 (22.57)	1.25-96.30
Indian	59.41 (29.43)	1.04-97.80
Pakistani	69.67 (23.26)	3.30-97.77
Bangladeshi	72.92 (19.68)	1.37-97.77
Black Caribbean	61.76 (23.28)	2.44-7.69
Black African	58.14 (23.26)	3.82-94.79
Analytical sample	63.94 (25.13)	1.04-97.80

Table 5.16 table shows that the average overall minority ethnic density for each ethnic group is relatively high, especially when compared to average own-group density shown in Table 5.15. Of the minority ethnic groups, the Bangladeshi group had the highest average levels of overall minority ethnic density, followed by the Pakistani group. The lowest average level was found for the Black African group. Further detail on the distribution of overall minority ethnic density is provided by Figure 5.7.

Figure 5-7 - Kernel density plot of overall minority ethnic density by ethnic group



Compared to the previous figure (Figure 5.6) showing own-group density, Figure 5.7 shows a different distribution. For all minority ethnic groups, overall minority ethnic density is highly skewed towards high density. The distributions for the Black Caribbean and Black African groups are again broadly similar. However, distributions for the Indian, Pakistani and Bangladeshi groups are somewhat different from one another. The figure indicates a greater proportion of the sample of these groups live in areas of high overall minority density. Kernel density plots showing own-group compared to overall minority ethnic density for each ethnic group are included in the Appendix in section 10.8 Figure 10.1.

Before proceeding to assess the association between ethnic density and mental health, the association between ethnic density and deprivation was assessed. The results of these tests are included in the Appendix, section 10.9 and demonstrate a statistically significant association between increasing overall minority ethnic density and higher EID. All subsequent analyses therefore include area deprivation (EID) as a control variable.

Having reviewed the descriptive statistics and distributions of both GHQ-12 and ethnic density for each of the key minority ethnic groups, the following section presents the results of the regression analyses used to assess their association.

5.15 Ethnic density and mental health associations

The following table presents the associations between each type of ethnic density and mental health, adjusted for all a-priori confounders unless otherwise specified.

Table 5-17 - Association between ethnic density and GHQ-12

Ethnic Group	[1]Own-group density partially adjusted (coeff, 95% CI)	Own-group density adjusted (coeff, 95% CI)	Overall minority density adjusted (coeff, 95% CI)	Black density adjusted (coeff, 95% CI)	South Asian density adjusted (coeff, 95% CI)
White British	0.04 (-0.13 0.22)	0.04 (-0.16 0.23)	-	-	-
Indian	-0.04 (-0.29 0.21)	0.00 (-0.25 0.25)	-0.09 (-0.25 0.06)	-	-0.10 (-0.30 0.09)
Pakistani	0.02 (-0.20 0.25)	-0.14 (-0.41 0.13)	-0.36** (-0.61 -0.11)	-	-0.14 (-0.38 0.10)
Bangladeshi	0.04 (-0.22 0.30)	0.07 (-0.22 0.36)	-0.34 (-0.70 0.01)	-	-0.11 (-0.43 0.22)
Black Caribbean	0.85 (-0.16 1.87)	0.07 (-1.06 1.20)	0.01 (-0.26 0.28)	-0.24 (-0.73 0.24)	-
Black African	-0.09 (-0.69 0.52)	-0.21 (-0.88 0.45)	0.28* (0.05 0.54)	-0.12 (-0.54 0.31)	-
Analytical sample	0.02 (-0.05 0.10)	0.06 (-0.07 0.19)	-0.06 (-0.16 0.04)	-0.30** (-0.50 -0.09)	0.08 (-0.02 0.18)

*p<0.05 ** p<0.01 *** p<0.001

Separate linear regression models. All modelled as per 10% unit increase for all density. All models adjusted for: age, sex, marital status, country of birth, household income, highest qualification, and area deprivation.

[1]Model adjusted only area deprivation (no other covariates adjusted for)

Table (5.17) shows these adjusted associations between four different measures of ethnic density and GHQ-12 using linear regression. No associations were observed at the statistically significant level for any ethnic group when employing the 'own-group density' measure. When employing 'overall minority density', associations were observed at the statistically significant level for two ethnic groups. For the Pakistani group, a 10% increase in overall minority density was associated with an average decrease in GHQ-12 scores of -0.36 (CI -0.61 -0.11 $p<0.01$), meaning better mental health. The GHQ-12 scale runs from zero to 36, so it should be noted here that this is a relatively small improvement in mental health per 10% increase in ethnic density. For the Black African group, a 10% increase in overall minority density was associated with an average increase in GHQ-12 scores of 0.28 (CI 0.05 0.54 $p<0.05$). Black ethnic density was found to be associated with GHQ-12 to a statistically significant level for the overall minority ethnic group only, for whom a 10% increase in Black ethnic density was associated with an average reduction in GHQ-12 of -0.30 (CI -0.50 -0.09 $p<0.01$). Again, these are relatively small changes based on a large change in ethnic density. No associations were observed at the statistically significant level for any ethnic group when the 'South-Asian ethnic density' measure was employed.

5.16 Summary

In this chapter I explained and justified the selection of the UKHLS data 'extra five minutes' composite sample (comprised of the GPCS, EMB and EM-LDA samples). I also explained the linked area-level data and justified my choice of the LSOA area unit from the 2011 census.

I presented an overview of the analytical sample, derived from the 'extra five minutes' composite sample and descriptive information by ethnic group. I then presented a comparison to those with missing outcome data and presented descriptive statistics and associations between ethnic density and mental health. I found that the analytical sample was in general better educated, more likely to have not been born in the UK, and more likely to be single or married. Compared to the analytical sample, those who did not have a valid response to the GHQ-12 measure were in general more likely to have no qualifications, have lower household income, have not been born in the UK and to live in a more deprived area.

I found variation in the distribution of ethnic density across ethnic groups and across measures of ethnic density. The distribution of own-group density was highly skewed to lower densities for both Black Caribbean and Black African groups. Own-group density appeared to be more evenly distributed among the Indian, Pakistani and Bangladeshi groups. Compared with the other density

measures, overall minority density was more skewed to higher densities across all the minority ethnic groups. This suggests that, in general, the sample were more likely to reside in areas of high minority density, than high own-group density.

I found evidence of variation in the average GHQ-12 scores across ethnic groups and by age and gender by ethnic groups. Finally, I found that, once all relevant covariates had been adjusted for, only Black density (protective for the analytical sample) and overall minority ethnic density (protective for the Pakistani group and detrimental for the Black African group) were statistically significantly associated with GHQ-12.

In the following chapter, the theoretical framework is revisited and the associations between the hypothesised mediators and ethnic density and mental health are presented.

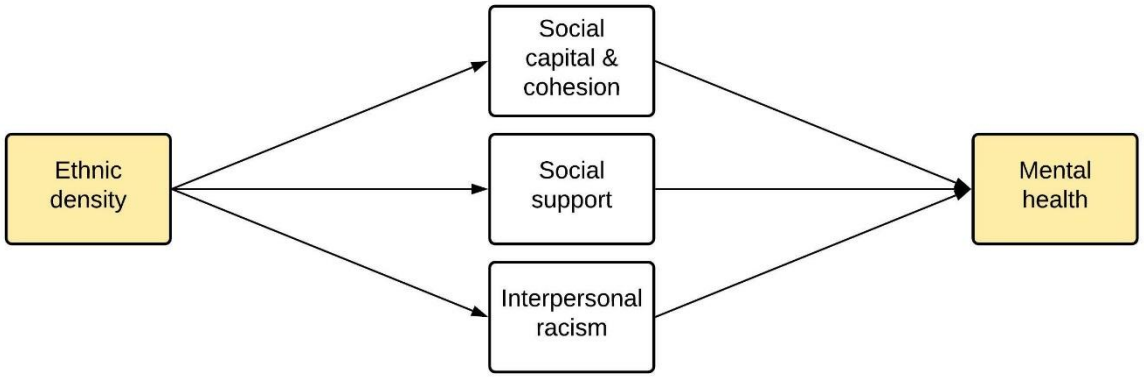
6 Chapter 6: Associations between hypothesised mediating variables, mental health, and ethnic density

Theoretical framework revisited

The theoretical framework quantitatively assessed in this chapter is introduced in Chapter 4 and is derived from the findings of the systematic review (Chapter 3). Several theories and concepts are brought together under this conceptual framework in order to describe the complex relationship between ethnic density and mental health. In this framework, three main indirect paths (social capital and cohesion, social support and racism) are detailed. A diagram of the theoretical framework introduced in Chapter 4 is repeated here (Figure 6.1) for clarity. Despite finding little evidence of a direct effect of ethnic density on mental health in Chapter 5 (as originally hypothesised in Chapter 4), it remains very possible that the effect of ethnic density on mental health is entirely indirect, via indirect pathways. In this chapter, the associations between the hypothesised mediating variables and ethnic density and mental health are assessed.

6.1 Quantitative analysis of hypothesised mediating variables

Figure 6-1 - Theoretical framework



This section presents descriptive statistics on the hypothesised mediators in the proposed theoretical framework, followed by regression analyses exploring the association between these variables and ethnic density and mental health. The synthesis of evidence presented in the systematic review suggests that these hypothesised mediators may have different associations across ethnic groups. Therefore, in order to explore how the associations between the hypothesised mediating variables and ethnic density and mental health may vary across ethnic groups, multiple

regression models are run and compared in the following sections. In the following, statistics for the White British group are presented alongside the minority ethnic groups of interest for comparative purposes. The 'analytical sample' refers to the final sample used for the more complex analyses presented in subsequent chapters and is comprised of the Indian, Pakistani, Bangladeshi, Black Caribbean and Black African samples receiving the 'extra five minutes' survey (see Chapter 5 for a detailed description of this sample).

Descriptive statistics on hypothesised mediating variables by ethnic group

Table 6.1 presents descriptive statistics for social cohesion (measured as a composite scale), social support (measured via close number of friends) and racism. There is relatively little variation in the scores of the composite social cohesion scale between ethnic groups (on a 1-5 scale with 5 being the highest cohesion). However, the Bangladeshi group has the highest cohesion (3.66), and the Black African group has the lowest cohesion (3.37). Descriptive statistics for each item of the scale for each ethnic group are presented in the Appendix (section 10.10, Table 10.7). In terms of the 'number of close friends' measure of social support, the white British group has the highest average (5.63), followed by the Black Caribbean group (4.94), with the Pakistani group having the lowest average number of close friends (3.61). In the final column, reports of racism are shown by ethnic group. The ethnic group with the largest proportion reporting having experienced a physical attack or verbal insults (attributable to ethnicity, nationality, religion, language or accent) in a public place was the Indian group (8.73%). The Indian and Bangladeshi groups had the second and third largest proportion of people reporting having experienced racism (8.73% and 8.63% respectively). Of the minority ethnic groups, the Black Caribbean group had the lowest proportion of those reporting having experienced racism (4.58%).

Table 6-1 - Summary of continuous and binary hypothesised mediating variables by ethnic group

	Social Cohesion Scale	Number of close friends	Experience of attack or insult	
			Yes	No
	Mean (SD)	Mean (SD)	N (%)	N (%)
White British	3.57 (0.73)	5.63 (6.73)	7 (0.97)	717 (99.03)
Analytical sample	3.51 (0.70)	4.25 (5.52)	202 (7.88)	2,363 (92.12)
Indian	3.56 (0.67)	4.66 (6.33)	57 (8.73)	596 (91.27)
Pakistani	3.58 (0.74)	3.61 (3.77)	48 (8.42)	522 (91.58)
Bangladeshi	3.66 (0.65)	4.33 (4.75)	34 (8.63)	360 (91.37)
Black Caribbean	3.40 (0.67)	4.94 (7.42)	21 (4.58)	438 (95.42)
Black African	3.37 (0.73)	3.74 (4.29)	42 (8.59)	447 (91.41)

Descriptive statistics for social support (measured via co-ethnic friends), are presented below in Table 6.2. The group with the highest proportion of people reporting that their friends are all from the same ethnic group is the White British group (36.33%). This is substantially higher than the rest of the groups, for whom the highest proportion is 32.23% for the Bangladeshi group. The group with the lowest proportion reporting that their friends are all from the same ethnic group is the Black Caribbean group (8.93%). The Black Caribbean group is also the group with the highest proportion of participants reporting that less than half of their friends are from the same ethnic group as their own (22.44%) followed by the Black African group (19.22%). Across all of the minority ethnic groups included, the largest proportion of participants within each group reported that more than half of their friends were from the same ethnic group (ranging from 36.14% for the Pakistani group, to 40.10% for the Bangladeshi group).

Table 6-2 - Hypothesised mediating variables: Proportion of friends from the same ethnic group by ethnicity

	Proportion of friends from the same ethnic group n(%)				
	All the same	More than half	About half	Less than half	Missing
White British	263 (36.33)	311 (42.96)	89 (12.29)	53 (7.32)	8 (1.10)
Analytical sample	507 (19.77)	983 (38.32)	588 (22.92)	424 (16.53)	63 (2.46)
Indian	120 (18.38)	236 (36.14)	160 (24.50)	124 (18.99)	13 (1.99)
Pakistani	150 (26.32)	214 (37.54)	120 (21.05)	66 (11.58)	20 (3.51)
Bangladeshi	127 (32.23)	158 (40.10)	64 (16.24)	37 (9.39)	8 (2.03)
Black Caribbean	41 (8.93)	182 (39.65)	122 (26.58)	103 (22.44)	11 (2.40)
Black African	69 (14.11)	193 (39.47)	122 (24.95)	94 (19.22)	11 (2.25)

Categories based on the wording used in the possible responses to the survey question.

6.1.1 Bivariate associations between ethnic density and hypothesised mediating variables

In this section, associations between the hypothesised mediating variables and ethnic density and mental health, and how these vary across ethnic groups are assessed. If statistically significant associations are observed with both ethnic density and mental health, then it is possible that the variable in question may be operating as a mediator in the association. This section begins by considering the associations with both overall minority ethnic density and own-group density, before moving on to explore associations with GHQ-12.

Table 6-3 - Own-group and overall minority ethnic density (per 10% increase) adjusted associations with social cohesion and social support

	Own-group density Coeff. (95% CI)		Overall Minority Ethnic Density Coeff. (95% CI)	
	Social cohesion	Social support	Social cohesion	Social support
White British	0.00 (-0.02 0.03)	-0.10 (-0.34 0.13)	-0.00 (-0.03 0.02)	0.10 (-0.13 0.34)
Analytical sample	0.07*** (0.06 0.09)	-0.17** (-0.29 -0.05)	0.01* (0.00 0.03)	-0.17*** (-0.27 -0.08)
Indian	0.03* (0.00 0.06)	-0.30* (-0.60 -0.01)	-0.00 (-0.02 0.02)	-0.33*** (-0.51 -0.15)
Pakistani	0.08*** (0.05 0.11)	-0.29*** (-0.44 -0.13)	0.03* (0.00 0.06)	-0.09 (-0.24 0.05)
Bangladeshi	0.04* (0.00 0.07)	0.22 (-0.02 0.46)	0.03 (-0.01 0.07)	-0.22 (-0.52 0.07)
Black Caribbean	-0.00 (-0.13 0.12)	-0.18 (-1.62 1.25)	-0.01 (-0.04 0.02)	-0.02 (-0.36 0.33)
Black African	-0.01 (-0.09 0.07)	-0.78** (-1.25 -0.31)	0.00 (-0.02 0.03)	-0.20* (-0.38 -0.03)

*p<0.05 ** p<0.01 *** p<0.001
Separate linear regression models. All models adjusted for: age, sex, marital status, country of birth, household income, highest qualification, and area deprivation.

In terms of own-group ethnic density, Table 6.3 shows that a 10% increase in own-group ethnic density was associated with a statistically significant improvement in social cohesion for all ethnic groups except the White British, Black Caribbean and Black African groups. The largest coefficients were found for the Pakistani sample, suggesting a 10% increase in ethnic density had a greater impact on social cohesion in these groups than the others. The social cohesion measure included here is a composite measure comprised of answers to eight questions and is measured on a scale which runs from one to five (with five indicating the highest cohesion). The coefficients for the analytical sample, Indian, Pakistani and Bangladeshi groups therefore represent small changes in the social cohesion scale with increased ethnic density. This suggests that ethnic density has a minimal impact on social support in the sample employed in this thesis. A 10% increase in own group ethnic density was found to be significantly negatively associated with social support (number of close friends) for the overall minority ethnic group and the Indian, Pakistani and Black African groups. This suggests higher density is associated with reporting lower numbers of close friends for these groups.

Fewer of the estimates for both hypothesised mediators were statistically significant in the analyses using the overall minority ethnic density measure. In terms of social cohesion, statistically significant

estimates were found only for the analytical sample overall and the Pakistani group and these were smaller than those for the own-group density associations, which were already small. Similarly, in terms of social support, fewer statistically significant associations were found. The effect sizes in these groups with significant estimates were a similar size to those found when using own-group density for the analytical sample and the Indian group, but the effect size was much smaller for the Black African group. Results showing the association between ethnic density and racism are presented below.

Table 6-4 - Association between ethnic density (per 10% increase) and racism

	Experienced racism?	Own-group density Coefficient (Log Odds) (95% CI)	Minority Ethnic Density Coefficient (Log Odds) (95% CI)
White British	No	Ref	Ref
	Yes	-0.18 (-0.45 0.08)	0.18 (-0.08 0.45)
Analytic sample	No	Ref	Ref
	Yes	-0.13** (-0.22 -0.04)	-0.20*** (-0.26 -0.14)
Indian	No	Ref	Ref
	Yes	-0.21* (-0.41 -0.01)	-0.20*** (-0.30 -0.10)
Pakistani	No	Ref	Ref
	Yes	-0.06 (-0.22 0.09)	-0.06 (-0.20 0.07)
Bangladeshi	No	Ref	Ref
	Yes	-0.20* (-0.38 -0.02)	-0.26* (-0.47 -0.6)
Black Caribbean	No	Ref	Ref
	Yes	-1.66* (-2.97 -0.36)	-0.32** (-0.54 -0.10)
Black African	No	Ref	Ref
	Yes	-0.78** (-1.27 -0.28)	-0.27*** (-0.40 -0.13)

*p<0.05 ** p<0.01 *** p<0.001

Separate logistic regression models using binary racism outcome. All models adjusted for: age, sex, marital status, country of birth, household income, highest qualification, and area deprivation.

Looking first at the own-group ethnic density measure, Table 6.4 shows that for all ethnic groups except the White British and Pakistani groups, a 10% increase in own-group ethnic density was statistically significantly associated with a lower odds of reporting racism compared with not. The group with the largest coefficient was the Black Caribbean group (β=-1.66, 95% CI -2.97 -0.36). This suggests that for most groups, higher own-group density is associated with lower odds of reporting experiences of interpersonal racism.

Turning to look at the estimates for overall minority ethnic density, statistically significant estimates were found for the same groups as in the own-group models. However, for the Black Caribbean and Black African groups the estimate sizes were smaller, whereas they were larger for the Bangladeshi and overall analytical sample. In addition, for a number of groups the confidence intervals were also smaller. These findings are somewhat unclear, but perhaps suggest that for some groups, own-group ethnic density is more protective of racism, while for others, overall minority density is more protective. However, it could also be, that overall minority ethnic density is a better proxy for own-group density for the Indian, Pakistani and Bangladeshi groups than the Black Caribbean and Black African groups. Results showing the association between the proportion of co-ethnic friends measure and ethnic density are presented below.

Table 6-5 - Association between ethnic density and co-ethnic friends

	Co-ethnic friends proportion Coefficient (Log odds) (95% CI)		
		Own-group density	Minority ethnic density
White British	All the same	0.35*** (0.21 0.49)	-0.35*** (-0.50 -0.21)
	> half	0.12* (0.00 0.24)	-0.12* (-0.24 -0.00)
	About half	-0.01 (-0.14 0.13)	0.01 (-0.13 0.14)
	< half	Ref	Ref
Analytical sample	All the same	0.49*** (0.40 0.59)	0.20*** (0.14 0.26)
	> half	0.36*** (0.27 0.44)	0.15*** (0.10 0.19)
	About half	0.23*** (0.14 0.33)	0.13*** (0.08 0.19)
	< half	Ref	Ref
Indian	All the same	0.73*** (0.51 0.94)	0.23*** (0.13 0.33)
	> half	0.66*** (0.45 0.86)	0.23*** (0.15 0.32)
	About half	0.58*** (0.37 0.79)	0.17*** (0.08 0.26)
	< half	Ref	Ref
Pakistani	All the same	0.25** (0.08 0.41)	0.08 (-0.06 0.22)
	> half	0.21** (0.05 0.38)	0.04 (-0.09 0.17)
	About half	0.07 (-0.10 0.24)	0.09 (-0.05 0.23)
	< half	Ref	Ref
Bangladeshi	All the same	0.27* (0.06 0.47)	0.31* (0.06 0.56)
	> half	0.20 (-0.00 0.39)	0.05 (-0.18 0.28)
	About half	0.07 (-0.15 0.30)	0.28* (0.01 0.56)
	< half	Ref	Ref
Black Caribbean	All the same	1.16** (0.35 1.97)	0.01 (-0.19 0.20)
	> half	0.99** (0.36 1.61)	0.13 (-0.00 0.25)
	About half	0.91** (0.26 1.57)	0.09 (-0.05 0.22)
	< half	Ref	Ref
Black African	All the same	0.42* (0.01 0.82)	0.12 (-0.02 0.27)
	> half	0.29 (-0.04 0.63)	0.08 (-0.04 0.19)
	About half	0.16 (-0.21 0.53)	0.06 (-0.06 0.18)
	< half	Ref	Ref

*p<0.05 ** p<0.01 *** p<0.001

Separate regression models. (Post estimation tests of ordered logistic regression models showed that the proportional odds assumption did not hold. Therefore, multinomial logistic regression was used instead) All models adjusted for: age, sex, marital status, country of birth, household income, highest qualification, and area deprivation.

In terms of own-group ethnic density, Table 6.5 shows that in general a 10% increase in own-group ethnic density was statistically significantly associated with an increase in the log-odds of being in any other category than the base category of 'less than half' for most ethnic groups. The estimates were especially large for the 'all the same' category for the Indian and Black Caribbean groups. This means that participants were more likely to report having half or more of their friends belonging to

the same ethnic group as their own, than to report having less than half of their friends from the same ethnic group. However, when looking at the results from the overall minority ethnic density models, fewer estimates were statistically significant and the estimates were mostly very small. This suggests that in the analytical sample, overall minority ethnic density was largely unrelated to the proportion of co-ethnic friends reported by the participant. For the overall analytical sample and Indian group, the estimate sizes were smaller in the model using overall minority ethnic density than in the model using own-group density, whereas for the Bangladeshi group they were slightly larger. It is theoretically plausible that own-group ethnic density is a stronger predictor of co-ethnic friendships than overall minority ethnic density, though it is surprising that this does not appear to be the case for the Bangladeshi group.

Associations between GHQ-12 and hypothesised mediating factors

In this final section, associations between the hypothesised mediating variables and mental health are presented. Mental health (GHQ-12) is measured as a continuous variable and runs from zero to 36, with higher scores indicating worse mental health.

Table 6-6 - Associations between social cohesion, social support, racism and GHQ-12

	Coefficient (95% CI)		
	Social Cohesion	Social support	Racism
White British	-1.40*** (-1.95 -0.85)	-0.04 (-0.09 0.02)	1.65 (-2.36 5.66)
Analytical sample	-1.72*** (-2.04 -1.40)	-0.03 (-0.07 0.01)	2.30*** (1.46 3.15)
Indian	-1.86*** (-2.48 -1.23)	-0.02 (-0.09 -0.05)	3.48*** (2.00 4.96)
Pakistani	-1.67*** (-2.37 -0.96)	0.03 (-0.12 0.18)	4.06*** (2.19 5.93)
Bangladeshi	-2.55*** (-3.37 -1.72)	0.05 (-0.07 0.17)	2.14* (0.16 4.13)
Black Caribbean	-2.12*** (-2.95 -1.29)	-0.05 (-0.12 0.02)	-0.26 (-2.86 2.34)
Black African	-1.49*** (-2.21 -0.77)	-0.04 (-0.17 0.08)	0.23 (-1.67 2.12)

*p<0.05 ** p<0.01 *** p<0.001
Separate linear regression models (racism as a binary measure). All models adjusted for: age, sex, marital status, country of birth, household income, highest qualification, and area deprivation.

Table 6.6 shows that social cohesion is statistically significantly associated with mental health for all ethnic groups, such that a one unit increase in social cohesion (measured as a composite scale) is associated with improved mental health (lower GHQ-12 score - measured on a zero to 36 scale) for all groups. Coefficients of one or larger indicate a substantial change in mental health. The largest coefficient is observed in the Bangladeshi group (β=-2.55, 95% CI -3.37 -1.72). Social support (measured via the number of a participant's close friends) does not appear to be significantly associated with mental health for any ethnic group. However, estimates were in the protective direction (though very small), mirroring findings from previous research assessing the association between the measure and GHQ-12 using the 'extra five minutes sample' (Nandi et al., 2016). Reporting having experienced racism compared with not having experienced racism was statistically significantly associated with worse mental health (higher GHQ-12 scores) for all groups except from the White British, Black Caribbean and Black African groups. The Pakistani group had the largest coefficient of 4.06 (95% CI 2.19 5.93), suggesting a large, detrimental effect on mental health. These results indicate that social cohesion (for all groups) and racism (for all but the White British, Black Caribbean and Black African groups) are associated with mental health. However, social support, measured via one's total number of close friends, does not appear to be associated with mental health. Table 6.7 presents the associations between social support measured via the proportion of co-ethnic friends and mental health for each ethnic group.

Table 6-7 - Association between GHQ-12 and Co-ethnic friends

		Co-ethnic friends proportion Coefficient (95% CI)
White British	All the same	ref
	> half	-0.12 (-1.04 0.80)
	About half	0.73 (-0.60 2.05)
	< half	0.58 (-1.02 2.18)
Analytical sample	All the same	ref
	> half	-0.27 (-0.91 0.36)
	About half	0.07 (-0.63 0.77)
	< half	0.44 (-0.33 1.21)
Indian	All the same	ref
	> half	-0.31 (-1.52 0.90)
	About half	-0.05 (-1.36 1.25)
	< half	1.63* (0.25 3.02)
Pakistani	All the same	ref
	> half	-0.43 (-1.79 0.93)
	About half	0.26 (-1.30 1.83)
	< half	-1.51 (-3.40 0.38)
Bangladeshi	All the same	ref
	> half	1.04 (-0.31 2.39)
	About half	1.41 (-0.34 3.15)
	< half	1.92 (-0.25 4.10)
Black Caribbean	All the same	ref
	> half	0.48 (-1.48 2.44)
	About half	0.98 (-1.08 3.04)
	< half	0.31 (-1.86 2.47)
Black African	All the same	ref
	> half	-0.51 (-2.17 1.16)
	About half	-0.33 (-2.10 1.45)
	< half	1.13 (-0.77 3.04)

*p<0.05 ** p<0.01 *** p<0.001

Separate linear regression models using binary racism outcome. All models adjusted for: age, sex, marital status, country of birth, household income, highest qualification, and area deprivation.

Finally, Table 6.7 shows the association between proportion of co-ethnic friends and mental health. In general, the proportion of co-ethnic friends measure was not significantly associated with mental health across most ethnic groups, and the size of the coefficients were small. The exception to this is the 'less than half' category which is statistically significant for the Indian ethnic group only. The coefficient for this category was modest (β= 1.63), and the confidence interval was wide (95% CI 0.25 3.02), suggesting a minimal impact of co-ethnic friends on mental health for the Indian group in the sample. This estimate suggests that, for the Indian group, compared to having all friends from the same ethnic group, having less than half of friends from the same ethnic group was associated

with worse mental health (increasing GHQ-12 scores). Overall however, the results of these models suggest that the proportion of co-ethnic friends was largely not statistically significantly associated with mental health.

6.2 Summary

In this chapter, the theoretical framework for the subsequent analyses was revisited, the potential mediating variables included in the data were introduced and their associations with both ethnic density and mental health were explored.

Analyses assessing the associations between hypothesised mediators and ethnic density indicated that the measure of ethnic density employed, whether own-group or overall minority ethnic, has an impact on the associations observed. Social cohesion was found to be associated with own-group ethnic density for all but the Black Caribbean and Black African groups. However, employing the overall ethnic density measure resulted in statistically significant estimates for the Pakistani and overall analytical sample only. Social support (measured via the number of close friends measure) was significantly associated with ethnic density across both measures for the analytical sample, Indian and Black African samples, but only with own-group density for the Pakistani sample. Both measures of density were associated with reduced racism for all groups except the Pakistani group, with evidence suggesting that the different measures of density may have more or less protective effects for different ethnic groups. Own-group density appeared to be a stronger predictor of the proportion of co-ethnic friends than overall minority density. Social cohesion and racism were associated with mental health for all ethnic groups except for the Black Caribbean and Black African groups for the racism measure. Neither social support nor co-ethnic friends appeared to be associated with mental health for most ethnic groups. Therefore, in terms of associations with ethnic density and mental health, there is evidence to suggest that social cohesion and racism may be operating as mediating pathways in the association.

Before proceeding to study these hypothesised mediating variables simultaneously as indirect pathways in a Multilevel, Structural Equation Modelling framework, the complexity of the social capital measure is first investigated in depth. In the following chapter, the individual questions comprising the social cohesion scale (rather than the composite measure employed in this chapter) are examined using factor analysis.

7 Chapter 7: Using factor analysis to measure social cohesion

So far, research questions 1a and 1b, relating to what is currently known of the relationship between ethnic density and mental health in the UK, were addressed in Chapter 3. This revealed several key hypothesised pathways which were synthesised into a theoretical framework presented in Chapter 4. Research questions 2a and 2b relating to the association between different measures of ethnic density and mental health across ethnic groups were then addressed in Chapter 5. In this chapter, a general lack of statistically significant associations between ethnic density and mental health were found for most ethnic groups and measures of ethnic density. Finally, in Chapter 6, research questions 3a and 3b, relating to associations between ethnic density, mental health and each of the hypothesised mediating variables, were addressed. Racism and social cohesion were found to be associated with both own-group ethnic density and mental health for most ethnic groups. However, the close number of friends measure did not appear to be associated with either ethnic density or mental health, and co-ethnic friendships was associated with ethnic density only.

Chapters 7 and 8 now turn to address the remaining research questions, 3c-3e, relating to the pathways between ethnic density and mental health and how they operate across ethnic groups. In order to arrive at a point where the full theoretical framework can be specified and its paths simultaneously estimated across ethnic groups, a number of preliminary steps are required to measure social cohesion which are carried out in this chapter.

7.1 Overall methods and purpose

This chapter introduces the overarching Structural Equation Modelling (SEM) approach, which is taken to testing the hypothesised theoretical framework, the results of which are described in Chapter 8. It then describes and presents the factor analysis process required for the measurement of social cohesion as a latent variable. This includes the Exploratory Factor Analysis process, and the Confirmatory Factor Analysis process (including the measurement invariance checks required across ethnic groups) in order to address research question 3c. Multilevel Structural Equation Modelling (MSEM) is then introduced and the overall advantages of using SEM which accommodates a multilevel framework are explained. Finally, the last element of the measurement analysis process of social cohesion is conducted, in which invariance is checked across both levels of the model.

7.1.1 Introducing Structural Equation Modelling (SEM)

The primary method of analysis used in this thesis is Structural Equation Modelling (referred to henceforth as SEM). The purpose of the SEM conducted in this thesis was to test a theoretical model of the ethnic density effect on common mental disorders, allowing for multiple indirect paths and latent variables. These aims are encompassed by the following research questions:

3d *Is there statistically significant evidence of cross-level indirect effects for the hypothesised mediating factors?*

3e *Are the path estimates of the indirect paths different across ethnic groups?*

SEM estimation is based on covariance (Kline, 2005) and assessing the model implied variance-covariance matrix compared to the variance-covariance matrix of the data. SEM brings together a range of statistical techniques (Beran and Violato, 2010). The method is thought to have arisen from a combination of the traditions of both factor analysis and path analysis (Tarka, 2018).

Utilising SEM to model the relationship between ethnic density and mental health has two main benefits. Firstly, SEM allows for the inclusion of latent variables (those which cannot be directly observed and are instead comprised of a number of indicators) using Confirmatory Factor Analysis (CFA) (Kline, 2005). This makes it ideal for modelling the complex constructs and indirect paths that are hypothesised to be in operation in the ethnic density-mental health association being examined in the present thesis. In modelling complex constructs as latent variables in SEM, it is possible to not only account for measurement error, but also provide greater detail regarding the various factors operating behind a construct which would otherwise be masked when using a composite measure of the indicators. Additionally, SEM allows for invariance testing of latent variables across groups, whereby the structure and measurement of latent constructs are investigated for equality across groups. This means that assumption that complex measures have the same meaning and measurement across ethnic groups can be explicitly assessed. This is particularly important in the context of this thesis as it enables comparison of the latent variables specified across ethnic groups. Secondly, it is possible to test the paths to and from variables hypothesised to be mediators via indirect pathways, and to model complex models with multiple indirect paths simultaneously. This means that, in theory, all hypothesised indirect pathways could be tested simultaneously which is particularly useful in the context of the ethnic density effect, where there are a number of variables hypothesised to operate via indirect paths involved.

Typically, and as is the case in this thesis, SEMs are used to represent a theoretical model of possible causal paths in between variables of interest which have been shown to be associated (Hayduk et al., 2007). Multiple fit measures are used to assess the fit of the model to the data (shown later in this chapter in Table 7.1 and discussed in section 7.1.4). However, as explained by Hyaduk and colleagues "finding a model that fits the covariance data does not say the model is the correct model, but merely that the model is one of the several potentially very causally different models that are consistent with the data" (Hayduk et al., 2007, p.843). It is for this reason that the specification of the model and its paths should be clearly and carefully guided by theory and existing knowledge. As argued by Bollen and Pearl, "researchers do not derive causal relations from an SEM. Rather, the SEM represents and relies upon the causal assumptions of the researcher" (2013, p.309). The relation between SEM and causal inference is described in greater detail below.

Approaches to model building and modification in SEM

The process for specifying and testing SEMs depends upon whether latent variables are included in the model. When these are included, it is necessary to test the fit of the measurement model and find good model fit before specifying the full path model (Kline, 2015). The fit of the measurement model is therefore assessed independently first, before the full model is specified and the fit of this model is also assessed.

SEM modification is the stepwise process by which model fit is improved to arrive at a final model with good fit. There are two primary approaches to SEM modification: exploratory and theory-driven SEM (Tarka, 2018, p.328). Exploratory SEM is the least common application of the method, whereby the model specification, paths and modifications are entirely data driven (i.e. all decisions on paths and variables are made based on model fit). However, this 'capitalisation on chance' can lead to nonsensical models which have good model fit (MacCallum et al., 1992). Contrastingly, pure theory-driven SEM foregrounds theory testing. The model is specified according to a carefully drawn-out theory and no modifications are implemented even if model fit is poor. At the intersection of these two primary approaches lies arguably the most common application of the method, and the one employed in this thesis. In this approach, a theoretically informed model is specified, but slight modifications to improve model fit are considered acceptable when guided by theory (Arbuckle, 2007, p.112). Where these data-driven modifications are made, they are clearly described and justified.

It should also be noted that unlike typical regression models, SEMs are not built sequentially, as this would go against the theory driven approach taken here. Instead, the full structural model is

specified and tested, and then singular adjustments made, in a stepwise fashion in order to achieve good model fit. Similarly, predictors in the model are not removed based on statistical significance. The predictors are a part of the theoretical model and are retained no matter their level of statistical significance (Kline, 2015, pp.38-39).

In summary, the application of SEM in this thesis is theory-driven, whereby the hypothesised causal framework specified in the SEM is drawn from published evidence and established theory. Wherever possible, theory was used to justify the decisions made. However, some decisions made in elements of the SEM analysis process were unavoidably driven by the data. In the following, where decisions were made which deviated from the original, theory-driven plan, these are clearly highlighted.

Assumptions and principles of SEM

SEM operates on many of the same assumptions as typical regression models including: the assumption of no measurement error, normal distribution and homoscedasticity, that regression coefficients describe linear relations, that the model is correctly specified (Kline, 2015, p.33), and that observations are independent. In the case of the data employed here (with individuals clustered in areas) this assumption of independence is not held. Greater detail is provided on the SEM approach employed in this thesis to appropriately handle the clustered nature of the data in section 7.7.

In addition, an underlying principle of SEM is that of parsimony. SEMs favour the most parsimonious models and penalise complexity, such that "given two models with similar fit to the data, the simpler model is preferred, assuming that the simpler model is theoretically plausible" (Kline, 2015, p.128). It may seem that this principle is at odds with the theory driven approach taken here, such as the decision to retain non-significant predictors. However, theory-testing is prioritised over this principle in this thesis.

SEM and its relationship with causal inference

It is important to note at this point how SEM is understood and interpreted in relation to causality in this thesis. Arguably, an SEM framework allows us to incorporate so-called 'causal thinking', but its ability to provide causal inference is contingent upon the use of longitudinal data and the assumption of a fully and correctly specified model (Kline, 2015, pp.124-126). It should therefore be noted that the SEM models employed in this thesis, whilst carefully constructed from theory and existing knowledge from the literature base, are not causal models and should not be interpreted as such. Due to this stance, the language of 'exogenous' and 'endogenous' and other related language

often employed in path models is deliberately avoided in this thesis due to the inherent associations these words have with causal inference. The conclusions drawn from the models tested in thesis are therefore made with caution, but also with an understanding of the role of building a bank of evidence of different types and assessing its consistency as an important building block for causal inference (Shimonovich et al., 2020).

7.1.2 Factor analysis in SEM and MSEM

Multigroup measurement models

The UKHLS survey data includes a multi-item scale for social cohesion, one of the key hypothesised mediators of interest in this thesis, which is thought to draw on a number of underlying constructs comprising social cohesion (Buckner, 1988). This presents a valuable opportunity to analyse the factor structure of this measure (something not yet exploited by earlier research). In addition to the opportunity to model complex hypothesised causal paths, SEM allows latent (not directly observed) constructs to be incorporated, meaning once defined, the factor structure of social cohesion can be incorporated into the model. As this thesis aims to investigate the ethnic group-specific pathways between ethnic density and mental health, multigroup checks are also required to assess measurement invariance across different ethnic groups. Measurement invariance checks can tell us if, across ethnic groups, the latent variable has the same structure (configural invariance), the same factor loadings (metric invariance) and the same item means (scalar invariance) (Putnick and Bornstein, 2016). If measurement invariance is established to at least the level of equivalent loadings (metric invariance), then it is possible to compare the structural relations of latent construct across groups (Kim et al., 2017). If this level of measurement invariance is not achieved, then it can be understood that the construct of interest has different meanings among the groups of interest to the extent that it is not possible to compare them.

Multilevel measurement models

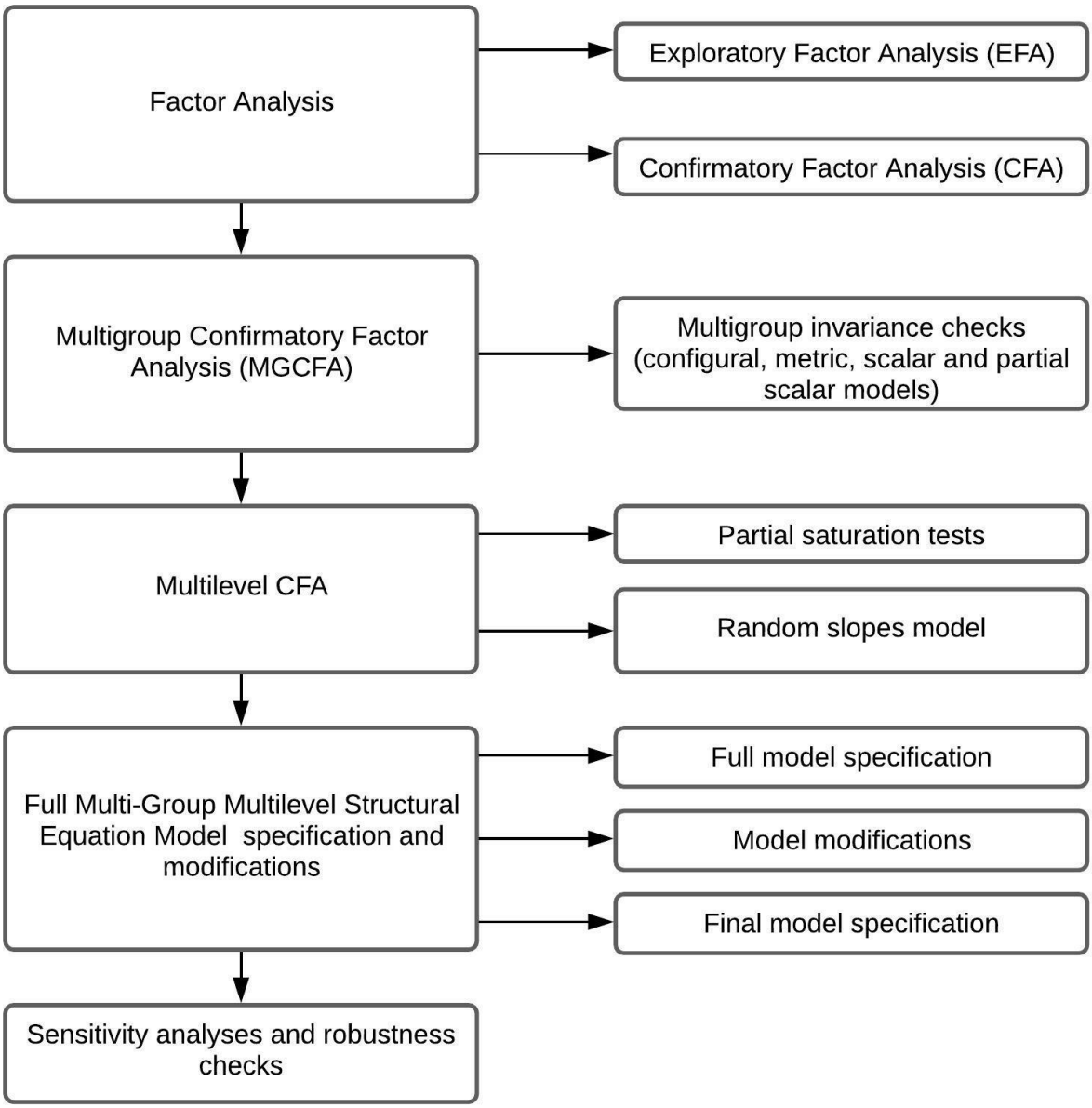
In standard SEM, the main benefit of including latent variables is that it is possible to model complex constructs, account for measurement error and allow factor loadings to vary across groups. Additionally, in Multilevel Structural Equation Modelling (MSEM), it is possible to incorporate multilevel measurement models for latent constructs. This is especially useful for constructs which are measured at the individual (person) level, but which reflect properties or processes thought to exist at the area or neighbourhood level. Theoretically, social cohesion can be thought of as a ‘fuzzy composition’ variable (Kozlowski and Klein, 2000) in the sense that it meaningfully operates at both

levels of analysis (both individual and area-level), but that the underlying factor structure may not be the same at both levels (Dyer et al., 2005). Often, measures of social cohesion are used as aggregate measures, without considering its measurement structure at both levels. By using MSEM, the variances of the factor(s) are decomposed into two parts, one for each analysis level (individual and area level). The multigroup and multilevel elements of these measurement models can be combined together under a unique type of SEM (introduced fully in Chapter 8) described by Asparouhov and Muthén (2012) which I refer to as Multi-Group Multilevel Structural Equation Modelling and which is henceforth referred to as MG-MSEM.

7.1.3 The SEM analysis process employed in this thesis

The SEM process used in this thesis is complex and comprised of many steps due to the multilevel and multigroup components. The below flow diagram (Figure 7.1) is set out in order to help the reader understand the full process and steps of the analysis. The flow diagram begins after having completed basic data analysis and assumption checks which were reported on in Chapters 5 and 6.

Figure 7-1 - MG-MSEM process flow chart



The following analyses were conducted in Stata (descriptive statistics, EFA) and Mplus (all other analyses). In the following, where available, $p<0.05$ is taken as the minimum level of statistical significance. The acceptable model fit estimates for analyses conducted in the SEM framework were based upon established norms in the field and a table presenting these adapted from Kenny (2020) is included in the following (Table 7.1).

7.1.4 Evaluating SEM model fit

In order to estimate a covariance matrix which is used to calculate the model parameters required, the SEM model should be over-identified, meaning more parameters are entered into the model than those calculated by the model (Kline, 2015, p.147). Unlike other models, SEM model fit is evaluated by a total of five measures. There is no consensus as to which of these measures are better indicators of model fit than others, and each has its own biases, meaning that all five measures are typically presented together. The acceptable thresholds of these measures vary depending upon discipline and journal. The thresholds used in this thesis are detailed below in Table 7.1. 'Good fit' is aimed for wherever possible throughout, but the secondary column of 'acceptable fit' levels are also considered acceptable where it is not possible to achieve the higher level of fit. Achieving the 'good' or 'adequate' fit thresholds on these indicators imply better correspondence between the model-implied and actual variance-covariance matrix of the data (Kline, 2015, p.266). Along with the threshold for each of the measures, Table 7.1 also gives a brief description of each of the measures.

Presenting and interpreting results

Where possible, raw beta coefficients (where for every one-unit change in X there is a predicted change in Y) are presented alongside standardised coefficients (where variables are standardised to have a mean of zero and a standard deviation of one, meaning for a one standard deviation change in X, there is predicted a predicted change in Y). However, in the SEMs used later in this thesis when using multilevel data, it is not possible to present standardised coefficients and so from Chapter 8 onward, all presented coefficients are unstandardised.

Table 7-1 - Model fit indices

Abbreviation used in this thesis	Full name of measure	Good fit	Acceptable fit	Detail
General model fit measures				
x^2	Chi-square	Not significant	-	Penalises large sample sizes (always statistically significant in samples of 400 or more).
CFI	Comparative fit index	≥0.95	≥0.90	Penalises for every additional parameter estimated.
TLI	Tucker-Lewis Index	≥0.95	≥0.90	Penalises model complexity.
RMSEA	Root Mean Square Error of Approximation	≤0.06	≤0.08	Penalises model complexity. Small sample sizes and low degrees of freedom positively bias the estimate.
SRMSR	Standardised Root Mean Square Residual	≤0.08	-	The standardised difference between the observed and predicted correlations. It does not penalise model complexity.
Nested model comparison measures				
AIC	Akaike Information Criterion	-	-	Penalises reduced complexity. Smaller AIC value indicates the better model.
BIC	Bayesian Information Criterion	-	-	Penalises increased complexity. Smaller BIC value indicates the better model.

(Table adapted from Kenny, 2020)

7.2 Measuring social cohesion using the shortened Buckner scale

A key benefit of the SEM framework is the ability to model complex constructs as latent variables, with measurement error included in analyses. The multi-item social cohesion scale included in UKHLS presented an opportunity to utilise this function within the SEM framework in order to: better retain its complexity, account for measurement error, assess its differential functioning across ethnic groups and (using MSEM) more accurately operationalise it as an individually measured construct, but with meaning at the neighbourhood level.

Factor Analysis

Despite a long-standing interest in the concept of social cohesion within a number of disciplines (see Fonseca et al., 2019 for a review of some of this literature), including psychology and sociology, there remains little consensus surrounding it's measurement. Relatedly, there has been inconsistent evidence coming from research on the dimensions which comprise it (Buckner, 1988, Bottoni, 2018,

Chuang et al., 2013). Buckner's cohesion scale (Buckner, 1988) is included in the UKHLS. In the original scale, Buckner claims that the items load onto three key dimensions "residents' sense of community felt within the context of neighborhood; residents' degree of attraction to live and remain in the neighborhood; and residents' degree of interaction within the neighborhood" (Buckner, 1988, p.774). However, of the 18 original questions included in the scale, only eight were retained in the UKHLS questionnaire due to limited space. The team at UKHLS chose these eight questions which they argue represent these three dimensions and had the strongest overall correlation with the main factor (Auty, 2018). However, the underlying factor structure of these items does not appear to have been assessed, and there is currently no published work available relating to this. In addition, the original scale was validated in white, middle-class areas of the US (Buckner, 1988). Based on this, I took the decision to perform Exploratory Factor Analysis on the shortened version of the scale, to assess the measurement structure in the ethnically diverse sample from England used in this thesis (as described in Chapter 5), before progressing to MGCFA.

Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) is a data-driven approach to identifying the factor structure of the data. No factor structure is imposed and the results indicate which items load onto which factors. It is appropriate when the factor structure of a set of indicators is not known (Finch, 2019, p.6). Whilst there is no consensus on the correct measurement of social cohesion, it is widely understood to be composed of a number of complex and overlapping concepts. The EFA analyses performed here were conducted in Stata 16 software and used to establish the factor structure of the eight-item social cohesion measure. Despite the method being primarily data driven, decisions made relating to variable inclusion and exclusion were guided by the existing evidence and theory, as well as the quantitative evidence generated on item performance.

Before commencing the EFA process, the ICCs of each of the indicators were assessed in order to establish the percentage of variance at the between-level to model in the final, multilevel model as Multilevel SEM requires substantial variance at the between-level (Silva et al., 2019). As shown in Table 7.2 most of the indicators had ICCs larger than 0.10 (except from indicators E and G), meaning that over 10% of the variance for each of these variables can be accounted for at the area level.

Table 7-2 - ICCs for each indicator

Variable	ICC
A- Belong to the neighbourhood	0.108
B- Local friendships mean a lot	0.115
C- Advice is obtainable locally	0.155
D- Can borrow things and exchange favours with neighbours	0.144
E- Willing to improve the neighbourhood	0.052
F- Plan to stay in the neighbourhood for a number of years	0.136
G- Think of self as similar to other people who live here	0.092
H- Stops and talks regularly with neighbours	0.136

The appropriateness of the data for EFA was then checked. The correlation table below indicates that multicollinearity is not present in these data, as all correlations are below 0.6. If multicollinearity issues were present, correlations of 0.7 or greater would likely be observed (Dormann et al., 2013). Bartlett's test of sphericity (with a null hypothesis that the items are not correlated) was statistically significant (chi= 3632.68 d.f. = 28, p<0.001) suggesting that factor analysis on the indicators may be appropriate. However, this statistic is heavily influenced by large sample sizes (Watkins 2018) and so the Kaiser-Meyer-Olkin test (Kaiser and Rice, 1974) for the variables was also produced. The value of the KMO test was 0.62 which, though not large, is an acceptable value (Hutcheson & Sofroniou, 1999, p.225; Kaiser, 1974). Based on these results, I proceeded with conducing factor analysis.

Table 7-3 - Correlation matrix between items

		1	2	3	4	5	6	7	8
1	A- Belong	1.00							
2	D- Friends	0.50***	1.00						
3	C- Advice	0.04	-0.01	1.00					
4	D- Favours	0.00	-0.04	0.58***	1.00				
5	E- Willing to improve	0.00	-0.00	0.01	-0.02	1.00			
6	F- Plan to stay	0.01	-0.00	0.37***	0.33***	0.02	1.00		
7	G- Similar to others	0.00	0.35***	0.01	0.02	-0.00	0.04*	1.00	
8	H- Stop and talk	-0.01	-0.06**	0.49***	0.40***	0.01	0.37***	-0.03	1.00

*p<0.05 ** p<0.01 *** p<0.001

7.3 EFA results

The following tables show the process of EFA, with an associated description for each table detailing the analysis performed, interpretation of the results and subsequent decisions made. Factor analysis

was performed using the iterated principal factor option in Stata and the results rotated using Promax rotation, under the assumption of some correlation existing between factors (Tabachnick et al., 2019, ch.13, p.500). Rotated loadings were considered acceptable if they were at minimum 0.3, but preferably 0.5 or higher. Cross loadings were not allowed. A stepwise approach was taken to the removal of any variables and justified based on the results of the EFA and logic behind their meaning.

Table 7-4 - EFA model 1

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Uniqueness
A	0.02	-0.00	0.57	-0.12	0.32	-0.01	-0.03	0.43
B	-0.02	0.00	0.81	0.14	-0.03	0.01	0.03	0.24
C	0.84	0.00	-0.04	0.08	0.03	-0.01	0.03	0.31
D	0.62	-0.00	0.03	-0.07	-0.02	0.27	-0.03	0.44
E	0.02	0.00	0.03	-0.07	-0.02	-0.01	0.24	0.95
F	0.10	0.48	-0.04	0.08	0.11	0.10	0.03	0.65
G	0.03	-0.00	0.05	0.63	-0.03	-0.01	-0.03	0.58
H	0.31	0.48	0.04	-0.08	-0.11	-0.10	-0.03	0.51

Table 7.4 shows the results of EFA for all of the items of Buckner's cohesion scale included in the UKHLS survey (Buckner, 1988). This produced two factors with eigenvalues above 1 (1.84 and 1.28). The loadings of each of the items for each suggested factor are presented, with green highlight showing loadings which reach 0.5, and orange showing loadings which are below 0.5, but above 0.3. The structure of the factors is unclear at this point. However, we see that item E (willing to improve the neighbourhood) does not load well onto any of the factors suggested by the EFA. This, in combination with its large uniqueness value (0.95) is considered to be evidence of poor fit of item E with the rest of the items and the underlying factors that these explain and it was therefore removed.

Table 7-5 - EFA model 2

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Uniqueness
A	0.03	0.59	-0.02	-0.13	0.00	0.29	0.43
B	-0.03	0.80	0.02	0.16	0.00	-0.03	0.24
C	0.82	-0.04	0.02	0.09	-0.02	0.03	0.32
D	0.61	0.03	-0.01	-0.07	0.25	-0.02	0.46
F	0.08	-0.04	0.43	0.09	0.15	0.16	0.66
G	0.03	0.06	-0.02	0.62	-0.00	-0.03	0.58
H	0.30	0.05	0.50	-0.10	-0.05	-0.08	0.51

Table 7.5 shows the results of EFA with item E removed. There remains two eigen values above 1 (1.83 and 1.27). This model reveals the beginning of a clearer structure, with C, D and H (advice is obtainable locally, can borrow things from neighbours and stop and talk regularly to neighbours) loading onto one factor (factor 1), and A and B (belonging to the neighbourhood and local friends mean a lot) loading onto the other (factor 2) (n.b. two-item factors are possible within Mplus and therefore factors composed of only two items are considered acceptable in the EFA process conducted here). These two separate factors make sense theoretically, with the items in factor 1 predominantly relating to concepts surrounding social capital and the items in factor 2 arguably tapping into concepts surrounding place-based attachment. The factor loadings shown above suggest that item G (think of self as similar to other people who live here) loads well only onto one factor independent of the other items. It does not appear to load well on to either of the two factors which the majority of the other indicators load onto and which have eigen values above one. In addition, item G arguably relates more to the concept of place-based identity, which is subtly different form of attachment to place than is captured by the other items in factor 2. For these reasons, it was decided that item G should be removed.

Table 7-6 - EFA model 3

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Uniqueness
A	0.09	0.66	-0.05	-0.11	-0.17	0.43
B	-0.09	0.82	0.03	0.03	0.23	0.25
C	0.83	-0.07	0.05	-0.03	0.12	0.32
D	0.63	0.03	-0.09	0.28	-0.05	0.48
F	0.08	0.08	-0.04	-0.01	0.65	0.59
H	0.40	0.05	0.32	-0.01	-0.09	0.61

Table 7.6 shows the results of model 3, which additionally excludes item G. This model indicated two factors with eigenvalues above 1 (1.51 and 1.22). We see that item F (plan to stay in the neighbourhood for a number of years) does not load onto either of the two main factor and instead now has an especially high loading onto one factor independently. It is surprising that this item does not load onto factor 1, with the other items tapping into place-based attachment. However, responses to this item are likely to be influenced by more than just attachment to a place, such as job prospects or school choices. For these reasons it was decided that item F should be removed.

Table 7-7 - EFA Model 4

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Uniqueness
A	-0.07	0.72	0.06	0.07	0.49
B	0.07	0.70	-0.06	-0.08	0.49
C	0.76	0.02	0.01	0.08	0.31
D	0.59	-0.01	0.20	-0.08	0.48
H	0.37	-0.02	-0.02	0.32	0.61

Finally, Table 7.7 shows the results after the removal of item F. EFA on the five remaining items indicated a two-factor model, with eigen values of 1.55 and 1.01 respectively (with the next eigen value being below 1, at 0.05) suggesting that these two factors explain 51% of the total variance of the observed variables which is considered to be an acceptable level (Merenda, 1997, p.158). A screeplot produced also showed a clear elbow after two factors. Initially, the five factor loadings were rotated via promax rotation with results shown in the above table. A post-estimation correlation matrix of the two promax (oblique) rotated factors gave a correlation of -0.04, suggesting that the factors were not correlated. The model was therefore re-run with varimax (orthogonal) rotation which assumes that the factors are uncorrelated (Tabachnick et al., 2019, ch.13, p.501), the results of which are shown below in Table 7.8.

EFA on the five variables retained

Table 7-8 - EFA model 5

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Uniqueness
A	0.03	0.71	0.04	0.04	0.25
B	-0.03	0.71	-0.05	-0.04	0.25
C	0.83	0.02	0.04	-0.03	0.26
D	0.71	-0.02	-0.09	0.06	0.33
H	0.59	-0.05	0.21	-0.00	0.42

Table 7.8 shows a clear two-factor structure, with items C, D and H loading well onto Factor 1, and items A and B loading well onto Factor 2. The final two-factor structure and the component questions for each of the factors are shown below in Table 7.9.

7.4 Interpreting the final social cohesion measurement structure

The factors resulting from the final two-factor structure, were named 'belonging' and 'social capital'. As described above, the two items on Factor 1 both appeared to refer to ideas of belonging and place-based attachment (Altman and Low, 1992). Two of items included in Factor 2 (social capital) seem to relate to concepts surrounding practical and informational support which are agued to be more available in communities which are cohesive (Kawachi and Berkman, 2000). However, though it loads well onto Factor 2, item H appears to relate to a slightly different concept when the question itself is considered. Its loading onto the factor measuring social capital is likely due to the conditionality of receiving support from neighbours on speaking to those neighbours. Given the prior work available on conceptualisations of the underlying constructs of social cohesion (Bottoni, 2018), it is reasonable that belonging and social capital emerged as the two main factors in the EFA performed in this thesis.

The three items included in Factor 2 which I have termed 'social capital' were originally designed to capture 'neighbouring' by Buckner (along with two other questions) and the two items on Factor 1 were originally designed to capture a 'psychological sense of community' along with seven other questions not included here[11] (Buckner, 1988). That these sets of items load together on the separate factors is consistent with Buckner's original formulation of these as separate constructs (1988).

Table 7-9 - Final item structure for both factors of social cohesion

Factor 1 (belonging)	Factor 2 (social capital)
A - I feel like I belong to this neighbourhood	C - If I needed advice about something, I could go to someone in my neighbourhood
B - The friendships and associations I have with other people in my neighbourhood mean a lot to me	D - I borrow things and exchange favours with my neighbours
	H - I regularly stop and talk with people in my neighbourhood

It is interesting to consider the three items which were eventually removed, items E, F and G (willing to improve the neighbourhood, plan to stay in the neighbourhood for a number of years, think of self as similar to other people who live here). In large part, these items seem to measure concepts

[11] However, it should be noted that Buckner ultimately finds evidence of just one underlying factor, rather the three underlying dimensions the author initially proposes.

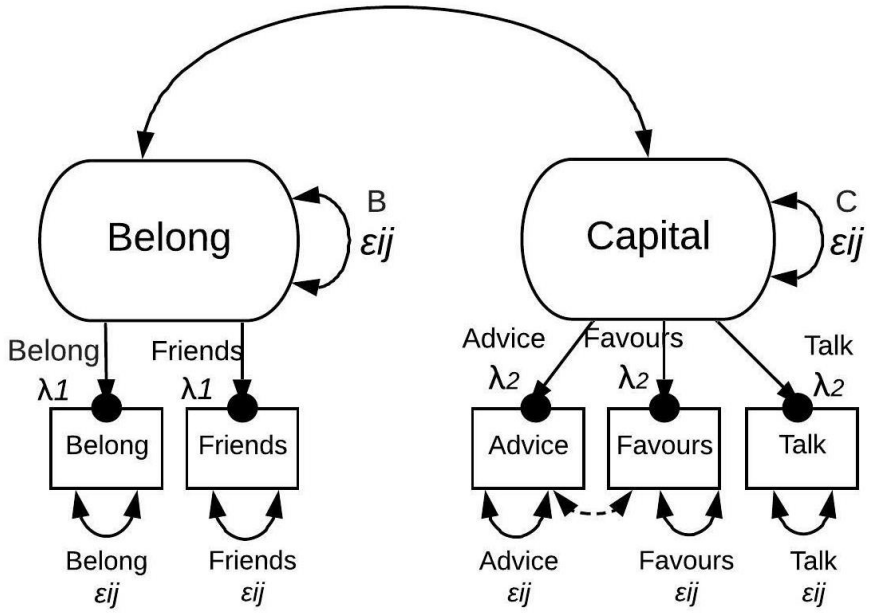
not captured by any of the other included questions. In particular, item E logically seemed to capture a sense of community organising for a common good which was not seen in any other question. In addition, though item F appears to relate to belonging, responses to the question are likely influenced by a number of factors which have little to do with belonging. Finally, that item G does not load onto Factor 1 (belonging) is perhaps a result of this question relating more to a sense of place-based identity, rather than generalised belonging. For example, it is plausible to suggest that one could feel a sense of belonging to a place without thinking themselves as similar to those who live in the area. This is similar to the distinction proposed by Wainwright et al., (2019) between affinity for place and place-based identity.

Cronbach's alpha for the three-item factor was 0.74. It is not possible to perform Cronbach's alpha on a two-item scale. Therefore, following the advice of Pallant (2010) the average inter-item correlation was calculated instead. The average inter-item correlation of the two items on Factor 1 was 0.50 which suggests that the items are correlated, but not too closely. However, a value of 0.5 is considered acceptable for scales which measure narrow (more specific) characteristics (Clark and Watson, 1995).

7.5 Confirmatory Factor Analysis (CFA)

Following the EFA process, it was then necessary to assess the resulting two-factor structure against the data using Confirmatory Factor Analysis (CFA). Figure 7.2 shows a diagrammatic representation of the factor structure specified in the CFA model.

Figure 7-2 - Measurement model diagram of Social Cohesion



Fitting the measurement model

Based on the results of EFA, CFA was then used to assess the fit of the measurement model to the data. The measurement model was created and applied to the data in Mplus 8 software. As there are five indicators included in the model, the model is overidentified, meaning it is possible to interpret and use the fit statistics estimated by the model to judge how well the model fits the data.

The CFA model was specified following the results of the EFA, with two factors, A and B on one factor and C, D and H on the other (or 'belonging' and 'social capital'). No other relationships were specified. However, in this initial model, the RMSEA fit statistic suggested that the model had bad fit. Modification indices (MI) were requested and these suggested a covariance should be included between items C and D (as this was the largest MI of all of the covariance statements suggested, MI = 50.02). Both of these items load onto the same factor and are logically related (respectively relating to getting advice from neighbours and borrowing from neighbours). Once this covariance was included, the model fit improved and suggested that the factor structure was a good fit to the data (the initial and final measurement model fit statistics are shown below in Table 7.10). The implication of the suggestion to include this covariance is that there is some shared variance between items C and D that is not captured by the factor, as indicated by the loadings of these two variables on Factor 2 compared with the loading of H. This is also unsurprising given that items C and D tap into similar concepts relating to practical support, compared with H as described above. Substantively, having to include this covariance to improve model fit suggests that the measurement model itself, as discussed above, could perhaps be improved. Once included, the correlation between these two items was 0.16. The chi square test statistic is statistically significant in these two models and indeed in all subsequent models due to the large sample size used (Kline, 2015, p.271).

Table 7-10 - Model fit indices for the initial and final CFA models

Abbreviation used in this thesis	Full name of measure	Minimum acceptable value	Initial measurement model fit indices	Final measurement model fit indices
x^2	Chi-square	Not significant	P<0.001	P<0.001
CFI	Comparative fit index	≥0.90	0.98	0.99
TLI	Tucker-Lewis Index	≥0.90	0.96	0.98
RMSEA	Root Mean Square Error of Approximation	≤0.08	0.09	0.06
SRMSR	Standardised Root Mean Square Residual	≤0.08	0.02	0.01

The results of the initial CFA model (without the added covariance between items C and D) are shown in Table 7.11 and include the standardised[12] factor loadings. Figures 7.3 and 7.4 show the unstandardised and standardised factor structure and loadings, of the final measurement model which includes the added covariance between items C and D (standard errors of the estimates are presented in brackets). As shown in Figure 7.3, the covariance between the two factors is high at 0.50, but not high enough to suggest that they necessarily should be combined into one factor.

Table 7-11 - CFA standardised factor loadings of the initial model

Variable	Factor 1 loadings (Belonging)	Factor 2 loadings (Social capital)
A	0.63	
B	0.78	
C		0.92
D		0.78
H		0.60

[12] Standardisation of the factor is achieved by fixing the variance of the latent variable to one and by fixing the mean to zero.

Figure 7-3 - CFA of Social Cohesion indicators (not standardised)

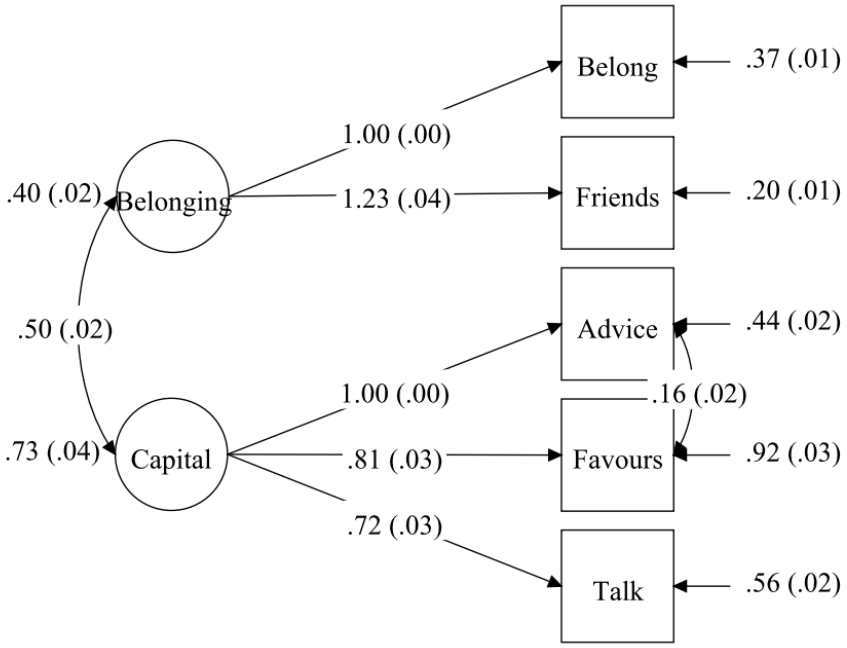
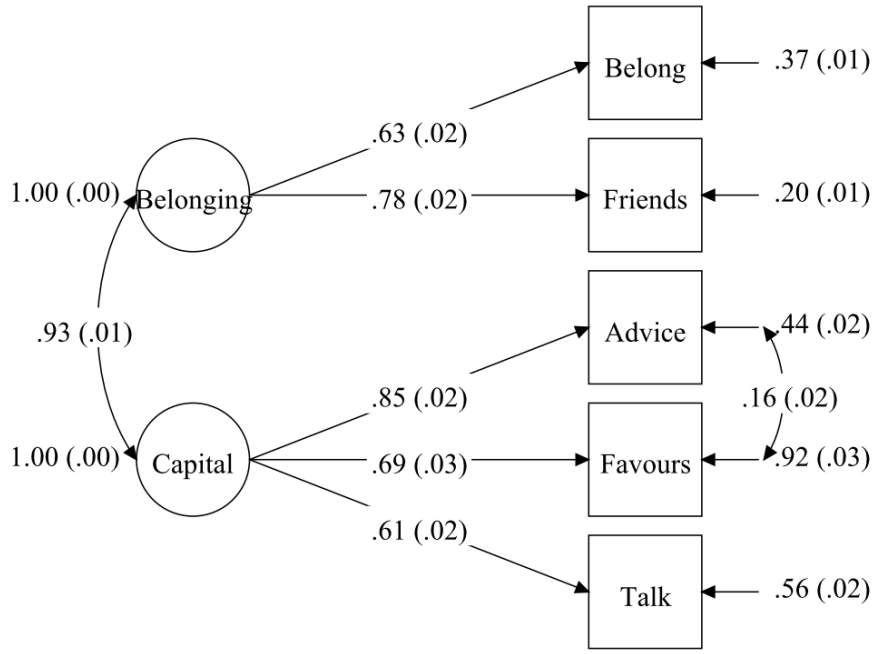


Figure 7-4 - CFA of Social Cohesion indicators (Standardised) [13]



[13] n.b The 0.93 value here between the two factors is a standardised covariance, not a correlation.

7.6 Multigroup invariance

Until this point, EFA and CFA have been performed on the whole sample. However, in order to be able to compare results relating to social cohesion across ethnic groups, measurement invariance must be established. This means, it must be established that the structure and measurement of social cohesion is the same across ethnic groups in order to compare them. There are three types of invariance; configural, metric and scalar. In configural invariance, the factor structure is the same (i.e. the same indicators load onto the same factors). In metric invariance, the item loadings are the same across groups (i.e. the strength and direction of each indicator on the factor is the same across groups). Finally, in scalar invariance, the most difficult level of invariance to achieve, the intercepts of each of the items are the same across groups (i.e. the averages of the item indicators are the same across groups). It is uncommon to achieve scalar invariance in survey data, but it is possible to also test partial scalar invariance, where the intercepts are constrained for each item in turn for factors with three or more indicators to assess if it is possible to achieve scalar invariance on just one item (Van de Schoot et al., 2012). The following describes the results of each step of the invariance testing process for the multigroup, single-level measurement model, including the fit statistics for each model. The acceptable fit statistics are the same as those described previously in Table 7.1. However, in addition to these, when comparing models for each step of the invariance process, chi square difference tests were used and changes in CFI, RMSEA and SRMR fit measures were assessed. The table below (Table 7.12) shows the maximum change across models considered acceptable for the indices of interest based on those proposed by Chen (2007).

Table 7-12 - Limits of change in each fit statistic across models

Measure	Change limit
CFI	-0.01
RMSEA	0.015
SRMR (Metric)	0.030
SRMR (Scalar)	0.015

Configural model

Firstly, configural invariance for all ethnic groups was tested. In this model, everything (intercepts and loadings) is allowed to vary across groups except from the factor structure which must be the same across groups. The below model fit shows good fit on all fit statistics except the chi-square, which is statistically significant as a result of the large sample size used in this thesis and is expected to be statistically significant for the rest of the SEMs conducted within this thesis as a result.

Table 7-13 - Configural model

	Minimum acceptable value	Model estimates
x^2	Not significant	P<0.001 (value= 141.292, d.f.= 35)
CFI	≥0.90	0.978
TLI	≥0.90	0.969
RMSEA	≤0.08	0.077 (CI 0.064 0.090)
SRMR	≤0.08	0.057

Metric model

In the metric model, the path coefficients are additionally constrained to be the same across groups. Chi square tests comparing this model to the above model (chi square difference= 9.445, degrees of freedom difference = 5) shows a value smaller than the critical value (11.07). Therefore, the test is non-significant, meaning that metric measurement invariance has been established. In addition, the CFI has decreased by only 0.001, RMSEA has decreased by 0.004 and the SRMR has increased by only 0.004, all of which are in the acceptable limit of change based on the cut-off points in Table 7.12 (Chen, 2007).

Table 7-14 - Metric model

	Minimum acceptable value	Model estimates
x^2	Not significant	P<0.001 (value= 150.737, d.f. = 40)
CFI	≥0.90	0.977
TLI	≥0.90	0.972
RMSEA	≤0.08	0.073 (CI 0.061 0.086)
SRMR	≤0.08	0.061

Scalar model

In the scalar model, the intercepts are constrained to be the same across groups. Chi square tests comparing this model to the above (chi square difference= 124.605, degrees of freedom difference= 20) is larger than the critical value (31.41) and therefore it is significant, meaning scalar invariance is not found. In addition, all three of the change thresholds proposed by Chen (2007) for the CFI, RMSEA and SRMR are exceeded, also suggesting that scalar invariance is not achieved.

Table 7-15 - Scalar model

	Minimum acceptable value	Model estimates
x^2	Not significant	P<0.001 (value= 275.342, d.f. = 60)
CFI	≥0.90	0.956
TLI	≥0.90	0.964
RMSEA	≤0.08	0.084 (CI 0.074 0.094)
SRMR	≤0.08	0.088

Partial scalar model

As scalar invariance was not achieved, partial invariance was assessed. Constraining the item means separately in turn resulted in significantly worse fit (this was only possible to assess this for Factor 2 as a minimum number of 3 indicators are required) (Van de Schoot et al., 2012). Due to finding neither full nor partial scalar invariance was achieved (only metric invariance was achieved), only that variances, covariances and regression coefficients, can be compared across groups, but not means (Kim et al., 2017). This means the absolute levels of the factors across groups should not be compared, but the structural relationships between the factors and other variables in the later SEMs can be compared across ethnic groups.

Invariance testing results summary

In summary multigroup invariance at just one level was assessed and invariance was established at the metric level only. However, nested data are used in this thesis which requires a different approach to standard SEM called Multilevel Structural Equation Modelling (MSEM). This presents the opportunity to model latent variables at both the 'within' (person) and 'between' (area) parts of the model and offers a distinct advantage when modelling latent variables which are thought to operate at both levels of analysis.

Introducing Multilevel Structural Equation Modelling

MSEM is a form of SEM which allows the user to model data when they are structured across levels (nested), for example pupils within schools, or in the case of this project, survey participants within LSOAs. Not only does a multilevel framework for SEM allow hierarchies of data to be specified, but it also allows the pathways and latent variables to be modelled at both levels and across levels. The assumption of independence is violated when data are clustered, as individuals within the same area are likely to be more similar than individuals from another area. Not accounting for this clustering can lead to overly confident standard errors (Ntani et al., 2021). Although it is possible to account for

clustering of standard errors in standard SEM, meaning one is able to account for a multilevel structure without having to specify this in the model, this is not appropriate for the data or research questions of this thesis. There are two common approaches to MSEM, the Generalised Linear Latent and Mixed Modelling (GLLAMM) and the one taken here, whereby the user creates 'within' and 'between' elements of the model (Muthén, 1994). In MSEM, the levels of the model are identified using the language of 'between' to denote the higher level, and 'within' to denote the lower or individual level. For the sake of clarity, for the rest of this thesis when discussing the model, the 'within' part will be referred to as the 'individual level' and the 'between' part as the 'area level'. MSEM works by partitioning the variance of the between and within parts of the model into two covariance matrices which are additive and uncorrelated (Silva et al., 2019). Diagrams depicting MSEMs show separate sections for the 'between' and 'within' parts of the model specification.

The research questions addressed in this thesis require the assessment of multiple indirect paths. It is not possible to model several mediators or outcome variables at both levels in normal multilevel models (Preacher et al., 2010; Preacher et al., 2011). In addition, the cross-level paths specifically are of interest and therefore require a multilevel framework to be specified.

7.7 Multilevel Confirmatory Factor Analysis

As described above MSEM enables modelling of latent variables at both levels and previous studies have shown the benefits of employing multilevel measurement models for the study of social cohesion (Bottoni, 2018). Therefore, the next step was to model this newly identified factor structure, in a multilevel format. Multilevel CFA (ML-CFA) is required as an additional step of the invariance testing process as it is possible that the factor structure could be different at the two levels of analysis.

An initial model was run which specified the same factor structure identified in the single-level CFA (the two-factor model with covariance between items C and D) at both the individual and area levels. However, an estimation issue was encountered as a result of a correlation of 1 between the two factors at the area level. This high correlation indicated that the factors should not be modelled separately at the area level, and they were instead modelled as one factor for the rest of the analyses. The resulting structure of the measurement of social cohesion for both the between and within levels of analysis is shown below in Table 7.16. The model fit for this multilevel measurement model is presented in Table 7.17 and a graphical depiction of the final multilevel measurement model structure in Figure 7.5 and its results in Figure 7.6.

Table 7-16 - Multilevel measurement model factor structure

WITHIN	
Factor 1 (belonging)	Factor 2 (neighbourhood social capital)
A - I feel like I belong to this neighbourhood	C - If I needed advice about something, I could go to someone in my neighbourhood
B - The friendships and associations I have with other people in my neighbourhood mean a lot to me	D - I borrow things and exchange favours with my neighbours
	H - I regularly stop and talk with people in my neighbourhood
BETWEEN	
Factor 1	
A - I feel like I belong to this neighbourhood	
B - The friendships and associations I have with other people in my neighbourhood mean a lot to me	
C - If I needed advice about something, I could go to someone in my neighbourhood	
D - I borrow things and exchange favours with my neighbours	
H - I regularly stop and talk with people in my neighbourhood	

Figure 7-5 - Graphical depiction of the multilevel measurement model

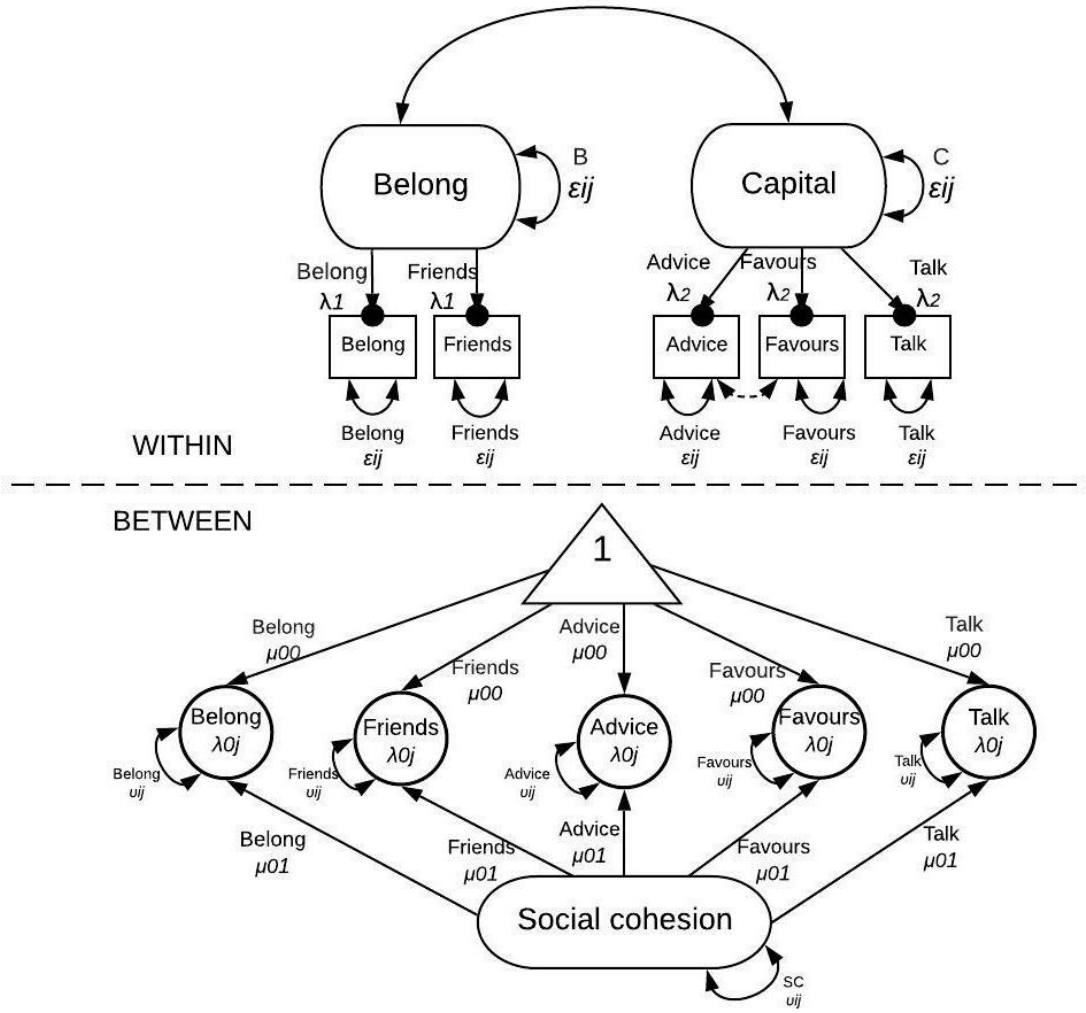


Figure 7-6 - Two-level CFA model results

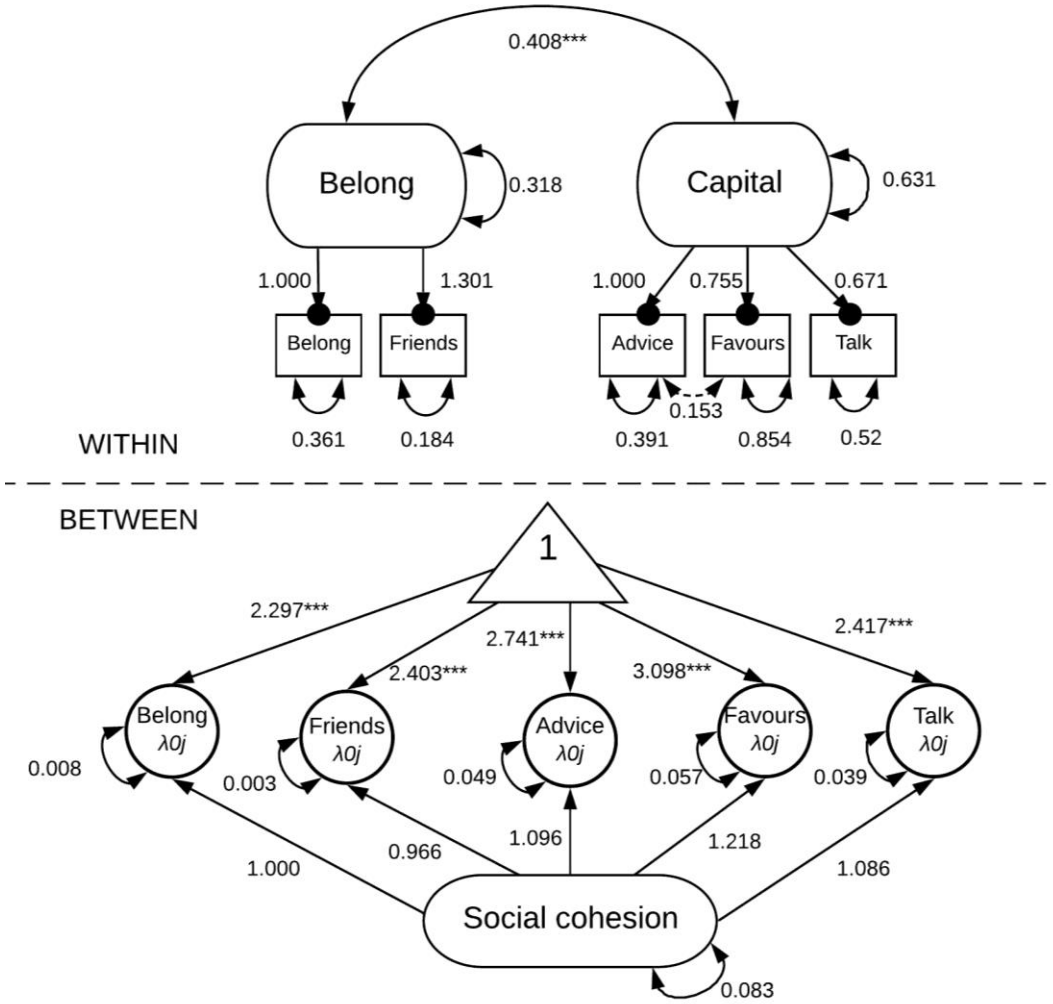


Figure 7.6 shows a graphical depiction of the multilevel measurement model, with two factors at the between level and one at the within level. Table 7.7 shows the fit statistics for this multilevel measurement model and shows good overall model fit. However, based on global fit indices for the model, it is not possible to know if these measures for the overall model are masking any potential model misfit at either level. The following section outlines the tests and results of models which allow the fit of each level to be assessed separately.

Table 7-17 - Model fit for the multilevel measurement model with two factors at the within and one at the between

	Minimum acceptable value	Model estimates
x^2	Not significant	47.60, d.f. 8, P<0.001
CFI	≥0.90	0.990
TLI	≥0.90	0.976
RMSEA	≤0.08	0.044
SRMR (within)	≤0.08	0.020
SRMR (between)	≤0.08	0.061

7.8 Assessing model fit at both the individual and area levels

Partial saturation fit tests

In order to check that misfit at one level was not obscured by the overall fit measures, the measurement model was run twice; once with a saturated model at the individual level and the one-factor structure specified at the area level, and once with the two-factor structure specified at the individual level and a saturated model at the area level. 'Saturation' refers to when a model is specified to be just-identified (where the number of parameters in the model is exactly equal to those estimated by the model), meaning that the part of the model which is saturated has 'perfect' fit. In estimating one level of the model, while saturating the other, we can see the model fit of just the over-identified part of the model. The below table (Table 7.18) shows the fit statistics for the overall model (repeated from the table above to aid comparison), the saturated individual (within) level and the saturated area (between) level models.

Table 7-18 - Partial saturation test fit statistics

Fit statistic	L2 saturated (2 factor structure within)	L1 saturated (one factor structure at between)	Overall 2-level model
x^2	55.71, d.f. 3, P<0.001	11.946, d.f. 5, p=0.0355	47.60, d.f. 8, P<0.001
RMSEA (≤.08)	0.083	0.023	0.044
CFI (≥.90)	0.987	0.998	0.990
TLI (≥.90)	0.915	0.993	0.976
SRMR (≤.08)	0.018	0.039	0.020 (within) 0.061 (between)

The results of the partial saturation fit tests show that in general, neither the between nor within parts of the model fitted the data significantly worse. However, high RMSEA is found for the L2 saturated model, suggesting any misfit in the model is likely coming from the within-level of the model. RMSEA penalises complexity, which may explain why this fit statistic is worse at the within level, with its two-factor structure.

Cross-level invariance

Cross-level invariance tests allow researchers to test if the measurement of factors varies across the levels of analysis (i.e. if the loadings of the factor are the same at both levels). Cross-level invariance is required to be able to compare the strength of coefficients across both analysis levels. In order to test this, a multilevel model is run with a Bayes estimator (Silva et al., 2019), which allowed the intercepts of the latent variable to vary randomly across clusters (i.e. across LSOAs). This model was then compared to the baseline model which was also run with a Bayes estimator, but without random slopes. The DIC of the model which allowed random loadings was lower (and therefore better) than the baseline model (DIC= 30396.719 for the random loadings model compared to DIC= 31150.476 for the baseline model), indicating that the random loadings model fitted the data better. In other words, allowing factor loadings to vary across areas produced better model fit, meaning cross-level invariance was not found.

Table 7-19 - Comparison of DIC fit measure across models

Model	DIC	pD[14]	Δ DIC
Baseline	31150.48	964.82	
Random loadings	30396.72	1679.68	753.76

7.9 Summary

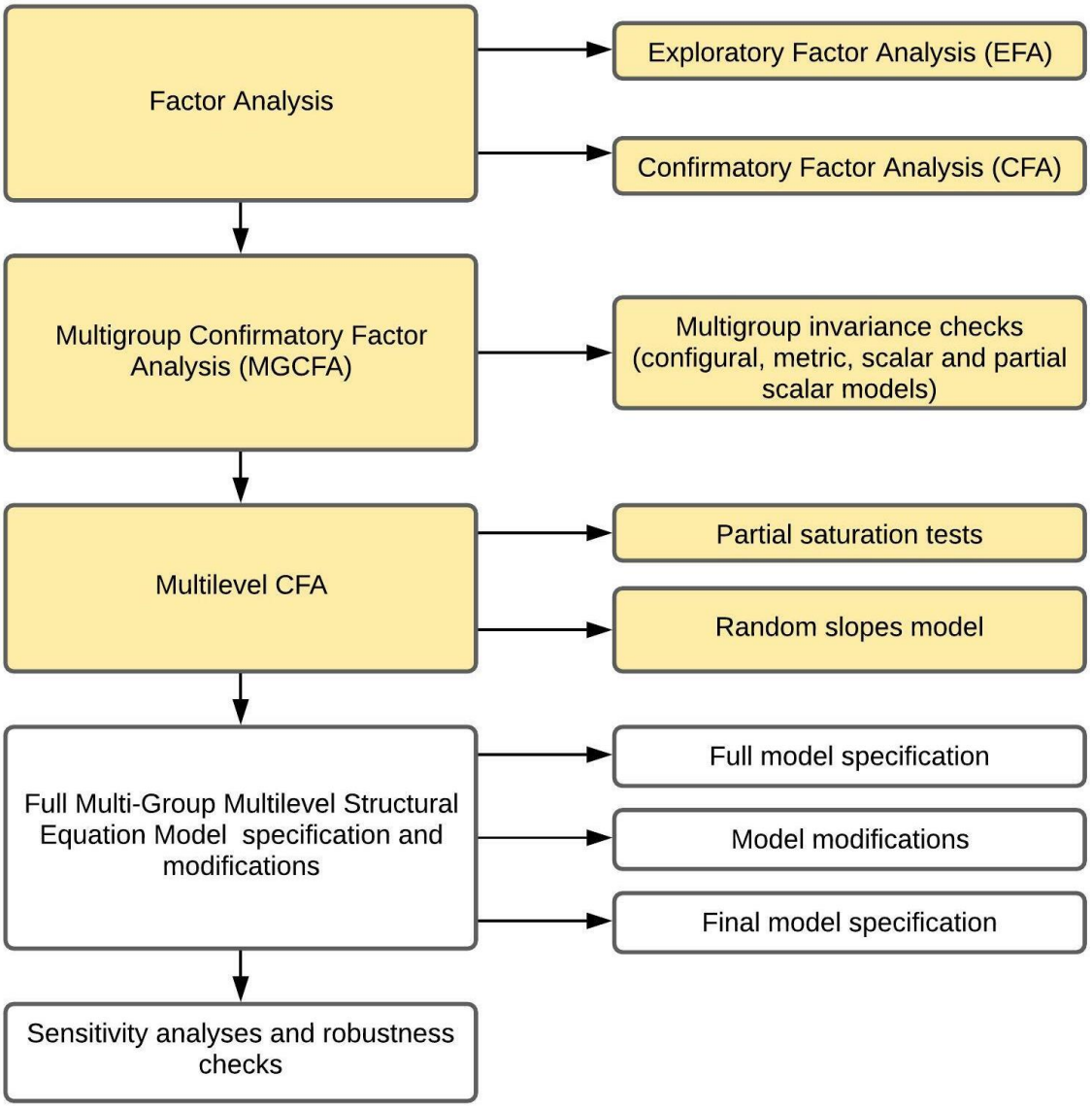
In this chapter I addressed research question 3c "what is the measurement structure of Buckner's social cohesion short scale and is this invariant across ethnic groups?". I found a two-factor structure which I termed 'belonging' and 'social capital', measured by two and three items respectively. I found measurement invariance across ethnic groups to the metric, but not scalar level. This suggests that, while the structure of the two latent factors are the same across ethnic groups, the meaning of these may differ across ethnic groups. Furthermore, I found a one-factor structure at the area-level, suggesting that social cohesion is better measured as just one factor at this level, rather than separating it into belonging and social capital. These steps not only provide insight into the multilevel measurement of social cohesion in this ethnically diverse sample, but produce a resulting factor structure which can be incorporated into the structural model presented in the following chapter.

[14] pD is "the estimated effective number of parameters" (Silva et al., 2019, p.76)

8 Chapter 8: From theory to data analysis: Specifying the Multi-Group Multilevel Structural Equation Model (MG-MSEM)

Now that measurement invariance across ethnic groups and across levels has been established in Chapter 7, the full multigroup model can be specified. Figure 8.1 depicts the steps completed and those which remain (in white) and will be covered in the present chapter. In this chapter, the Multi-Group Multilevel Structural Equation Modelling (MG-MSEM) approach is introduced, followed by descriptive information relating to the variables included in the analysis. The conceptual framework, hypotheses and full MG-MSEM model are then presented. Finally, several sensitivity analyses and robustness check are performed.

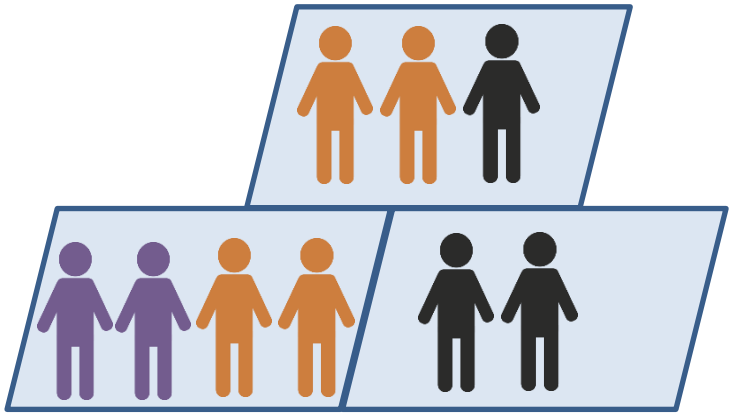
Figure 8-1 - Chapter 8 MG-MSEM process flow chart



8.1 Introducing MG-MSEM

As described previously, the nested structure of the data (individuals within areas) is taken into account and modelled using the MSEM approach, by decomposing the variance-covariance matrices into two, the 'within' (individual) and 'between' (area) parts (Silva et al., 2019). However, the main research question of this thesis relates not only to the cross-level paths between ethnic density and mental health, but whether these differ across ethnic groups. Therefore, there is an additional clustering variable, ethnicity, which has to be specified in order to obtain ethnic group-specific estimates. This additional grouping variable is therefore at the individual level, rather than at the area level. As explained by Asparouhov and Muthén 2012 "[a] model with a within level group variable is generally more difficult to estimate because the fundamental equation (6) does not generally hold"… "each cluster now contains observations from different groups and the cluster level random effects can be different in all the groups" (Asparouhov and Muthén, 2012, p.7). In the case of this thesis, this means that areas may contain individuals who belong to different ethnic groups, as demonstrated below in Figure 8.2. The model therefore allows the estimated effects of clusters (areas) to vary across ethnic groups, meaning it is possible to assess if ethnic density has different effects across the different ethnic groups. Webnote 16, published by Mplus, describing the multi-group multilevel modelling approach was followed, specifically using Appendix E (Asparouhov and Muthén, 2012, p.24).

Figure 8-2 - Depiction of multilevel data with a within-level grouping variable used in this project



Key

= represents LSOAs

= represents individual survey respondents. Colours represent different ethnic group categories.

A note on general MSEM language

In the following, 'cluster' refers only to areas (LSOA) within which individuals are nested, and the term 'group' is used to refer only to ethnic groups (the sets of sample respondents who identified with the same ethnic group category). In addition, 'individual-level' is used only to refer to the effects observed at the person-level (referred to as 'within' or 'L1' in the wider literature), whereas 'area-level' is used only to refer to the effects observed at the area-level (referred to as 'between' or 'L2' in the wider literature).

Graphical depiction and notation

The graphical depiction employed here is based on that of Silva and colleagues (2019) and a key detailing the meaning of each element of these graphs is shown in the following figure (Figure 8.3). The black dots at the end of an arrow indicate a random intercept, based on the traditional depiction of these models established by Muthén & Muthén (2017). Rectangles denote directly observed variables, whereas circles denote latent (or not directly observed/model derived) variables. Arrows with one head indicate a direct path from the variable of origin to the variable in which the arrow ends. Arrows with a head at each end between variables denote covariance (joint variability of two variables), and when a double headed arrow originates and ends at the same variable, this denotes measurement error (or residual/unexplained variance). The notation style used for the models presented is also derived from Silva and colleagues (2019) who draw on standard MLM notation and the style of Raudenbush and Bryk (2002) to clearly denote the differing models for the coefficients on both levels of analyses.

Figure 8-3 - SEM graphical notation key

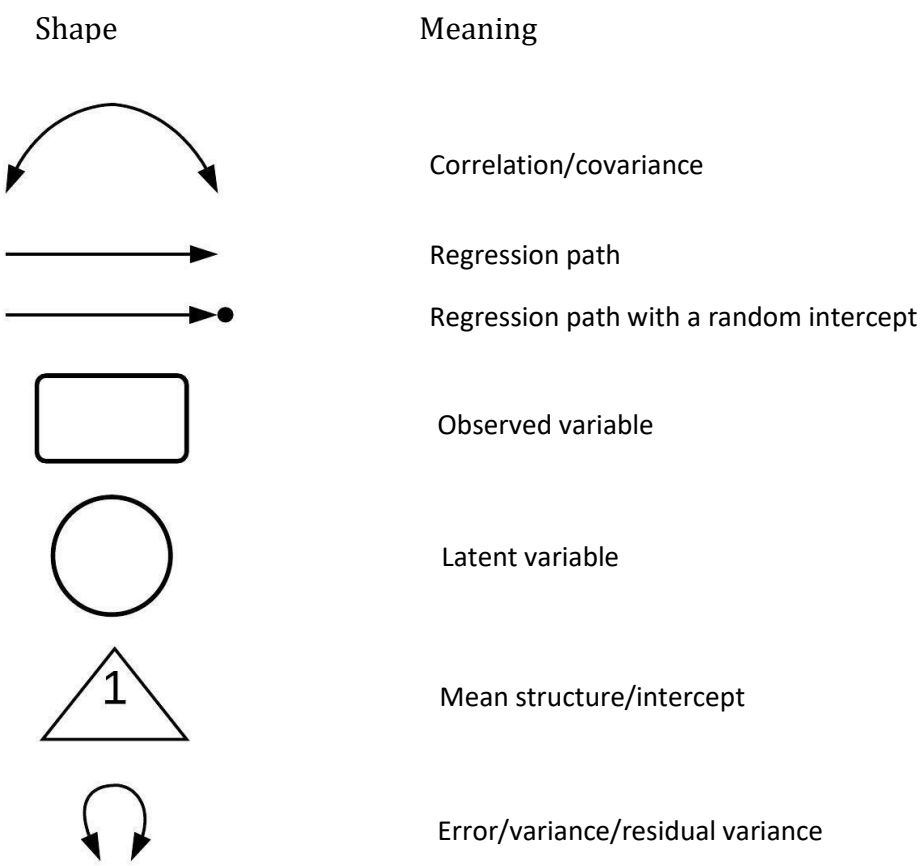


Figure 8.3 adapted from Silva et al., 2019

8.2 MG-MSEM model description and notation

MG-MSEM addresses the need to model a within-level grouping variable in a multilevel analysis, rather than a cluster-level grouping variable. This presents additional computational challenges to typical MSEM. The following notation can be used to describe this model.

$$Y_{ijg} = Y_{Wijg} + Y_{Bjg} \quad (1)$$

$$Y_{Wijg} \sim N(\mu_{1g}, \Sigma_{1g}) \quad (2)$$

$$Y_{Bj.} \sim N(\mu_{2.}, \Sigma_{2.}) \quad (3)$$

$$Y_{Bjg} \sim N(\mu_{2g}, \sigma_{2g}) \quad (4)$$

$$Cov(Y_{Bj1}, Y_{Bj2}) = \rho. \quad (5)$$

The MG-MSEM approach is described in a series of equations above, using the example of a two-group model, where the grouping variable is gender in a context of students nested within classrooms. The notation for these models follows the standard conventions for expressing multilevel models. For example, in terms of equation (1), 'Y_{ijg}' is the observed variable for the *i*th person in the *j*th cluster in group *g*, with the 'W' and 'B' parts referring to the 'within' and 'between' parts with the model, which are additive and uncorrelated. Importantly, in the MG-MSEM framework, the groups share variables, which means that the log-likelihood cannot simply be summed across groups and indeed it is not possible to identify group-specific log-likelihoods. Clusters (areas) here contain individuals from different groups (ethnic categories), such that in this analysis, survey participants from different ethnic groups may be found within the same area.

Equation (2) describes how the 'within' level components of the model are separate for each group. In terms of equation (3), as succinctly described by Asparouhov and Muthén "$Y_{Bj.}$ is a vector that contains all the random effects for all the groups $Y_{Bj.} = (Y_{Bj1}, ..., Y_{BjG})$. The mean vector $\mu_{2.}$ and the variance covariance matrix $\Sigma_{2.}$ give the joint distribution of all the random effects $Y_{Bj.}$ and thus the random effects in cluster *j* for the different groups can be correlated." (2012, p.7). This means that the average between-level effect can differ across the groups employed and that these effects are correlated, as members of different groups can be found in the same cluster. This is shown in equations (4) and (5). In equation five the correlation of the random effects of the between-level

variables are shown, whereas in a model with the grouping variable at the between (cluster) level, these are modelled as not correlated.

8.3 Descriptive information for the variables included in MG-MSEM analyses

In the following, descriptive information for each of the variables included in the model is presented and discussed in relation to their appropriateness for MG-MSEM.

Variable correlations

Table 8.1 below shows the correlations between the key continuous variables of interest. The largest correlation observed was between the Favours (item C) cohesion variable and the Advice (item D) cohesion variable (0.58***). All other correlations were below 0.5, suggesting that multicollinearity was not present between any of the variables. In addition, the largest correlations observed were between items of the cohesion scale. Additional testing of the Variance Inflation Factor (VIF) produced values of no greater than 1.75 which is lower than the most conservative upper limit of 5 (James et al., 2013) and all tolerances for each variable were greater than 0.1, suggesting that issues of multicollinearity are not present in these data.

Table 8-1 - Correlation matrix of key continuous and ordinal variables

		1	2	3	4	5	6	7	8	9	10
1	Minority density	1.00									
2	GHQ-12	0.02	1.00								
3	Age	-0.06**	0.07***	1.00							
4	Household income	-0.20***	-0.12***	0.08***	1.00						
5	EID	0.44***	0.09***	-0.10***	-0.36***	1.00					
6	Cohesion: Belonging	-0.02	0.02	-0.00	0.01	0.02	1.00				
7	Cohesion: Friendships	-0.01	-0.00	-0.00	-0.03	0.00	0.50***	1.00			
8	Cohesion: Advice	-0.04	0.14***	-0.12***	0.06**	-0.03	0.04	-0.01	1.00		
9	Cohesion: Favours	-0.03	0.07***	0.02	0.05*	-0.01	0.00	-0.04	0.58***	1.00	
10	Cohesion: Stop and talk	-0.02	0.10***	-0.16***	0.08***	-0.01	-0.01	-0.06**	0.49***	0.40***	1.00

Between-level variance of the key outcome variables

The ICC shows the proportion of the variance accounted for by area level. Table 8.2 shows that the percentage of variance for each of the key variables of interest at the between level is over 10%, suggesting that there is a substantial amount of variance at the between-level which is required for MSEM (Silva et al., 2019).

Table 8-2 - ICCs of final included outcome variables

Variable	ICC
Cohesion: belonging	0.116
Cohesion: friendships	0.113
Cohesion: advice	0.147
Cohesion: favours	0.134
Cohesion: stop and talk	0.133
racism	0.111
GHQ-12	0.137

Continuous variable descriptive statistics

Assumptions of SEM include normal distributions of included variables. Measures of skewness and kurtosis are presented in Table 8.3. Following the guide thresholds presented by Kline (2015), skewness values between -3 and +3 and kurtosis values between -10 and +10 were considered acceptable (pp.76-77). As shown in Table 8.3, all of the variables of interest fell within the acceptable range and for these reasons, transformation was not required.

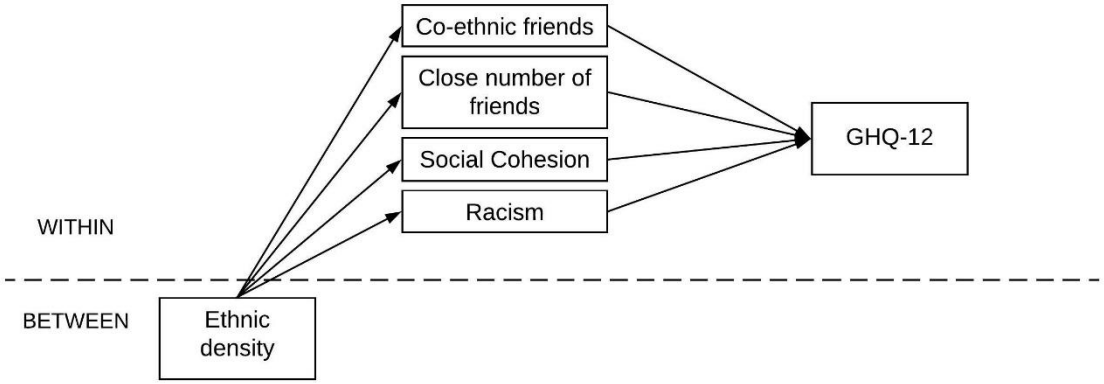
Table 8-3 - Descriptive statistics for the key continuous variables

Variable	Range	Number of missing values	Mean	Standard deviation	Skewness	Kurtosis
Cohesion: Belonging	1-5	1	2.29	0.88	0.71	3.70
Cohesion: Friendships	1-5	4	2.39	0.90	0.58	3.44
Cohesion: Advice	1-5	0	2.73	1.08	0.42	2.44
Cohesion: Favours	1-5	0	3.08	1.18	0.06	1.39
Cohesion: Stop and talk	1-5	0	2.41	0.97	0.67	0.94
GHQ-12	0-36	0	11.29	6.00	1.14	4.67
Ethnic density	1.00 – 97.8	0	63.94	25.13	-0.76	2.50

8.4 Fitting the full MSEM

The diagram in Figure 8.4 presents the theoretical model that this thesis aimed to test, inspired by the existing evidence on the ethnic density effect reviewed in Chapter 3 using variables available from UKHLS Wave 3.

Figure 8-4 - Conceptual framework



This model contains all three of the key variables operating between ethnic density and mental health of interest highlighted by the systematic review (with social support measured both via co-ethnic friends and close number of friends). In addition, although not shown above, two other elements were originally specified. The first of these was a moderation path operating on an indirect path , whereby the slopes of the variables involved in the indirect paths are conditional upon the level of ethnic density. The second of these was a random slopes specification for the latent social cohesion variable, as well as intercepts (i.e. the slopes of the indicators were allowed to vary across areas) based on the finding of the invariance analyses shown in Chapter 7 section 7.8. As is evident from the above diagram, this model is complex and ambitious, particularly for data with a complex structure modelled using MG-MSEM. With this complexity in mind, the full model was specified. However, the model was too complex for the software and data available. Therefore, changes had to be made to the proposed model. The goal was to specify a model that could be run while remaining close to the original conceptual framework and enabling some of the main research questions to be addressed. A process of stepwise model simplification was undertaken in order to arrive at this compromise.

Firstly, despite the random slopes model indicating better fit in Chapter 7 section 7.8, in the interests of parsimony and considering the lack of any specific theoretical justification for their inclusion,

these were removed. Removing the random slopes part of the model reduced the model complexity, but not enough to allow the model to run. Secondly, an approach of using single-item factor indicators based on Hayduk and Littvay (2012) was tested as an option to reduce model complexity without having to alter the theoretical model. In this approach, a variable containing the average of the items replaces the items themselves and the loading is fixed to be 1 and the error term is specified based on the results of the measurement model. However, implementing this did not reduce model complexity enough to allow the model to run and preliminary results suggested that implementing this produced bad model fit. Based on this, the single item indicator approach was abandoned.

Finally, as a last resort, modifications to the theoretical model had to be made. The results of the systematic review were consulted, considering the volume of high quality evidence and theoretical justification, along with the results of the preliminary analyses in Chapter 6. Pathways were then removed from the model in a stepwise fashion, starting from those with the poorest quality evidence and least established theoretical justifications. Two pathways had to be removed before it was possible to run the model. These pathways were the two social support measures: number of close friends and co-ethnic friends. The remaining pathways were racism and social cohesion. This simplified conceptual framework and its associated hypotheses are described below in section 8.5 Figure 8.5.

Ethnic density measure employed

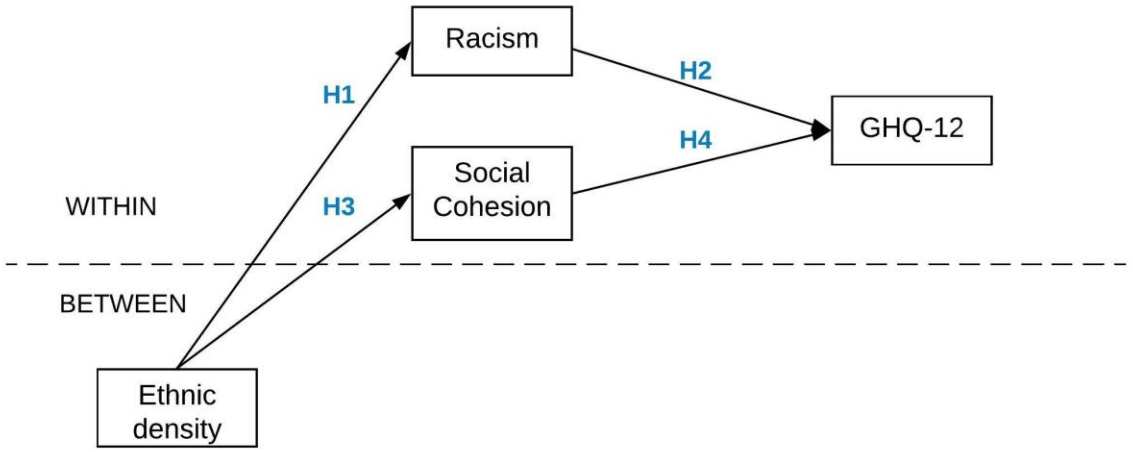
It would have been preferable to use ethnic group-specific density variables at the between-level, rather than overall minority ethnic density. In Chapter 5 it was demonstrated that the distribution of own-group density is much more similar to overall minority ethnic density in some ethnic groups than others. In addition, it was demonstrated in Chapter 6 that the associations between the hypothesised mediating variables and ethnic density varied depending on the density measure used. However, despite the model allowing for different between-level averages of between-level variables across groups, it assumes that the cluster-specific estimate for between-level variables is the same for all the individuals within that cluster. For this reason, it was only possible to use overall minority ethnic density in the model.

8.5 MG-MSEM model and pathways

Based on the theories and pathways proposed, and the empirical evidence available to date, this study tests a theoretical framework based upon two indirect pathways. The below figure (Figure 8.5)

shows these paths with the hypothesis for each path indicated in blue and then elaborated upon in greater detail below.

Figure 8-5 - Conceptual framework tested and associated hypotheses



Research Questions:

3d *Is there statistically significant evidence of cross-level indirect effects for the hypothesised mediating factors?*

3e *Are the paths to and from the indirect paths different across ethnic groups?*

Hypotheses:

H1 - Living in areas with higher overall minority ethnic density levels are associated with reduced likelihood of reporting racism

H2 - At the individual level, not experiencing racism compared with experiencing racism is associated with lower GHQ-12 scores (better mental health)

H3 - Living in areas with higher overall minority ethnic density is associated with higher social cohesion levels

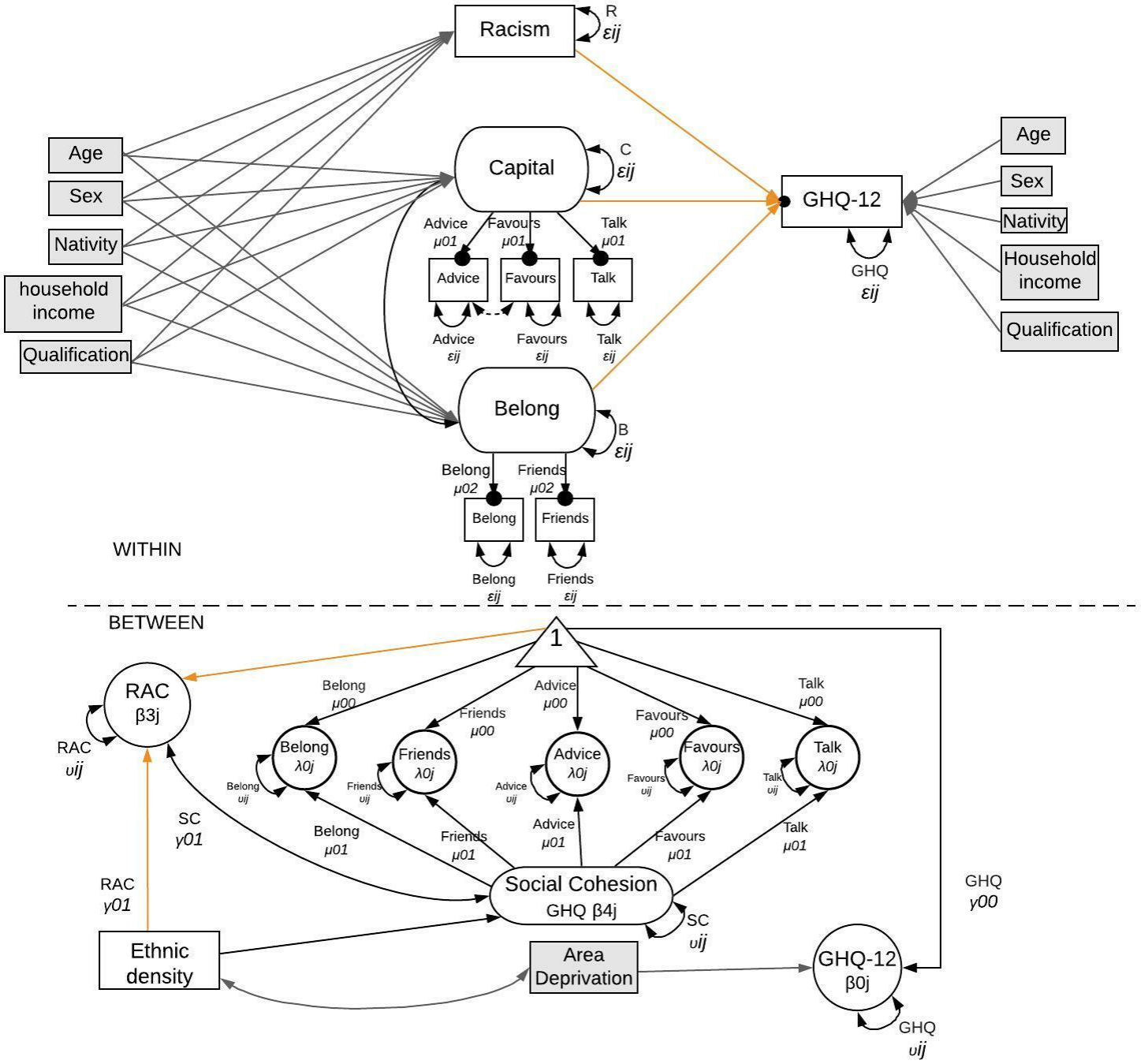
H4 - At the individual level, higher social cohesion levels (on both factors) are associated with lower GHQ-12 scores (better mental health)

H5 - (not depicted in Figure 8.5) - These associations will differ across ethnic groups.

In order to address these research questions, the multilevel measurement model defined in Chapter 7 is combined with the structural part of the model. Therefore, based on the analyses in Chapter 7, social cohesion is included in the model as having two factors at the individual level. These are 'social capital' (made up of three questions: "if I needed advice about something, I could go to someone in my neighbourhood", "I borrow things and exchange favours with my neighbours", and "I regularly stop and talk with people in my neighbourhood") and 'belonging' (made up of two questions: "I feel like I belong to this neighbourhood", and "the friendships and associations I have with other people in my neighbourhood mean a lot to me"). However, social cohesion is measured as just one latent factor at the area level, with all five of the above questions loading onto one factor.

Figure 8.6 shows this full model estimated within Mplus, including control variables (shown in grey) and the paths which are set to vary across ethnic groups (shown in orange). The multigroup element of the model is not explicitly shown here.

Figure 8-6 - Diagrammatic representation of the final model



8.5.1 Model summary

The path diagram is divided into the 'within' (individual) and the 'between' (area) parts. In the 'within' part, paths are drawn between variables at the individual level. In the model, two latent variables for social cohesion are included, along with two covariance arrows, one between the two factors and one between indicators C and D, to reflect the findings of the measurement model process (Chapter 7). In addition, one other observed indirect path (through racism) is included. The paths from all three intermediate variables end at GHQ-12 with a circle to indicate a random slope. Five control variables are included (age, sex, nativity, household income and highest qualification) which are drawn (in grey) as regression paths to the relevant variables.

In the 'between' part, all variables measured at individual level, but modelled at the 'between' (area) level are model-estimated and are therefore not directly observed (and hence are denoted by a circle). Only variables directly measured at the area level are presented in rectangles. These are minority ethnic density, and area deprivation. Ethnic density predicts the random intercepts of each of the indirect pathways and is modelled as co-varying with area deprivation due to the known interdependence of the two variables. Finally, at the between-level, a path from area deprivation to mental health is specified as a control for the direct effect of area deprivation on mental health. The triangle shown denotes the mean structure.

8.6 Assessing model fit in MSEM

Before presenting the results of these analyses, it should be noted that the usual fit statistics for multilevel models are not available for the model type employed. Therefore, model fit is instead evaluated using AIC and BIC estimates for nested models. Table 8.4 shows the fit indices and AIC and BIC estimates for nested, sequential models, using the pooled sample. These models are: 1) a simple random intercept model with the full model at the 'within' part specified and one random intercept specified at the 'between' level only (the effect of ethnic density on racism), 2) a model which, building on the previous model, includes all the other latent covariate paths (GHQ-12), and 3) the full model with all paths and the latent variable at the between level added in.

Table 8-4 - Pooled sample model comparison (i.e. not multigroup)

Model	AIC	BIC	Model fit indices
1. Random intercept	35926.59	36201.17	Chi= p<0.001, CFI= 0.968, TLI= 0.933, RMSEA= 0.046, SRMR between= 0.083, SRMR within= 0.023
2. Random intercept + latent covariates	34277.87	34593.36	Chi=p<0.001, CFI=0.969, TLI= 0.930, RMSEA= 0.047, SRMR between= 0.060, SRMR within=0.024
3. Random intercept + latent covariates + latent factor (*estimated with two level random Monte Carlo integration*)	34212.13	34574.35	Not available

Here, we can see that, the AIC and BIC estimates for the final model (3) are lower than the previous two models, indicating better fit. In addition, the full fit statistics for the previous two models also showed good fit. These results suggest that the full (non-multigroup) model specification fits the data well. Therefore, it is acceptable to proceed to the full, multigroup model, now that it has been established that the structural model has good fit. A multigroup, non-multilevel version of the model fit is not presented for comparison here as this model is not nested within the above models. Instead, the fit of this model is presented alongside the results tables.

Mplus has a limit of 1,000,000 in the variance of any variable included in the model and runs optimally when variances are smaller (Muthén and Muthén, 2017). Therefore, in order for the model to run efficiently, some variables had to be rescaled in order to reduce their variance. In addition, 'overall minority ethnic density' was rescaled so that a one-unit change represented a 10% increase, rather than a 1% increase in order to aid interpretation, following standard convention in the existing literature (Bécares and Nazroo, 2013; Bécares et al., 2012; Schofield et al., 2016b; Das-Munshi et al., 2010). The following variables were rescaled (by dividing the variable by the specified integer) using the integers as presented in Table 8.5. For clarity, in the following the results of the final full model are presented in two tables, one presenting the individual-level paths (Table 8.6), and the other presenting the area-level paths (Table 8.7).

Table 8-5 - Variance reduction of variables

Variable	Variance reduced by a factor of:
Deprivation	10000
Household income	10000
Minority ethnic density	10

8.7 MG-MSEM results

Table 8-6 - MG-MSEM: Individual-level results for each ethnic group

	Indian beta (SE) N_i = 653 N_j= 320	Pakistani beta (SE) N_i = 570 N_j= 255	Bangladeshi beta (SE) N_i =394 N_j= 143	Black Caribbean beta (SE) N_i =459 N_j= 311	Black African beta (SE) N_i =489 N_j= 305
'Within'/ individual level					
Factor loadings					
(Belong)- Belong	0.55*** (0.09)	0.55*** (0.09)	0.55*** (0.09)	0.55*** (0.09)	0.55*** (0.09)
(Belong)- Friends	0.71*** (0.03)	0.71*** (0.03)	0.71*** (0.03)	0.71*** (0.03)	0.71*** (0.03)
(Social Capital)- Advice	0.72*** (0.19)	0.72*** (0.19)	0.72*** (0.19)	0.72*** (0.19)	0.72*** (0.19)
(Social Capital)- Favours	0.54** (0.18)	0.54** (0.18)	0.54** (0.18)	0.54** (0.18)	0.54** (0.18)
(Social Capital)- Talk	0.50*** (0.08)	0.50*** (0.08)	0.50*** (0.08)	0.50*** (0.08)	0.50*** (0.08)
Regression paths					
Racism -> GHQ-12	2.634*** (0.869)	3.813** (1.255)	0.911 (1.234)	-1.242 (0.512)	-0.751 (0.963)
Belong -> GHQ-12	2.937 (8.087)	-7.336 (33.436)	-0.156 (11.201)	7.758 (24.237)	7.999 (27.190)
Social Capital -> GHQ-12	-1.692 (7.125)	-1.33 (34.072)	2.063 (12.247)	-6.524 (23.341)	-6.999 (26.467)
Covariances					
Belong with Social Capital	0.96*** (0.19)	0.96*** (0.19)	0.96*** (0.19)	0.96*** (0.19)	0.96*** (0.19)
Advice with Favours	0.19* (0.08)	0.19* (0.08)	0.19* (0.08)	0.19* (0.08)	0.19* (0.08)

*p<0.05 ** p<0.01 *** p<0.001

Model adjusted for: age, sex, nativity, household income (equivalised) and highest qualification. AIC= 60172.910, BIC= 61189.467

Table 8-7 - MG-MSEM: area-level results for each ethnic group

	Indian beta (SE) N_i = 653 N_j= 320	Pakistani beta (SE) N_i = 570 N_j= 255	Bangladeshi beta (SE) N_i =394 N_j= 143	Black Caribbean beta (SE) N_i =459 N_j= 311	Black African beta (SE) N_i =489 N_j= 305
'Between'/ area level					
Factor loadings					
(Social Cohesion)- Belong	0.28 (0.23)	0.28 (0.23)	0.28 (0.23)	0.28 (0.23)	0.28 (0.23)
(Social Cohesion)- Friends	0.24*** (0.07)	0.24*** (0.07)	0.24*** (0.07)	0.24*** (0.07)	0.24*** (0.07)
(Social Cohesion)- Advice	0.34 (0.23)	0.34 (0.23)	0.34 (0.23)	0.34 (0.23)	0.34 (0.23)
(Social Cohesion)- Favours	0.36 (0.24)	0.36 (0.24)	0.36 (0.24)	0.36 (0.24)	0.36 (0.24)
(Social Cohesion)- Talk	0.32*** (0.08)	0.32*** (0.08)	0.32*** (0.08)	0.32*** (0.08)	0.32*** (0.08)
Regression paths					
Minority density -> Social Cohesion	0.002 (0.045)	0.002 (0.045)	0.002 (0.045)	0.002 (0.045)	0.002 (0.045)
Deprivation -> GHQ-12	-2.097 (1.850)	1.333 (2.111)	-0.327 (3.252)	4.205 (2.424)	2.365 (2.451)
Minority density -> Racism	-0.016** (0.005)	0.000 (0.005)	-0.011 (0.010)	-0.013* (0.005)	-0.020** (0.007)
Covariances					
Racism with Social Cohesion	0.027* (0.012)	0.027* (0.012)	0.027* (0.012)	0.027* (0.012)	0.027* (0.012)
Minority density with Deprivation	0.150*** (0.010)	0.150*** (0.010)	0.150*** (0.010)	0.150*** (0.010)	0.150*** (0.010)

*p<0.05 ** p<0.01 *** p<0.001

Model adjusted for: age, sex, nativity, household income (equivalised) and highest qualification. AIC= 60172.910, BIC= 61189.467

Tables 8.6 and 8.7 show the results of the MG-MSEM analysis. The estimates for the hypothesised control variables are not presented in these tables. More detailed tables which present this information are included in the appendix (section 10.11, Table 10.8). The effects which were allowed to vary across ethnic groups are shown, along with those which were fixed (shown with a grey background). The model was run with the Maximum Likelihood estimator and using Monte Carlo integration. The remainder of this chapter will discuss the results of the MG-MSEM in relation to the hypotheses specified at the start of the chapter. Diagrams depicting the results of the model per ethnic group are included in the appendix, section 10.12.

8.7.1 The overall model

A number of estimates were not set to vary across ethnic groups. These included factor loadings and the covariances specified which were not set to vary across groups. The covariance between factors one and two is positive, implying that the values of these factors increase together. This finding is expected, as worse values of belonging logically are also related to worse values of social capital. The covariance between indicators C ("If I needed advice about something I could go to someone in my neighbourhood") and D ("I borrow things and exchange favours with my neighbours") is also positive, suggesting that higher (worse) scores on C are associated with higher (worse) score on D. At the 'between' level, the covariance between racism and cohesion indicates experiencing racism compared with not having experienced racism is positively associated with social cohesion (with higher scores meaning worse cohesion). Finally, minority ethnic density and area deprivation are significantly positively correlated. This follows established knowledge of the association between high ethnic density and area deprivation (Das-Munshi et al., 2010; Stafford et al., 2009; Bécares et al., 2012b).

In the following, the results of the models are discussed in relation to each pathway hypothesis.

8.7.2 Racism pathway (H1 and H2)

H1- Living in areas with higher overall minority ethnic density levels are associated with reduced likelihood of reporting racism

Evidence was found to support hypothesis 1 for the Indian, Black Caribbean and Black African groups. Table 8.7 shows that, per one unit increase in minority ethnic density at the area level, the predicted log odds of experiencing racism compared to not having experienced racism is largest for the Black African group (β= -0.020** (SE= 0.007)), followed by the Indian group (β= -0.016** (SE=

0.005)) and then the Black Caribbean group (β= -0.013* (SE= 0.005)). These results suggest that higher minority ethnic density at the LSOA level was associated with a reduced likelihood of experiencing racism for these ethnic groups. It is important to note however that these estimates are very small, but that small effect sizes at the between level are common in MSEM. However, no statistically significant effects were observed in either the Pakistani or Bangladeshi groups.

H2- At the individual level, not experiencing racism compared with experiencing racism is associated with lower GHQ-12 scores (better mental health)

Table 8.6 shows the results of the pathway between racism and mental health across ethnic groups. Support for this hypothesis was found only in the case of the Indian and Pakistani groups, whereby experiencing racism compared with not having experienced racism was associated with significantly worse mental health by a factor of 2.634*** (SE= 0.869) and 3.813** (SE= 1.255) respectively. These coefficients are large and suggest racism substantially worsens mental health in these groups. The coefficients for the Bangladeshi, Black Caribbean and Black African groups were not statistically significant.

Racism pathway summary

Reviewing both the individual level and area level elements of the indirect pathway, evidence is found only for a full indirect effect in the Indian group, for whom higher minority ethnic density was associated with lower odds of experiencing racism, and experiencing racism was associated with worse mental health. For this group, the total indirect effect of ethnic density on mental health via racism is -0.042* (SE= 0.019).

8.7.3 Social cohesion pathway (H3 and H4)

H3- Living in areas with higher overall minority ethnic density is associated with higher social cohesion levels

Table 8.7 shows the results of this pathway at the area level. Unfortunately, based on model limitations, it was not possible to allow this measure to vary by ethnic group and just one estimate was provided for all the ethnic groups combined (0.002, SE 0.045). Therefore, the model provided no evidence in support of this hypothesis.

H4- At the individual level, higher social cohesion levels (on both measures) are associated with lower GHQ-12 scores (better mental health)

Table 8.6 shows the results of the path between the two cohesion factors and mental health. No statistically significant effects were observed for either of the two cohesion factors in any ethnic group. Therefore, the hypothesis of higher social cohesion being associated with better mental health was not supported.

Social cohesion pathway summary

Reviewing both the 'within' and 'between' pathway elements, no evidence was found for an indirect effect of social cohesion across any of the ethnic groups. The possible meaning and reasons for this are discussed below in section 8.8.

8.7.4 H5- These associations will differ across ethnic groups

The model results presented in both tables demonstrate statistically significant effects for some groups and not others. However, in the groups in which statistically significant effects are found, the estimates are in the same direction, although the effect size varies somewhat. Model tests were performed using the Satorra-Bentler scaled chi square difference test (using the loglikelihood) (Satorra and Bentler, 2001) for nested model comparison. Two additional models were run, one in which coefficients were constrained to be equal for the path between racism and GHQ-12 across ethnic groups, and one in which coefficients were constrained to be equal for the path between minority density and racism. These models were each compared to the final full model using the Satorra-Bentler test, using the log likelihood, scaling correction factors and number of free parameters estimated by each model.

The result of this test for the model where the path between racism and mental health was constrained was not statistically significant, suggesting that the paths did not differ significantly (x^2= 2.628, d.f.=4, p>0.05). In other words, allowing the path coefficient to vary across ethnic groups did not produce a better-fitting model. This suggests that the path between racism and mental health did not vary significantly across ethnic groups. However, the result for the model where the path between ethnic density and racism was constrained was statistically significant, suggesting that the paths differed significantly (x^2= 34.138, d.f.=4, p<0.001). In other words, allowing the path coefficients to vary across ethnic groups produced a better-fitting model. This suggests that the path between ethnic density and racism varied significantly across ethnic groups.

8.8 Discussion

This analysis demonstrates evidence of the detrimental impact of racism on the mental health of some ethnic groups, and most importantly, supports the contention that ethnic density is associated with lower likelihood of experiencing interpersonal racism in three of the five ethnic groups: Indian, Black Caribbean and Black African. In addition, evidence for an indirect pathway between minority ethnic density and mental health via the experience of racism was found in the Indian group. The post-analysis Satorra-Bentler tests performed suggested that the coefficients for the area level but not the individual level part of the pathway varied significantly across ethnic groups. In other words, the association between overall minority ethnic density and the likelihood of experiencing racism differed significantly across ethnic groups. However, the association between racism and mental health did not vary significantly across ethnic groups.

Theoretically it is not implausible to suggest that the association between racism and mental health is likely similar, regardless of ethnic group. However, overall minority ethnic density may be differentially associated with the likelihood of experiencing racism depending on two factors. Firstly, overall minority density may be a better proxy for own-group density for some groups compared with others (as demonstrated in the differing distributions of own-group and overall minority ethnic density in Chapter 5), with the theory being that own-group density may be more strongly associated with racism than overall minority density. Secondly, overall minority density may be differentially associated with racism across groups due to different patterns of the perpetrators of racism towards different ethnic groups. For example, some groups may experience more racism from other minority ethnic groups than others, as well as experiencing racism from the White British group. This might explain why overall minority ethnic density could have a less negative association, or indeed a null association, with the likelihood of experiencing racism for some ethnic groups.

Racism

The lack of evidence supporting an association between racism and mental health for the Bangladeshi, Black Caribbean and Black African groups is puzzling. However, these findings are similar to the findings of the regression analyses assessing the adjusted association between racism and mental health conducted in Chapter 6, in which the results for the Black Caribbean and Black African groups were also not statistically significant. One explanation for the lack of evidence for the Black Caribbean group could be the smaller sample size of those who reported having experienced racism compared with the other ethnic groups as shown in Chapter 6, Table 6.1). Relatedly, one

explanation for the lack of statistical significance in the Bangladeshi sample is possibly a result of the overall sample size of this group, which has the smallest sample of the ethnic groups analysed (n=394). However, the lack of statistical significance in the Black Caribbean group is especially surprising as previous studies have demonstrated detrimental associations between racism and mental health for this ethnic group in particular (Das-Munshi et al., 2012; Bécares et al., 2009; Astell-Burt et al., 2012). At least two of these studies (Das-Munshi et al., 2012; Bécares et al., 2009) employed adult samples and modelling techniques which rendered their samples representative, and each showed reports of racism to a similar or higher level to the other ethnic groups assessed. It is possible that the present results could be explained by the sample employed, which is not representative of the general population due to missingness and the lack of inclusion of sampling weights. However, it is worth noting that the black Caribbean ethnic group comprised the second smallest percentage of the missing sample after the White British group (8.67%).

The fact that minority ethnic density was protective of racism for the Indian, Black Caribbean and Black African groups is also interesting to consider. Although it was not possible to use 'own group density' here, the results suggest that living in an area with a higher proportion of people from any minority ethnic group may be protective. This has implications for some of the theories proposed earlier in the thesis (discussed in greater detail in Chapter 9). Other explanations of the differing findings could be, as described above, that the overall minority ethnic density measure may be a better proxy of own-group density for some groups than others. However, Figure 5.6 in Chapter 5 and Figure 10.1 included in the Appendix showing the distribution of these different density measures by ethnic group interestingly suggest that the densities of the Black Caribbean and Black African groups have the least overlap with the distribution of overall minority ethnic density. This suggests the differing results are unlikely to be explained by overall minority ethnic density operating as a proxy for own-groups density.

Social cohesion

The lack of statistical significance for the social cohesion variable at both levels of analysis is also interesting, given that the composite measures was consistently associated with mental health across all ethnic groups in Chapter 6. However, as shown in Chapter 6 Table 6.3, although social cohesion was associated with own-group ethnic density for all but the Black Caribbean and Black African groups, the overall measure was statistically significant for the Pakistani group only, and the coefficient was weaker. This might suggest that the lack of evidence for a pathway between density

and cohesion at the between level may be due to overall minority ethnic density having less of an association with social cohesion than own-group density.

Finally, it should be noted that the results of an earlier version of the model which did not include estimated covariance between the two social cohesion factors showed a statistically significant path coefficients between Factor 1 (Belonging) and GHQ-12 for some groups (Indian, Bangladeshi, Black Caribbean and Black African). The estimates for these groups suggested worse Belonging was associated with worse mental health. However, this model had poor fit and it was necessary to include the covariance between the factors in order to achieve adequate model fit. Therefore, the results of this preliminary model are not included here. It is possible that the inclusion of this covariance masks the direct effect of Factor 1 (Belonging) on mental health. However, the covariance between the two factors was large and it was necessary both in terms of theory and in terms of the model fit to include it. It could have been possible, using a data driven method, to retain only Factor 1 (Belonging), and discard Factor 2 (Social Capital) based on its non-significance. However, the theoretical framework tested here reflected that of 'social cohesion'. In removing Factor 2, only items relating to belonging would remain, which alone do not constitute social cohesion. Alternatively, it may provide evidence that 'social cohesion' as a whole is less important in the ethnic density effect, compared to certain specific elements of it such as belonging (or indeed other constructs not included in the survey). The measurement of social cohesion as a factor variable in this thesis has many benefits, however its measurement is ultimately limited to the questions available in the survey.

8.9 Robustness checks and sensitivity analyses

The MG-MSEM employed here is novel and there are currently no published examples of these models or discussions of their performance in comparison to other models. Therefore, a number of sensitivity analyses and robustness checks were performed in order to assess the functioning of the model, as well as to address the possibility of selection bias in distorting the results observed.

1. Pooled sample MSEM

Firstly, a pooled version of the sample was modelled in a non-multigroup Multilevel SEM (MSEM) framework. Table 8.8 showing the results for this model is presented below.

Table 8-8 - Pooled sample MSEM model

	Beta (SE)
Within	
Factor loadings	
(Belong)- Belong	0.556 (0.033)***
(Belong)- Friends	0.710 (0.031) ***
(Social Capital)- Advice	0.747 (0.054) ***
(Social Capital)- Favours	0.529 (0.056) ***
(Social Capital)- Talk	0.530 (0.031) ***
Regression	
Racism -> GHQ-12	1.662 (0.577)**
Belong -> GHQ-12	2.817 (1.017)**
Social Capital -> GHQ-12	-1.561 (1.005)
Covariances	
Belong with Social Capital	0.922 (0.024)***
Advice with Favours	0.179 (0.024)***
Between	
Factor loadings	
(Social Cohesion)- Belong	0.298 (0.053) ***
(Social Cohesion)- Friends	0.282 (0.046) ***
(Social Cohesion)- Advice	0.349 (0.095) ***
(Social Cohesion)- Favours	0.430 (0.090) ***
(Social Cohesion)- Talk	0.300 (0.049) ***
Regression	
Minority Density -> Social Cohesion	0.022 (0.012)
Deprivation -> GHQ-12	1.354 (1.017)
Minority Density -> Racism	-0.012 (0.003)***
Covariances	
Racism with Social Cohesion	0.022 (0.012)
Minority Density with Deprivation	0.150 (0.010)***
Indirect effect	
Minority Density -> Racism -> GHQ-12	-0.020 (0.009)*

(AIC= 52066.384, BIC= 52428.605)
*p<0.05 ** p<0.01 *** p<0.001
Unstandardised, estimated using maximum likelihood

The results from the model using the pooled sample show similar associations to those observed in the ethnic-group specific estimates of the final model. However, we see that in this model, Factor 1 (Belonging) is statistically significant, and suggests that higher scores on this factor (meaning greater disagreement with statements related to belonging, i.e. a lesser sense of belonging) predict worse mental health. The coefficients for racism on mental health, and density on racism are both in the same direction as those observed in the multigroup models and are statistically significant. That no

strikingly different estimates were obtained suggests that the MG-MSEM modelling strategy does not appear to be causing any clear large bias to the estimates in comparison to a standard MSEM.

2. Individual group MSEM

As an additional sensitivity analysis, MSEMs were run on the separate ethnic group samples. However, estimation issues were encountered when running these models on both the Black African and Black Caribbean groups. This is likely due to the small overall sample size for each of these groups, coupled with their high number of clusters (meaning that on average there are fewer participants per area for these two groups) (Table 10.3 showing the average sample size per area for each ethnic group is included in the Appendix). Similar estimation issues are not encountered in the full multigroup model likely due to the fact that sample members from other ethnic groups add to the average sample size per cluster. As a result of this computational issue, it was possible to run separate models only for the Indian, Pakistani and Bangladeshi groups. Table 10.9 is included in the appendix (section 10.13) detailing the results of these ethnic group specific models.

In these models, effects which were statistically significant in the multigroup model were also significant in the separate models, and no additional statistically significant effects were identified in these models. Furthermore, the effect directions are the same. However, it appears that the effect sizes are slightly larger in the multigroup model than the individual group models, which could suggest that the results of the final model are slightly inflated. Overall, the similarity of these models to the multigroup model suggests that the results of the final multigroup model are broadly similar to the individual group models.

3. Selection bias

In any study assessing area effects, concerns of the effect of composition versus context arise. In ethnic density research, issues surrounding selection bias, or 'social drift' explaining the observed results are often cited (Pickett and Wilkinson, 2008; Halpern, 1993). In other words, it is argued that the average level of mental health in these areas could be the result of the people who have chosen to live there, rather than as a result of ethnic density. However, it is worth noting that the selection processes typically hypothesised to be involved in the ethnic density effect should theoretically attenuate any effects of ethnic density observed (Pickett and Wilkinson, 2008). For example, it is most often posited that people with worse mental health may be selected into higher ethnic density areas (Schofield et al., 2016b). For example, financial issues linked to mental health may mean individuals drift to more deprived areas, as high ethnic density areas typically have lower housing

costs. However, it is also possible, although arguably less likely, that people with better mental health may move to more areas with higher ethnic density. Using contrasting logic, people with better mental health may have more financial resources due to participation in the labour force which is not impacted by their mental health, meaning they may have more ability to choose their neighbourhood and place of residence.

Existing studies have attempted to incorporate the assessment of selection effects by utilising questions relating to participants' desire to move (Yan et al., 2019; Knies et al., 2016). It is argued that this variable indicates whether the current neighbourhood is the one of choice, and therefore can be used to determine if the observed effects are a result of selection processes. In order to test whether the effects observed could be explained by selection bias, a variable measuring the desire to move home "If you could choose, would you stay here in your present home or would you prefer to move somewhere else?", which had a binary response option, was included in the model. Utilising this question as an indicator of selection affects is arguably imperfect, however it was the best option to attempt to assess selection effects in this analysis.

Unfortunately, it was not possible to perform two separate multi-group, multilevel SEMs, one MG-MSEM for those who report a desire to move and one MG-MSEM for those who do not due to limited sample size. Instead, this binary variable was included as an additional covariate in the final model (results presented in the Appendix, Table 10.10, section 10.14). This model was then compared to the final model in order to compare any changes in effect size or direction. In this additional model, the desire to move variable significantly predicted Factor 1 (Belonging) and 2 (Social Capital) scores for all five ethnic groups, with a preference to move associated with worse cohesion scores for each group. This suggests that those who wish to move also perceive lower levels of belonging and social capital. In addition, the desire to move significantly predicted racism for the Black Caribbean group. However, no large changes in effect size or statistical significance were observed in the associations between ethnic density, mental health and the hypothesised intermediate variables. These results suggest that controlling for the desire to move did not have a large impact on the model estimates, and therefore did not explain the associations observed.

8.10 Summary

In this chapter I addressed the remaining research questions 3d "is there statistically significant evidence of cross-level indirect effects for the hypothesised mediating factors?" and 3e "are the path estimates of the indirect paths different across ethnic groups?". The purpose of this analysis

was to address the dearth of empirical research on the pathways operating behind the ethnic density using methods which employ path-based analyses.

The modelling approach employed to investigate these research questions had several benefits. Firstly, in using SEM it was possible to assess the pathways between ethnic density and mental health and is the first time this has been done using this method in a UK context. Secondly, in using a multilevel application of SEM (MSEM), it was possible to account for the clustering of the data, to model area-level effects explicitly and to incorporate multilevel measures of complex latent variables. This provided the opportunity to model the area level effects of ethnic density on racism and social cohesion explicitly. In addition, it was possible to measure social cohesion as a complex, multilevel latent variable, accounting for measurement error and the underlying factor structure of the items. Finally, the use of a multi-group form of MSEM (MG-MSEM) provided the potential to analyse ethnic groups separately, so that differences between ethnic groups in the effects of the indirect paths could be investigated.

However, the modelling approach also presented a number of challenges. Firstly, it was not possible to use own-group ethnic density, despite previous analyses in Chapter 6 indicating that this is a better measure than overall minority ethnic density when analysing certain pathways. Secondly, due to model complexity, a reduced number of indirect pathways were ultimately possible to test compared with the original proposed theoretical framework. Finally, due to the modelling technique employed, it was not possible to allow cohesion to vary at the area level, meaning it was not possible to assess any potential between ethnic group differences in this pathway.

Overall, the results of these models indicated support for the hypothesis that, for at least the Indian ethnic group, there was a significant indirect path from ethnic density to mental health via racism. No evidence was found to support the role of social cohesion as operating via an indirect path, based on the measurement of the concept employed in this study. Evidence was found which suggested that the association between minority ethnic density and reporting racism varied significantly across ethnic groups. However, the association between racism and mental health was not found to vary significantly. The additional checks conducted suggested that the model results are robust to selection effects and that the estimates produced by this novel MG-MSEM application do not diverge in direction or significance from a standard MSEM framework for the pooled sample, or for the separate, ethnic group-specific samples which were possible to test.

In the next chapter, these findings are discussed in relation to the findings of the previous chapters, as well as in relation to the findings of other existing studies. Recommendations are then made for future research based on the findings of this thesis.

9 Chapter 9: Discussion

This thesis aimed to add to the existing body of research on the ethnic density effect, by taking a theory-driven approach to examine the potential pathways operating between ethnic density and mental health across minority ethnic groups in the context of England. This chapter reviews the principal findings of the thesis, putting these into context, and then reflects on the original contributions and limitations of the research, making recommendations for policy and future research.

9.1 Principal findings

The primary aim of this thesis was to investigate the pathways by which ethnic density impacts upon the mental health of minority ethnic groups in England, taking an ethnic group-specific approach. The three main research questions were as follows:

1. What is currently known about the relationship between ethnic density and mental health in a UK context?
2. What is the relationship between ethnic density and mental health in an ethnically diverse sample from the panel survey Understanding Society (UKHLS)?
3. What pathways are operating between ethnic density and mental health in an ethnically diverse sample from the panel survey Understanding Society (UKHLS)?

9.1.1 1) What is currently known about the relationship between ethnic density and mental health in a UK context?

Building on calls for better evidence on the pathways operating behind the ethnic density effect (Pickett and Wilkinson 2008; Bosqui et al., 2014), findings from the systematic review in Chapter 3 revealed how the pathways between ethnic density and mental health have been conceptualised and tested in UK based research to date. This systematic review adds to evidence from previous systematic reviews on the ethnic density effect which have summarised in general terms the pathways examined in global research (Bécares et al., 2018) by making the assessment of pathways a primary focus of the review and doing so solely from a UK context.

There is a large body of good quality cross-sectional evidence showing a negative association between ethnic density and both 'severe' mental illness and anxiety and depression in a UK context. However, where disaggregated minority ethnic categories were employed, the evidence was more mixed. Three studies, all from the anxiety and depression study group, reported statistically significant protective associations for some groups as well as detrimental associations for at least one ethnic group (Bécares and Nazroo, 2013; Dorsett et al., 2019; Schofield et al., 2016a). These findings suggest that using aggregated minority ethnic categories in these analyses may be hiding differences in the ethnic density effect by minority ethnic group. The findings also reinforce the conclusions of previous systematic reviews which have called for a greater focus on ethnic group-specific analyses (Bosqui et al., 2014). However, despite a large volume of good quality cross-sectional evidence, there remains scant longitudinal evidence. Just two studies included in the review employed a longitudinal approach and both reported no association between ethnic density and mental health (Jun et al., 2020; Jonsson et al., 2018). However, both of these studies assessed young people only. It was therefore not possible to judge whether this lack of effect was due to a focus on young people, for whom neighbourhood-level ethnic density likely has different meaning, or due to the longitudinal approach taken.

1a) How have the pathways between ethnic density and mental health been conceptualized in UK based research?

There is limited knowledge about the pathways in operation behind the ethnic density effect. In the included studies, there was a general lack of theorisation and justification for the pathways which were hypothesised to be in operation. The pathways theorised included: interpersonal racism and stigma, social capital and cohesion (including service provision and access, collective action, place-based belonging and identity, and isolation and exclusion), interpersonal social support, social stress, migration and deprivation. The qualitative studies included in the review typically covered many of the same pathways as those investigated by the quantitative studies, but with additional discussion relating to structural racism, population instability and the role of mental health-based discrimination from within communities. While the quantitative studies frequently suggested pathways operating behind the effect, few assessed these pathways quantitatively.

1b) What is the empirical evidence in relation to these hypothesised pathways?

Those studies which did assess one or more pathways did so with inconsistent measures and using standard regression modelling techniques, rather than path-based analyses. The pathways which were quantitatively tested in at least one study in the review were: racism, social capital and

cohesion, social support and social stress. These pathways broadly fit into existing work on the theoretical models in operation behind the ethnic density effect, particularly in relation to the social norms model and the buffering effects model (Bécares, 2009). The evidence appeared to be most consistent for the racism pathway, assessed by a total of five studies (Das-Munshi et al., 2012; Bécares et al., 2009; Astell-Burt et al., 2012; Das-Munshi et al., 2010; Shields and Wailoo, 2002). The evidence for the social support and social capital and cohesion pathways was mixed, and evidence for the social stress pathway was the weakest. Where studies employed disaggregated minority ethnic group categories, heterogeneity was often seen in the effect sizes and sometimes also in the direction of the associations (see Bécares and Nazroo, 2013). However, as a result of the lack of engagement with the theoretical underpinnings of these hypothesised pathways, there was in general little discussion surrounding how and why these pathways may vary across ethnic groups.

Based on the findings of the systematic review, a theoretical framework was produced and described in Chapter 4. The framework proposed social capital and cohesion, social support and racism as the three key indirect paths in the association between ethnic density and mental health.

9.1.2 2) What is the relationship between ethnic density and mental health in an ethnically diverse sample from the panel survey Understanding Society (UKHLS)?

Chapter 5 contributed to the body of evidence on the relationship between several different measures of ethnic density and mental health across ethnic groups (measured via GHQ-12) via an analysis of Wave 3 UKHLS data (data collection period 1st of January 2011 to the 30th of June 2013). Initial descriptive analyses of the analytical sample indicated that, compared to those who were excluded from analyses, the sample was biased towards better educated individuals with higher average household income, who were more likely to own or privately rent their homes. It was not possible to apply weights in the analyses, and therefore the bias of the sample towards these characteristics should be considered when interpreting the results of the analyses addressing the following research questions.

2a Does the relationship between ethnic density and mental health differ by ethnic group?

2b Does the relationship vary depending on the measure of ethnic density employed?

Linear regression analyses were used to assess the association between ethnic density and GHQ-12, and were adjusted for the following covariates: sex, age, marital status, deprivation, nativity, household income and highest qualification. In these models, the following measures of density were employed: own-group density, overall minority ethnic density, South Asian density and Black density (all modelled per 10% increase). These models largely showed no statistically significant evidence of an association with mental health (GHQ-12) for any ethnic group. The exceptions to this were for overall minority ethnic density, which was protective for the Pakistani ethnic group (β= -0.36**, 95% CI= -0.61 -0.11) and detrimental for the Black African group (β= 0.28*, 95% CI= 0.05 0.54), and for Black density, which was found to be protective for the overall minority ethnic group (β= -0.30**, 95% CI= -0.50 -0.09). The general lack of statistically significant associations found was somewhat surprising given the evidence supporting an ethnic density effect found in the systematic review of studies assessing anxiety and depression outcomes in Chapter 3. However, this fits with the proposed theoretical model in Chapter 4 in which only indirect effects were theorised.

Three earlier studies included in the systematic review using the same outcome measure (GHQ-12) also showed inconsistent results. Two of the three studies reported protective effects for some ethnic groups and detrimental effects for others (Bécares and Nazroo, 2013; Dorsett et al., 2019), while one found entirely detrimental effects across all groups (Yan et al., 2019). However, at least two of these studies (Yan et al., 2019; Dorsett et al., 2018) were atypical in their use of ethnic categories and in the density measure they employed. Dorsett and colleagues (2018) combined migrant generation categories with standard ethnic identity categories, while Yan and colleagues (2019) operationalised ethnic density by quintiles. In addition, Dorsett and colleagues (2018) did not appear to have adjusted their analyses for area deprivation, despite clear evidence of an association between ethnic density and deprivation (Das-Munshi et al., 2010; Stafford et al., 2009; Bécares et al., 2012b). The study by Bécares and Nazroo (2013) is most similar in terms of regression model specification and variable measurement to that which is conducted here, although the authors use 2004 data from the Health Survey for England. However, unlike the study by Bécares and Nazroo, I find no association between own-group ethnic density and GHQ-12. Bécares and Nazroo's study contains larger ethnic group-specific sample sizes and also employs larger area units (MSOA), meaning the average number of participants per area is likely much larger and which may explain this difference in statistical significance of the findings.

The differences observed in the direction of association between overall minority ethnic density and GHQ-12 between the Pakistani and Black African groups is also worth noting. This suggests that minority ethnic density may not have the same meaning across ethnic groups, possibly due to the

different migration histories and processes of racialisation discussed in Chapter 1. The differences in association reported further emphasises the need to move away from using aggregated ethnic group categories and highlights the importance of exploring the mechanisms behind the ethnic density effect in order to better understand these results.

9.1.3 3) What pathways are operating between ethnic density and mental health in an ethnically diverse sample from the panel survey Understanding Society (UKHLS)?

Chapter 6 contributed to the existing literature base on the pathways operating behind the ethnic density effect, by examining several hypothesised mediating paths proposed by the theoretical framework in Chapter 4. Using UKHLS data, the pathway measures and how they vary across ethnic groups were described. The associations between the pathway measures and ethnic density and mental health were then assessed, addressing research questions 3a and 3b.

3a) Is there an association between the hypothesised mediating variables and ethnic density?

3b) Is there an association between the hypothesised mediating variables and mental health?

Findings on the associations between the hypothesised mediators and ethnic density and mental health were mixed, varying across ethnic groups and the measure of ethnic density used. Social cohesion (measured as a composite scale) was associated with lower GHQ-12 scores (indicating better mental health) for all ethnic groups. Social cohesion was positively associated with increasing own-group ethnic density for all ethnic groups except the White British, Black Caribbean and Black African groups. However, the use of overall minority ethnic density showed smaller effect sizes and statistically significant estimates only for the Pakistani group and the pooled minority ethnic sample. The reason behind this is unclear, but it may be related to factors surrounding the distribution of differing ethnic density measures by ethnic group. For example, Figure 10.1 in the Appendix shows that the Pakistani sample were more likely to live in areas with the highest proportions of overall minority density than other ethnic groups. Social support (measured via the participant's number of close friends) was negatively associated with own-group ethnic density for the pooled minority ethnic sample, and the Indian, Pakistani, and Black African groups. Analyses using overall minority density showed statistically significant associations only for the Indian, Black African and pooled

minority ethnic sample. Again, there was no clear reason behind these differences by ethnic group. However, it is likely that the interpretation of the meaning of 'close friend' differs with the differing cultures across ethnic groups. Therefore, differences between ethnic groups in this measure should not be overemphasised. Social support appeared to be unrelated to GHQ-12 for any ethnic group. Both higher own-group and overall minority ethnic density measures were associated with lower odds of reporting having experienced interpersonal racism for all groups except the Pakistani and White British groups. In addition, racism was associated with worse mental health (higher GHQ-12 scores) for all groups except the White British, Black African and Black Caribbean groups. It is unsurprising that the coefficient was not statistically significant in the case for the White British group, due to the minimal reporting of racism in the group. However, based on prior research and theory on the impacts of racism on people from Black African and Black Caribbean backgrounds, the lack of effect in these groups is surprising. One explanation may be that too few people from the Black Caribbean group reported racism (4.58%) compared to other ethnic groups (around 8%). This does not explain the result for the Black African group however (8.59% reported racism). The regression models included only one hypothesised pathway at a time, and it may be that factors which exert a buffering effect (such as social cohesion) are strong enough in the Black African group that the effect of racism on mental health is concealed when these are not also included in the model. Finally, own-group ethnic density was positively associated the proportion of co-ethnic friends, for all ethnic groups. In comparison, estimates from analyses using overall minority ethnic density lost their statistical significance for the Pakistani, Black Caribbean and Black African groups. This may suggest that, for the Pakistani, Black Caribbean and Black African groups, living in areas which are ethnically dense does not mean they are more likely to be friends with people from the same ethnic group than if they were living in a less ethnically dense area. In addition, Figure 10.1 in the Appendix also suggests that distribution of people from Black African and Black Caribbean backgrounds in the sample is more dispersed, which may also partially explain the loss of statistical significance when using this density measure. The co-ethnic friends measure was mostly not significantly associated with GHQ-12. However, having less than half of one's friends from the same ethnic group was associated with worse mental health for the Indian group, compared to having all friends being from the same ethnic group.

The results of these regression analyses suggested that racism and social cohesion may lie on the causal pathway, for at least some ethnic groups, based on their associations with mental health and ethnic density and the theories underpinning their hypothesised role. Neither social support nor co-ethnic friends appeared to be associated with mental health, suggesting that these variables may

not be mediators in the association. Importantly, associations between ethnic density and the hypothesised mediating variables appeared to vary depending on the ethnic density measure used. In particular, the effect sizes in the association with social cohesion were smaller when overall minority ethnic density was used. This is likely due to factors associated with social norms and cultural maintenance theories (Bécares, 2009; Berry, 1997), for which own-group density would be more relevant than overall minority ethnic density. In the analyses assessing the association between overall minority ethnic density and racism, whether the effect sizes were larger or smaller compared to own-group density varied across ethnic groups. This could be due to different levels of protection afforded by overall minority density for different groups, as well as possible differences in informal social control by ethnic group (Sampson et al., 1997). This idea is revisited when interpreting the results of the MG-MSEM model in research questions 3d and 3e. These findings suggest that different measures of ethnic density are likely more relevant for some mediating pathways than others, and that the meaning of overall minority ethnic density is likely not equal across groups.

The hypothesised mediators with the most consistent evidence resulting from these analyses largely mirror the findings of the systematic review. The results of the analyses assessing racism were in general consistent with the findings of the studies in the anxiety and depression study group of the systematic review (Astell-Burt et al., 2012; Das-Munshi et al., 2010; Shields and Wailoo, 2002). However, the present study showed evidence of a negative (protective) association with ethnic density and a positive (detrimental) association with mental health across more ethnic groups than in the existing studies. Neither of the studies assessing social support included in the anxiety and depression study group reported the results of any tests of association between social support and mental health (Das-Munshi et al., 2010; Halpern and Nazroo, 2000). However, both studies reported positive associations between at least one of the social support measures employed and ethnic density. In contrast, in this thesis, associations between co-ethnic friends and ethnic density were found in the opposite (negative) direction. Finally, in terms of social cohesion, just one study in the systematic review assessed the association between social cohesion and common mental disorder (Bécares and Nazroo, 2013). The authors reported protective associations between both individual and area level measures of social cohesion and mental health. Similarly, in this thesis, all of the associations with social capital (measured via a composite scale) for all ethnic groups were negative (protective). In addition, Bécares and Nazroo (2013) reported lower individual level cohesion with increasing own-group density for the 'Black Caribbean' and 'Bangladeshi' groups, and higher cohesion with increasing own-group density for the 'Indian' and 'Pakistani' groups. However, in the

present study, own-group density was found to be associated with higher (better) social cohesion for all groups, except the Black Caribbean and Black African groups for whom the effect was null.

3c) What is the measurement structure of Buckner's social cohesion short scale and is the measurement and structure of this the same across ethnic groups?

Chapter 7 presented the stage of the analysis which addressed research question 3c and involved factor analysis to assess the underlying constructs of the multi-item measure of social cohesion.

As discussed in Chapter 3, section 3.5, social cohesion as a concept is nebulous and there is little agreement on the most appropriate way to measure it. It is widely agreed that it is comprised of several overlapping aspects, with elements operating at both individual and area-levels, yet its complexity is rarely explicitly modelled in health research. In addition, Buckner's social cohesion scale questions (the social cohesion measure available in Wave 3 of UKHLS) were originally validated in a white middle-class neighbourhood of the US (Buckner, 1988). Factor analysis was therefore used to investigate the structure and measurement of the factor in an ethnically diverse sample from England, allowing for the complexity of social cohesion to be explicitly modelled in later analyses. Using Exploratory Factor Analysis (EFA), I found a two-factor structure, representing Belonging and Social Capital respectively. These results suggest that these two factors are the main underlying features of the shortened version of Buckner's cohesion questionnaire in this ethnically diverse sample in England. The items which I found to load separately onto these two factors were also designed to measure separate constructs in Buckner's original scale. However, in the original scale (comprised on 18 questions) these constructs were differently termed (Buckner, 1988). A third element was included in the original scale termed 'attraction to neighbourhood'. However, no questions designed to measure this element were retained in the EFA process conducted here. Though there is little consensus on the measurement of social cohesion, it is arguable that the measures employed here do not capture all of the core features of social cohesion, particularly in relation to aspects relating to organising for the common good (Schiefer and van der Noll 2017) or what has been termed 'civic and political participation' (Bécares, 2009). This is an element of cohesion which was discussed in several of the included studies in the systematic review (Bécares et. al., 2009; Bécares and Nazroo, 2013; Campbell and Mclean, 2002; Kirkbride et al., 2007; Kirkbride et al., 2008; Kirkbride et al., 2014).

As described above, inconsistencies have been found across ethnic groups in the association between social cohesion and ethnic density and mental health, both in the existing work and preliminary analyses. There has been little research to date on the differential meaning of social

cohesion and if the measures of social cohesion commonly used operate similarly across ethnic groups. Multi Group Confirmatory Factor Analysis (MGCFA) allows these potential differences to be assessed. In the final stage of the MGCFA process, I found the factor structure to be invariant to the metric level across all five ethnic groups. This suggests that the structure of the latent variables belonging and social capital (i.e. how many factors and which questions constitute them), and the extent to which each question contributes to each factor (i.e. the relative importance of each question to the factor), are similar enough to compare across ethnic groups. In other words, the constructs are measured the same across ethnic groups. However, the average levels of the items were found to differ across groups. In other words, for the same score on the latent variable, the intercepts of the items which constitute it may be different across groups. This implies that the meaning of these social cohesion questions differ across ethnic groups in this sample, that these should therefore be interpreted with caution, and that the mean levels of the factors should not be compared.

As argued by Kawachi and Berkman (2000), social cohesion can be thought of as a collective characteristic. However, the constructs which make up social cohesion are often arguably only possible to measure at the individual-level. Attempts to measure cohesion by area-level voter turnout, as seen in the studies included in the systematic review (Kirkbride et al., 2007; Kirkbride et al., 2014), do not adequately capture the multi-dimensional nature of social capital and are biased by other factors. Relatedly, Bécares and Nazroo (2013) assessing 'cognitive social capital' employed both area-level and individual-level measures, finding different results at each level. Multilevel Confirmatory Factor Analysis (ML-CFA) presents a valuable opportunity in neighbourhood effects research to measure area-level constructs which are composed of individual-level measures (Dunn et al., 2015). The findings of the ML-CFA conducted here suggested a one-item structure provided the best fit to the data at the area level. This implies that, at the individual level, the social cohesion items separate out into belonging and social capital, whereas at the area-level, they are indicative of just one factor, which I labelled 'Social Cohesion'. As outlined in the systematic review (Chapter 3), there were often difficulties associated with distinguishing between social cohesion and social capital, in both the authors' conceptualisations and the measures they employed. However, the approach adopted here allows for the modelling of several factors constituting social cohesion and for the variance of items to be separated into the individual and area levels. This means both individual and area level properties can be simultaneously modelled, net of each other, helping to address this issue of measurement level going forward. One study specifically dedicated to assessing social cohesion via ML-CFA currently exists (Bottoni, 2018). The authors also conclude that social

cohesion, while measured by individual-level constructs, has area-level meaning (Bottoni, 2018). However, Bottoni (2018) utilises a more diverse range of questions (n=24) and finds seven, second order factors. The factor analysis performed in this thesis improves our understanding of the multilevel measurement of social cohesion and of the measurement of Buckner's shortened cohesion scale in an ethnically diverse sample. The analysis resulted in similar factors identified to the elements of the original scale and were similarly constructed across ethnic groups. However, uncertainty remains around the missing community organising element of social cohesion and there is limited research explaining how different ethnic groups may understand elements of social cohesion differently.

3d) Is there statistically significant evidence of cross-level indirect effects for the hypothesised mediating factors?

3e) Are the path estimates of the indirect paths different across ethnic groups?

The final two research questions were addressed through the use of MG-MSEM. However, due to the limits imposed by the model, and based on the results of the systematic review and regression analyses, only racism and social cohesion were assessed as indirect paths in the MG-MSEM employed. The results of this final MG-MSEM model, presented in Chapter 8, were mixed, complex and challenging to interpret.

Firstly, the results showed no statistically significant associations between any of the social cohesion factors and GHQ-12 or overall minority ethnic density. This result is surprising given that a composite version of the cohesion measure was associated with ethnic density and GHQ-12 for almost all ethnic groups in the regression analyses (although these were unadjusted for clustering) presented in Chapter 6. As described in Chapter 8, it was not possible to allow the path to the area-level measure of social cohesion to vary across ethnic groups, perhaps hiding between-group differences in its effect. However, at the individual level, the statistically significant protective effect of belonging on mental health in the model without the covariance between the two factors included is worthy of note. It may be that belonging directly affects mental health, but that other elements of social cohesion do not. For example, it is plausible that social capital could moderate the association between racism and mental health (such as via the proposed 'buffering effect'), but not directly affect mental health. For example, research from other contexts suggests that social capital may modify associations between racism and discrimination and mental health (Lewin et al., 2010; Hall et al., 2019).

In terms of racism, several statistically significant paths were observed from overall minority ethnic density to racism, and racism to mental health. However, a full indirect path for the effect of racism was found only for the Indian ethnic group. Possible reasons for this finding in the Indian group only are that this group has the largest sample size, both in terms of participants and area units included, as well as having the highest proportion having reported experiencing racism (8.73%). The results of the full model suggested that, for three ethnic groups (Indian, Black Caribbean and Black African), ethnic density protects against experiencing racism, and for the Indian ethnic group, ethnic density protects mental health via protection from racism. Regression models of overall minority ethnic density and racism showed no significant association for the Pakistani group, and so it is unsurprising that a lack of association is also found in the final MG-MSEM for this group. However, that racism is not statistically significantly associated with overall minority ethnic density for the Bangladeshi group is interesting. It is worth noting that the Bangladeshi group has the smallest sample size of all of the ethnic groups, which may have affected the statistical accuracy of the estimate. Finally, racism was not statistically significantly associated with mental health for the Bangladeshi, Black Caribbean, or Black African groups. This finding is similar to that of the previous regression model, in which the estimates for the Black Caribbean and Black African groups were not statistically significant and the confidence interval for the Bangladeshi group was very wide. The MG-MSEM model includes the social cohesion paths simultaneously to the racism paths, suggesting that the lack of association reported in the previous regression models was not due to buffering effects of social cohesion masking the effect. It is perhaps more likely to do with the small sample size of the Bangladeshi group and the nature of the dispersion of own-group and overall minority ethnic density for the Black Caribbean and Black African groups that explains this lack of association.

The results of this study are similar to the findings of an existing study using similar methods. In a study by Bécares using US data, a Structural Equation Modelling (SEM) approach was used to investigate the pathways between ethnic density and psychological distress (Bécares, 2014). In the study, a single-level approach to SEM was applied to test both racism and social cohesion as pathways, both as modelled as multi-item latent variables. Bécares reports a statistically significant path from ethnic density to racism and racism to mental health in two ethnic groups ('Puerto Rican' and 'Mexican American'), but no full path for the social cohesion measure, which was largely not significantly related to ethnic density or mental health for most ethnic groups. The results of the present analyses therefore add further weight to the evidence base suggesting that the protective effect of ethnic density is, in part, a result of a reduction in exposure to racism. In addition, the

present study also fails to demonstrate an indirect effect of social cohesion, suggesting that the role of social cohesion in the association may be more complex and requires further investigation.

Finally, I find that the effect of ethnic density on racism varied significantly across ethnic groups, partially confirming the hypothesis that the effect of ethnic density varies across ethnic groups. This might suggest that the protection afforded by overall minority ethnic density is not equivalent across ethnic groups. For example, a qualitative study from a diverse neighbourhood in Toronto, Canada assessed diversity and social cohesion in a low-income neighbourhood. The author found that, while participants reported feeling more tolerant towards other cultures, they also often expressed discriminatory views towards others or reported experiencing discrimination themselves within the neighbourhood based on stigmatised characteristics (Ahmadi, 2018). In particular, Ahmadi (2018) draws on two quotes where participants report discriminatory experiences which were explicitly Islamophobic in nature. This is important for interpreting the findings of the present study. Statistically significant protective effects of overall minority ethnic density were found only for the Indian, Black Caribbean and Black African groups. Though suggestions as to why this may be can only be speculative, it is worth noting that Islam is the dominant religion in the countries of origin of the only two ethnic groups not found to have statistically significant associations (Pakistani and Bangladeshi). The most recent official crime statistics suggest that Muslims are subject to hate crime more than other religions (Home Office, 2021). Statistics available closest to the period of data collection for the survey wave used (2011-2013) showed that Muslims experienced the most hate crimes (1.4% of the population) after the 'other' religion group (1.8% of the population) (Home Office, 2015). It is also possible that the explicit declaration of a hostile environment towards migrants during the period of data collection (2011-2013) of the UKHLS wave used in this study may have contributed to the incidence of racist encounters towards this group. Therefore, while overall minority ethnic density may protect from generalised racism, it may not provide protection from discrimination based on other highly stigmatised identities, such as religious identity. This reinforces the need to assess the effect of ethnic density separately across ethnic groups. Several of the qualitative studies identified by the systematic review in this thesis focused on Black African or Black Caribbean groups (Schofield et al., 2019; Campbell and McLean, 2002; Ochieng, 2011) with the rest assessing mixed groups. Qualitative work with a focus on Pakistani and Bangladeshi groups, and on the additional stigma and discrimination faced by Muslims, would be beneficial to helping us to better understand ethnic group specific differences in the ethnic density effect. In terms of quantitative research, recent advances in methodological approaches to assessing intersectionality

(see Bauer and Scheim, 2019) may prove valuable in further understanding these differences across other stigmatised identities within ethnic groups.

9.2 Strengths and unique contributions

This thesis presents the findings of the first review to systematically collate and evaluate the pathways which have been theorised and tested to date. It is also the first review of studies on the ethnic density effect on mental health from a UK context only. In evaluating the evidence for the pathways which have been tested to date, a theoretical framework was constructed to guide the analyses and ensure the research was informed by existing knowledge. In general, there has been limited recognition of the role of context in the ethnic density effect to date, particularly in systematic reviews which compare findings across countries. This is despite studies pointing to the importance of the role of country contexts, and their differing histories, policies and processes of racialisation in relation to health outcomes and the ethnic density effect specifically (Nazroo et al., 2007; Bécares et al., 2012c). In focusing on a UK context, the systematic review was able to hold some of these factors constant (though notably not all, as policies impacting the ethnic density effect change over time and are implemented differentially across local geographies), meaning that any heterogeneity observed across ethnic groups is not a result of country context specific factors.

The quantitative element of this study utilised data from the EMB sample, encompassed within the 'extra five minutes' questionnaire of UKHLS (Understanding Society, 2021a). This is arguably the best data currently available for minority ethnic groups in England in terms of sample size for specific ethnic groups and range of variables available. Using these data meant that the association between numerous hypothesised paths and ethnic density and mental health could be assessed for each of the largest ethnic groups separately. This was important given that previous research had indicated that associations in the ethnic density effect varied by ethnic groups (Bosqui et al., 2014; Bécares et al., 2009; Bécares and Nazroo 2013; Dorsett et al., 2019; Schofield et al., 2016a).

To my knowledge, this is the first study to assess the multilevel factor structure of the reduced set of questions from Buckner's Cohesion scale included in UKHLS, and to do so using an ethnically diverse sample. This is an important contribution as the original scale was validated in the US, in a White, middle-class area (Buckner, 1988) and there has been limited work assessing the underlying factor structure of the full scale in the UK (for an exception see Fone et al., 2006). In addition to this, employing ML-CFA allowed the measurement of the factor at both the area and individual level to be assessed, revealing different structures at both levels and allowing for the clustering of the data

to be properly accounted for. Studies which have used the composite version of this scale in the past (for example see Bamford et al., 2021) may benefit from explicitly modelling the two factors identified by this research by improving our knowledge of how the different elements of social cohesion matter for health. In addition, in using an ML-CFA approach, the 'fuzzy' nature of social cohesion (meaning that it operates at both levels but measured differently at each) (Kozlowski and Klein, 2000), which has been the source of uncertainty and debate in the ethnic density research, is possible to model explicitly.

To my knowledge, this study is also the first to take a Multilevel Structural Equation Modelling (MSEM) approach to the study of ethnic density. It is also the first to apply a Multi-Group Multilevel Structural Equation Modelling framework (MG-MSEM), as described by Asparouhov and Muthén (2012), to model hierarchical data with a 'within' level grouping variable. Not only did the MSEM approach allow for the correct handling of clustered data, taking account of the fact that individuals within the same areas are likely to be similar, but it also allowed area-level variance to be modelled explicitly. Furthermore, the multi-group element of the MG-MSEM allowed the estimates for the pathways of interest to vary across ethnic groups and allowed the quantitative assessment of whether the path estimates varied significantly across ethnic groups. The use of MSEM for researching area effects presents an exciting opportunity for future research, discussed further in section 9.4.

Finally, this thesis provides the best evidence available so far of an indirect effect of interpersonal racism, from ethnic density, through racism to mental health, in an English context. This contributes to the evidence available from a US context also demonstrating that ethnic density is protective of racism (Bécares, 2014) despite average levels of ethnic density being much higher in the US. This finding has important implications for understanding the effects of residential patterns of minority ethnic groups in England and for political discourse surrounding 'segregation' and 'integration' discussed further in section 9.5.

9.3 Limitations

Data related limitations

There are some important points to note when interpreting the results of this thesis. Firstly, the sample employed in this thesis of minority ethnic groups is not representative of minority ethnic groups in England. It was not possible to apply weights to account for non-response or to account for the sampling strata in the final model. This means that, as a result of the sampling process (Berthoud

et al., 2009), the sample employed over-represents people living in relatively high ethnic density areas and in urban areas. In addition, as shown in section 5.9 of Chapter 5, the sample is biased towards younger, better educated individuals, with higher household income and who own or privately rent their homes. Therefore, the descriptive analyses conducted in Chapters 5 and 6 should not be thought of as indicative of the average levels of these measures in minority ethnic groups in England. However, despite the lack of representativeness of the sample, it was still possible to test the hypothesised pathways operating behind the ethnic density effect in urban areas.

In addition, despite the longitudinal survey design of UKHLS, it was not possible to utilise more than one survey wave due to the associated reductions in sample size. Utilising more than one wave would have rendered disaggregated ethnic group sample sizes too small to analyse separately. Using only one wave of the survey means that the causal ordering of the effects cannot be determined. For example, it is possible that those with poorer mental health may be more likely to both experience and report racism. In addition, the cross-sectional approach taken means that the effects of racism are likely to be underestimated. There is good evidence to suggest that the effects of racism accumulate over the life course, such that past experiences of racism continue to negatively impact mental health into the future (Wallace et al., 2016).

Another issue arising from a lack of data is that of the available sample size for White minority groups, which was too small to facilitate inclusion of these groups separately in this study. This is unfortunate, as a previous study included in the systematic review showed a significant protective effect of ethnic density for the Irish ethnic group (Bécares and Das-Munshi, 2013), and there is currently limited evidence on the ethnic density effect on mental health for other White minority ethnic groups. In addition, just one study included in the systematic review assessed ethnic density effects for the Chinese ethnic group independently, but with a small sample size (n = 214). Though estimates for the group were in the protective direction, these were not statistically significant. The recognition and measurement of White and other minority ethnic groups is important as these groups also experience discrimination. Relatedly, it has been argued by Hickman and Ryan (2020) that the Irish are often forgotten in migration and ethnicity-based research. The first available study on the ethnic density effect from a UK context revealed a protective association only for men from the Irish ethnic group using data from 1981 (Cochrane and Bal, 1988). Although analysis techniques and knowledge of confounders of the association have developed substantially since this study, it is interesting to note the results of this study in context. The Irish were arguably one of the earliest and largest migrant groups in England with residential patterns less clustered in London compared with other new migrant groups (Panayi, 2014). It is therefore plausible that at the time of this study, the

population numbers, migration history, racialisation and residential patterns of the Irish group were sufficient for density to provide protective effects in comparison to other, lesser established ethnic groups. This reinforces the importance of considering the ethnic-group specific findings of ethnic density in context and for assessing 'other White' minority groups in the context of an increasing population of these groups (ONS, 2012), as discussed in Chapter 1.

Finally, the mechanisms which were possible to test in this study were limited to the availability of variables in the UKHLS survey. This meant that the measure available for racism, while comprehensive in terms of the context and reason for the racist incident experienced, lacked measurement of aspects such as intensity and frequency, which have been identified as important considerations (Krieger, 2000b). Based on the cross-sectional nature of the study and the somewhat limited measure of racism employed, I argue that it is likely that the true impact of racism on mental health is not fully captured in this study.

Modelling related limitations

This study presents the first application of the MG-MSEM framework as described by Asparouhov and Muthén (2012). There are no available methods papers which test the possible biases of these models. Although multiple robustness checks were conducted in order to assess the functioning of the model against other, well-established models (see Chapter 8 section 8.9 and Appendix sections 10.13 and 10.14), it remains possible that the results of the model are biased due to the specification of the MG-MSEM. In personal correspondence, Mplus support suggested that the risk of bias may be that the model estimates could be low (Mplus, 2021). However, this has not yet been confirmed via any empirical tests of applications of the approach.

In addition, the use of MG-MSEM, while facilitating the modelling of separate ethnic groups, had implications for the number of paths and variables which could be modelled and the measure of ethnic density which could be used. The MG-MSEM model was already complex in specification, meaning careful decisions had to be made regarding the number of paths which could be assessed. Ultimately, it was only possible to test two indirect paths (social capital and racism). Other possible indirect paths such as social support and moderation paths (such as the possible moderation of social support on the path between racism and mental health) could not be tested. Furthermore, in order to employ an area-level measure of ethnic density in the model, only overall minority ethnic density, rather than own-group ethnic density, could be used. This is because the model assumes that all individuals in the same area have the same area-level measures, even if those individuals are from different ethnic groups. The impact of this is that the density measure employed is likely more

relevant to some intermediate variables (such as racism), than others (such as social cohesion), as described above and in Chapter 6.

Although the modelling strategy allowed path estimates to be specific to ethnic groups, the measure of density ultimately employed was more general and less specific to these groups. The analyses in Chapter 6 showed that some hypothesised mediators appeared to be associated with own-group density to a greater degree than overall minority ethnic density (such as social cohesion), and that the strength of association compared with the own-group measure varied across ethnic groups (such as social support and racism). This, combined with the different distribution patterns of overall minority ethnic density across ethnic groups (see Chapter 5, section 5.14 and Appendix section 10.8), suggests that overall minority density measures a quality of areas which is distinct from own-group minority ethnic density. Existing research has largely focused on own-group ethnic density, and indeed evidence from Chapter 6 implies that this is the most relevant measure for assessing social cohesion. However, the meaning of overall minority ethnic density is likely different across different ethnic groups and is in itself of interest to investigate, as overall minority density and own-group density do not exist independently of one another. Therefore, though the model was constrained to the use of overall minority ethnic density, it nevertheless advances our knowledge of the ethnic density effect and the pathways operating behind the effect.

9.4 Avenues for further research

As is evident from the above discussion, many of the limitations of the study carried out in this thesis, and in other research on ethnic density, relate to the available sample size of minority ethnic groups. A new survey, Evidence for Equality National Survey (EVENS), has recently been conducted specifically to address this issue. The target sample size of the survey is 17,000 minority ethnic participants (EVENS, 2021), meaning it should be possible to examine a wide range of minority ethnic groups independently. This survey has even greater relevance after the heightened attention ethnic inequalities have received in the wake of the Covid-19 pandemic (Nazroo and Bécares, 2021). Data of this volume and quality would make ethnic group-specific analyses, particularly for currently under-studied groups such as White minority groups, more feasible, helping to improve our understanding of ethnic inequalities. In addition, improved sample size over time would facilitate the possibility to take a longitudinal approach to the study of ethnic density by ethnic groups. For example, research questions such as ‘does the association between ethnic density and mental health hold over time?’ could be addressed. Longitudinal evidence on the ethnic density effect, as highlighted by the findings of the systematic review (Chapter 3), is lacking in a UK context. One high

quality longitudinal study exists examining 'ethnic diversity' (using the Herfindahl Index) on well-being (Li et al., 2021) to date, but no such studies currently exist on the ethnic density effect in adult populations in the UK.

MSEM itself, which the MG-MSEM approach builds upon, remains under exploited in the 'neighbourhood effects' literature within social epidemiology, despite presenting a valuable opportunity for several aspects of research. Firstly, MSEM provides the opportunity to understand the measurement of concepts which are typically only feasible to measure at the individual-level, but which draw upon area-level concepts, while accounting for clustering of observations within areas (Dunn et al., 2015). This could be useful for the study of constructs like social capital. For example, Bécares and Nazroo (2013) demonstrated that the level of measurement of social capital which was studied (individual compared to area level) affected the associations observed with ethnic density. By employing MSEM, both measurement levels of social capital could be modelled explicitly and simultaneously, with the variance partitioned across the levels. Providing social capital was found to be similarly composed across both levels, tests could be performed to determine at which level of analysis social capital is most important. Secondly, MSEM is well-suited to the study of area effects, particularly in analysing multiple indirect paths across levels. In utilising Bayesian estimation, it is also possible to assess cases of moderated mediation across levels, by incorporating random slopes. These two benefits of the method make it ideal for assessing complex, cross-level paths in data which have a large number of clusters (a typical feature of many panel survey datasets available). Future neighbourhood effects research could benefit from greater use of this method. Relatedly, the MG-MSEM approach employed in this thesis has potential for neighbourhood effects research which seeks to assess inequalities across groups. This would be of particular use to studies which seek to assess community qualities such as diversity or cohesion on individual-level outcomes across groups for which it is theorised outcomes are likely to be different.

Ultimately, quantitative research on ethnic inequalities is limited by the necessitation of the use of constructed ethnic categories which implies homogeneity in populations which are diverse. Relatedly, this issue also arises in the use of the binary category of 'migration background' (or similar) employed in many studies, which some argue is used without theoretical meaning and/or proper justification (Vietze et al., forthcoming). Mixed methods research offers the opportunity to better investigate this diversity and the different experiences of people within the same ethnic and migration categories. Just one mixed methods study on the ethnic density effect in the UK was identified by the systematic review and focused on older populations of two main ethnic groups ('Jamaican Caribbean' and 'Gujarati Indian Hindu') (Bécares and Nazroo, 2013). This mixed methods

approach allowed the authors to provide greater detail and nuance to the quantitative findings, particularly in relation to the differing meanings and importance of belonging and social capital between the two ethnic groups. Therefore, more mixed methods research could provide better evidence on the potential differential meaning and operation of the pathways between ethnic density and mental health across ethnic groups. This type of research could be particularly useful for investigating the aforementioned additional role of religious identification in the ethnic density effect across groups. In addition, mixed methods research with families (adults living with children they care for) living in high ethnic density areas may help to provide better evidence on the pathways by helping us to understand the lack of association observed in studies of young people (Jun et al., 2020; Jonsson et al., 2018; Astell-Burt et al., 2012).

Although some studies to date have analysed ethnic density in a categorical form (such as via quintiles: Schofield et al., 2011; Yan et al., 2019, via quartiles: Pickett et al., 2009, and via tertiles: Astell-Burt et al., 2012; Boydell et al., 2001), no study has directly addressed nor provided any clear evidence of a threshold effect in a UK context. This is an important topic for future study as it is possible that very high levels of density may attract more racism, potentially reversing the protective effects of ethnic density. Research from a US context has indicated a threshold effect for 'Black' people, whereby the protective effect of density became detrimental at the highest level of density (85%) (Bécares et al., 2014). While it is worth noting that the range and distribution of ethnic density is very different in the UK, a threshold effect may still operate at a lower absolute level, and this warrants further investigation.

9.5 Recommendations

The results of this study from both the systematic review and empirical analyses emphasise the need to carefully consider the meaning of ethnic density for different ethnic groups. The MG-MSEM analyses suggest that the effect of area-level overall minority ethnic density is differently associated with racism across ethnic groups. In addition, the qualitative evidence summarised in the systematic review suggests that neighbourhood qualities and the people who live there may have different meanings for different ethnic groups (Bécares and Nazroo, 2013). It is therefore important not to homogenise diverse ethnic groups or to make assumptions about the experience of different minority ethnic groups. This has implications for the way in which public health practitioners and researchers understand the role of the proposed pathways operating behind the ethnic density effect.

The results of this study suggest that protection from interpersonal racism is likely one of the primary benefits conferred to people from minority ethnic backgrounds living in areas of high overall minority ethnic density. By definition therefore, it suggests that greater discrimination is encountered when living in areas with more people from a White British background. This has implications for policy and public discourses around integration, segregation and community cohesion. Indeed, the "Integrated Communities Strategy" green paper lists 'segregation' as one of the main issues alongside other issues relating to community cohesion (HM Government, 2018). In addition, the "Building cohesive communities: an LGA guide" (Local Government Association, 2019) continued to reference 'segregation' as an issue and the associated data presented in the LG Inform report tracks the index of dissimilarity as a key indicator (LGA Research Team, 2019). However, in the wake of Brexit, the prevailing hostile environment and sustained high levels of hate crimes motivated by racism (Home Office, 2021), if one of the principal benefits of living in high ethnic density areas is protection from racism, then it is unlikely that this spatial clustering will change. In addition, if one of the underlying determinants of moving and neighbourhood selection is economic factors (Coulter 2013; Clark and Ledwith, 2007), and people from minority ethnic backgrounds remain underrepresented in higher-paying professions (Brynin and Güveli, 2012), this also suggests residential patterns are unlikely to change. The current political climate towards migrants and the consequences (intended or not) these have on non-migrant minority ethnic people, combined with ethnic inequalities in income and employment, is therefore at odds with political goals relating to integration, social cohesion and equality.

Finally, throughout this thesis I have attempted to emphasise that there is no place for an a-historical, a-theoretical approach to studying ethnic density. Future research must adequately consider the role of context and processes of racialisation in determining the effect of ethnic density on health and must justify the choices of scale used and mechanisms tested with theory and/or evidence. Furthermore, research on the ethnic density effect would benefit from a greater consideration of structural racism, both in determining resource access and residential patterns, but also in understanding the temporal relevance and meaning of ethnic density. The UKHLS data employed in this theory covered the period of the explicit introduction of the hostile environment (Griffiths and Yeo, 2021). However, it was not possible to assess the potential implications of this due to the cross-sectional approach taken. Future research assessing the possible changes in the ethnic density effect after the incidence of divisive political action, such as the Brexit vote, could shed more light on the temporally contingent meaning and importance of living in more ethnically dense areas.

9.6 Conclusion

This thesis sought to collate the UK based evidence on the pathways between ethnic density and mental health and to operationalise this knowledge into a theoretical framework which could be tested through a quantitative empirical analysis for specific ethnic groups. The findings of the systematic review indicated that four main pathways have been tested to date: racism, social support, social capital and cohesion, and social stress. The most consistent and largest volume of evidence was found for the racism and social capital and cohesion pathways, though these were inconsistently tested, and findings varied across ethnic groups. The theoretical framework drawn from the results places an emphasis on three of these pathways: social capital and cohesion, social support and racism.

Results of the descriptive analyses using UKHLS data showed that there were generally few statistically significant associations between ethnic density and mental health. However, statistically significant associations with mental health and ethnic density were observed for the social capital and cohesion and racism pathways. Both social support and social stress appeared to not be related to mental health, though they were associated with ethnic density for some groups. The ethnic density measure used (whether overall minority ethnic or own-group) impacted the associations observed, reducing the effect sizes in some instances and increasing them in others. Results from the EFA and ML-CFA indicated that, in this sample, social cohesion could be measured by two factors, belonging and social capital at the individual level, but that it was best measured by just one social cohesion factor at the area level. MGCFA showed that at the individual level, the measurement of social cohesion by two factors, belonging and social capital, and the extent to which each questionnaire item predicted these factors were comparable across ethnic groups. Finally, results of the MG-MSEM model suggested that ethnic density was protective of racism and that the effect of ethnic density on racism differed significantly across ethnic groups. In addition, evidence for a full indirect effect of racism in the ethnic density effect was found for the Indian group. However, social cohesion, measured as a latent variable, did not appear to be associated with mental health or ethnic density in this model.

The proportion of people identifying as beloning to a minority ethnic group in Egland and Wales continues to increase (ONS, 2020) and inequalities in mental health remain across these ethnic groups (McManus et al., 2016; Halvorsrud et al., 2019; Weich et al., 2004). Improving our understanding the pathways by which ethnic density affects mental health is therefore important for identifying potential avenues for reducing these health inequalities. This thesis has contributed to

the literature base by providing better evidence on the pathways operating between ethnic density and mental health for specific minority ethnic groups. It adds weight to the argument that the combined minority ethnic category is too crude in ethnic density research, and that the use of finer ethnic categorisations can reveal important heterogeneity. It suggests that further investigation is required to understand these differences and that an investigation of the role of Islamophobia in particular could be valuable, given the high levels of hate crime reported for this group (Home Office, 2021). In addition, the results of this study suggest that protection from interpersonal racism is likely one of the primary benefits conferred to people from minority ethnic backgrounds living in high minority ethnic density areas. This echoes the findings of research using similar methods from a US context (Bécares, 2014). By definition, in utilising an overall minority ethnic density measure, the findings suggest that greater discrimination is encountered when living in areas with more people from a White British background. The sustained concern over the residential patterns of minority ethnic people in political discourse, demonstrated by the discussion of 'segregation' in recent government documents on cohesion and integration (HM Government, 2018 and LGA Research Team, 2019), is therefore perhaps misplaced. The results of this thesis suggest that protection from racism is likely the primary benefit conferred when living in an area of high minority ethnic density.

10 Appendices

10.1 Ethical approval and the role of PPI

Ethics

This project and its associated patient and public involvement work was approved by the University of Sheffield ethics system (approval granted 12/11/2019, application reference number 028028). The ethics application was updated during the research to reflect changes in appropriate research practices during the Covid-19 pandemic (Covid update approved 26/06/2020). Previous to the update, all PPI sessions had been conducted in a face-to-face, focus group style setting. However, the ethics update instead moved all future PPI sessions to be online only.

Patient and Public Involvement

Patient and public involvement (PPI) formed an important part of this project and is a required element of NIHR funded research. The aim of patient and public involvement is to provide opportunities for the public to engage with research, so that their experiences are reflected in the research. In this project, PPI events were not seen as data collection exercises and the ideas and discussions resulting from the events were not treated as data. PPI events were treated as a formative exercise and were used to guide the research, so that the knowledge of participants was reflected in the decisions made for the project.

Several events were held throughout the project aimed at involving the public. These events took the form of focus groups in which a number of people from the local area were brought together for a short period (usually between one and two hours) to discuss a pre-defined topic. Materials detailing the topic of the session were circulated to participants prior to the event and all participants were reimbursed with shopping vouchers to the value of approximately £15 per hour as per the NIHR Involve guidelines (NIHR, 2020). The PPI events were supported with the use of hand-outs, power point slides and note paper, encouraging verbal discussions and written notes.

PPI sessions were conducted at important stages of the research process including in research question formulation, research design and in the presentation and interpretation of the findings. The first of these sessions used an established PPI group set up by a local GP with 12 attendees from the local area, lasting approximately 45 minutes. The aim of this session was to clarify the research questions. In particular, this session focused on questions surrounding what the group felt was most

important to them in terms of diversity and cohesion in their local area. For the second PPI session, participants with a greater variety of experiences were sought. In order to achieve this, a group was assembled using the expert knowledge of a staff member at a local community health centre to help identify and invite participants from a variety of backgrounds and with diverse experiences of the local area. This session lasted approximately 2 hours and had 10 attendees. The main purpose of this session was to gain a better understanding of some of the pathways that might operate between ethnic density and mental health from the perspective of members of the public. This helped to clarify the most important pathways to assess in the quantitative data and to identify any important pathways not yet identified in the existing research. Both of these in-person sessions helped to guide my approach to the project and my thinking about how the ethnic density effect may operate.

10.2 Comparison of existing reviews

Table 10-1 - Comparison of existing systematic reviews on the ethnic density effect

Ethnic Density & Health Reviews							
Article title	**Authors**	**Year**	**Country context**	**Type of review & method**	**Number of articles included**	**Aims & scope**	
1. Minorities and mental health	Halpern D.	1993	Mostly US & UK	Narrative synthesis	(not clear/not systematic)	"This paper will attempt a comprehensive exploration of the relationship between the experience of minority status and mental health. The idea will be explored that the mental health of a group's members is fostered or protected by higher group concentration: a generalized 'group density effect'" p.597	**Conclusions/key points** "In sum, the evidence supports the intuitively plausible conclusion that in terms of mental health, it should be 'integration' rather than 'assimilation' that should be sought as a route towards future parity between groups." p.605 **Concepts Covered** Social 'drift' (includes diagram explaining this concept), argues against selection theory, ethnic minorities not homogenous group and different effects seen by different ethnic groups, difference between within ethnic group effect and between ethnic group effect, role of unit of analysis of density, other aspects of identity density are also important. **Pathways discussed** Stress, social support, prejudice as a chronic stressor, minority group experience of change and dislocation, social and cultural belonging and identity

							Limitations of reviewed literature/gaps Unit of analysis of density not consistent and not as plausible at a regional or national level compared to neighbourhood, measures of mental health need to be better considered
2. Racial residential segregation: a fundamental cause of racial disparities in health	Williams D R., Collins C.	2001	US (with reference to Macintyre's work in Glasgow)	Narrative synthesis	(not clear/not systematic)	"We review evidence that suggests that segregation is a key determinant of racial differences in socioeconomic mobility and, additionally, can create social and physical risks in residential environments that adversely affect health." p.116	**Conclusions/key points** "The evidence reviewed suggests that racial residential segregation, an institutional manifestation of racism, is one of the most important "spiders" responsible for persisting black-white inequalities in health. Effective efforts to reduce racial disparities in health status should seriously grapple with reducing racial disparities in socioeconomic circumstances, and with targeting interventions not only at individuals but also at the geographic contexts in which they live." p.413 **Concepts Covered** Access to education and work, role of SES, institutional racism, pathogenic residential conditions, unequal access to services, medical care quality and access **Pathways discussed**

							Racism and prejudice, unequal access to services **Limitations of reviewed literature/gaps** -"Research is needed to explore the extent to which segregation affects the health of other minority populations and to identify the fundamental causes of all racial/ethnic disparities in health" - "The consequence of segregation for whites is another issue worthy of careful empirical scrutiny." - "Research is needed to catalogue and quantify the specific aspects of the social and physical environments of segregated neighbourhoods that are plausibly linked to health." - "The conditions under which segregation can positively and negatively affect health are not well understood" - "Additionally, theoretically driven multilevel analytic models are needed that will identify how characteristics of the physical and social environment relate to each other and combine with individual predispositions and characteristics in additive and interactive ways to influence health" all p.412
3. Future directions in residential segregation and health	Acevedo-Garcia D., Lochner K A., Osypuk, T L.,	2003	US only	Narrative synthesis	29	"The authors examine the research evidence on the effect of residential	**Conclusions/key points** "to assess the role of residential segregation in racial/ethnic health disparities, there is a need for a multilevel approach grounded in both the sociological and social epidemiology

research: a multilevel approach	Subramanian S V.					segregation on health, identify research gaps, and propose new research directions." (p.215)	literatures on neighbourhood effects and residential segregation." P.215 **Concepts Covered** Density of other identity aspects, ethnicity as a stronger driver of spatial grouping than SES, geographic patterns of segregation **Pathways discussed** Neighbourhood effects, socio-economic attainment, experiences of racism/discrimination, concentration of poverty **Limitations of reviewed literature/gaps** -Future research needed to improve focus on conceptual frameworks and pathways - "Future studies should explore whether segregation across various minority groups has similar effects on health outcomes" p.218 - "Much of the conceptual complexity present in the sociological literature has yet to be incorporated into the social epidemiological research on residential segregation and health." p.218 - "Future research should emphasize the conceptualization of specific pathways through which various segregation dimensions may be positively associated with both overall and cause-specific mortality and morbidity in various age groups and operationalize such pathways through the use of multiple

							(conceptually justified) segregation indexes." p.218
4. People like us: ethnic group density effects on health	Pickett K E., Wilkinson R G.	2008	Global	Narrative synthesis	(not clear/not systematic)	"In this paper we survey published research on ethnic group density and health with the aim of stimulating further research. We go on to discuss processes which may underlie ethnic density effects, and highlight gaps in the literature and opportunities for further research." p.321	**Conclusions/key points** Members of ethnic minorities who live in areas where there are few like themselves are likely to be materially better off, and vice versa but they may be made more aware of belonging to a low status minority group, and the psychosocial effects of stigma may offset any advantage. "If the psychological effects of stigma are sometimes powerful enough to override material advantage, this may have implications for our understanding of how low social status affects health more generally" p.321 Ethnic density effects may vary by age in Black populations in the US. Density by religion/occupation/class may also be important. "In conclusion, there is a growing body of evidence that ethnic group density may affect both mental and physical health, although further work is needed to clarify the scope and magnitude of effects and the underlying mechanisms." p.331 **Concepts covered** Numerous health outcomes including morbidity/mortality, mental health and pregnancy outcomes. Ethnicity as a structure that affects health not ethnicity as identity.

							Pathways discussed Social anxiety, fear of crime/attack, Durkheim & social relationships, stigma, exposure to racism **Limitations of reviewed literature/gaps** -"The scale within which group density effects have most salience remains an open question." p.325 -"Longitudinal studies of ethnic density and migration are needed…" p.330 - "Other methodological issues that could be addressed in future research include systematic explorations of whether or not group density effects are a generalised phenomenon among all minority groups or only among low status groups, or only among particular ethnic minorities at specific times in specific places." p.330 -"More research is also needed to explore whether the underlying mechanisms reflect the positive effects of social integration in high density areas or the negative impacts of racism and/or stigma in low density areas." p.330 -"The 'tipping point' or degree of density needed to exert a protective effect on health remains unknown, as is the size of the area/community within which these effects are most relevant." p.331

							-" further work is needed to clarify the scope and magnitude of effects and the underlying mechanisms" p.331
5. Is segregation bad for your health?	Kramer M R., Hogue C R.	2009	US only	Narrative synthesis	39	"Utilizing a systematic review of the health and social science literature, the authors consider the segregation-health association through the lens of 4 questions of interest to epidemiologists: How is segregation best measured? Is the segregation-health association socially or biologically plausible? What evidence is there of segregation-health associations? Is segregation a modifiable risk factor?" p.178	(Search conducted in September 2008) **Conclusions/key points** Proportions of ethnic groups are incomplete measures of residential distribution. "The weight of the available evidence is that the process of racial residential segregation is associated with generally deleterious health of African Americans, and particularly for poor pregnancy outcomes, but this evidence is limited in many regards." p.189 **Concepts Covered** Five dimensions of segregation, SES, limited housing choices, limited job choices, Differential access to health resources, measures to change segregation levels, structural racism **Pathways discussed** Produces theoretical framework explaining the possible pathways between segregation and health. Socioeconomic status, unhealthy environments, modifiers of social capital, individual risk behaviour **Limitations of reviewed literature/gaps** - "The majority of reviewed studies are cross-sectional and use coarse measures of segregation." P.178

							- "continued development of methodological and conceptual tools to better understand residential segregation is necessary" p.198 - "Future work should extend recent developments in measuring and conceptualizing segregation in a multilevel framework" p.178 -Future work should "utilize longitudinal data sources to illuminate opportunities for public health action to reduce racial disparities in disease" p.178
6. Separate and Unequal: Residential Segregation and Black Health Disparities	Landrine H., Corral I.	2009	Mostly US	Narrative review (of theory)	(not clear/not systematic)	"We summarize the research needed on the role of segregation in health disparities and emphasize the hypothesis that these may be differences between Whites and segregated Blacks alone." p.179 "This review details the empirical evidence for 3 separate pathways through which segregation contributes to, and indeed may account	**Conclusions/key points** "Thus, Black-White health disparities might be better understood and eliminated by focusing, not on Black people and cultures, but on Black places and contexts." p.183 **Concepts Covered** Number of health outcomes covered including mortality, CVD and asthma, health behaviours, pollutants, local health care service standards, access to facilities **Pathways discussed** They produce model showing "segregation and black health disparities" which highlights environmental exposures, disparities in healthcare quality and disparities in the built environment. **Limitations of reviewed literature/gaps** -limited study on effects on White population

						for, Black health disparities." p.179	- "Studies that use multilevel modeling to control for both neighborhood and individual level SES would be most beneficial, given that current studies tended to control for only one of these."p.182
7. Racial/ethnic residential segregation: framing the context of health risk and health disparities	White K., Borrell L N.	2011	US studies only	Narrative review	45	"…the present review seeks to distinctly contribute to the discourse on segregation and health by focusing on select conceptual (operationalizing segregation as a formal versus proxy measure), methodological (macro-area unit of analysis used to measure segregation), and analytical (i.e. testing mediating pathways, effect modification, test of causality) concerns in empirical segregation and health research." p.439	(Searches conducted between 1950 and 2009) **Conclusions/key points** "The majority of the reported findings to date identify an association between residence in highly segregated areas and deleterious health outcomes, and to a lesser extent suggest a protective effect of segregation." p.441 "…there is some evidence suggesting that there are social resources within segregated neighbourhoods that may mitigate against the material disadvantage" p.446 **Concepts covered** Scale of measurement, conceptual pathways, segregation measures measure different conceptual pathways, modifiable areal unit problem, length of residency and accumulation of exposure, role of 'nativity status' in segregation, 5 geographic patterns of segregation **Pathways discussed** Protection from racism, social capital **Limitations of reviewed literature/gaps**

							- “the lack of differentiation between a formal and a proxy measure of segregation could possibly underestimate associations as well as overlook potential policy opportunities for targeting health disparities” p.442 - “Future studies should attempt to examine the differences between formal versus proxy measures in relation to health outcomes” p.442 - “Future studies to describe the effects of segregation at different levels of geography and to understand the influence of MAUP on segregation estimates should be a priority.” p.443 - “Future studies investigating the role of residential segregation and its contribution to health risk and health disparities should test specific intermediary pathways at both the individual- and neighbourhood levels” p.444 - “Uncovering the differential effect of segregation by neighborhood characteristics should be a high priority in future studies.” p.444 - “It is important that future studies determine the health outcomes, behaviours, and factors associated with resilience that may buffer against and compensate for material deprivation of segregated communities.” p.445 - “Studies exploring experiences of discrimination, social capital, and social support are needed” p.444-445

8. Impact of ethnic density on adult mental disorders: narrative review	Shaw, R.J., Atkin, K., Bécares, L., Albor, C.B., Stafford, M., Kiernan, K.E., Nazroo, J.Y., Wilkinson, R.G. and Pickett, K.E.	2012	USA and UK	narrative review of studies published up to January 2011	34	"To systematically identify relevant studies, summarise their findings and discuss potential explanations of the associations found between ethnic density and mental disorders" p.11	(Searches performed from the earliest date available in each database to January 2011) **Conclusions/key points** "The most consistent associations with ethnic density are found for psychoses. Ethnic density may also protect against other mental disorders, but presently, as most studies of ethnic density have limited statistical power, and given the heterogeneity of their study designs, our conclusions can only be tentative." p.11 **Concepts covered** Different ethnic groups and varying outcomes, context, different mental health outcomes, sample size **Pathways discussed** "Countering the adverse material effects of deprived areas, often where ethnically dense communities are found, mental health benefits may be derived from enhanced social support, mitigated racism, positive identity and higher self-evaluation. However, it must be noted that these are theoretical mechanisms, and they have received very little investigation in the context of ethnic density" p.16 **Limitations of reviewed literature/gaps** -The theoretical mechanisms have received little exploration

							- "It is not clear either theoretically or empirically whether or not ethnic density operates at small or large scales" p.17 - "…with such a high level of heterogeneity, it was not possible to conclusively attribute the variation in results to any particular methodological differences between studies, or to contextual differences, such as the national setting or minority ethnic group analysed" p.17 - "Further research with improved methods, such as larger sample sizes and longitudinal designs, may allow for stronger conclusions." p.17
9. Ethnic Density Effects on Physical Morbidity, Mortality, and Health Behaviors: A Systematic Review of the Literature	Bécares L., Shaw R., Nazroo J., Stafford M., Albor C., Atkin K., Kiernan K., Wilkinson R., and Pickett K.	2012	Mostly US and UK (five studies not from these countries)	Systematic review with narrative discussion	57	"Our purpose in this study was to systematically review the literature examining the ethnic density effect on physical health, mortality, and health behaviours." p.33 "The aim of this study was to systematically review the literature examining the ethnic density effect on physical health,	(Searches performed from the earliest date available in each database to 2011) **Conclusions/key points** Associations vary by ethnic group and location (US vs UK). Extent and nature of density is vastly different in the US compared to UK. The null results found in UK are likely a result of smaller sample sizes. Effects of density on health conditions other than mental health may have a lag as they may be impacted first via effects on mental health. They argue that it is more likely to find relationship with mental health outcomes than other health outcomes because of this. **Concepts covered** Density, number of health outcomes including behaviours and mortality, different ethnic

						mortality, and health behaviours" p.33	groups, measurement of density (measured by own ethnic density vs. overall ethnic minority density) **Pathways discussed** Perceived ethnic density to capture actual intensity of contact with people of similar ethnicity may better at reflecting actual social/cultural experience of neighbourhood. Density reduces interpersonal discrimination and moderates the effect of racism on health. Acculturation and social norms **Limitations of reviewed literature/gaps** - "Only a handful of studies have focused on understanding the mechanisms by which ethnic density protects the health of racial/ethnic minorities." p.64 -Existing studies limited by sample sizes & cross sectional nature -varying measures of 'neighbourhood' and inclusion of different potential confounders limits comparability of studies.
10. A systematic review and meta-analysis of the ethnic density effect in psychotic disorders	Bosqui T J., Hoy K., Shannon C.	2014	7 UK, 1 Netherlands	Meta-analysis and narrative synthesis	8	"This review aimed to establish the existence of the effect by answering the review question: is there an ethnic density dose effect in the prevalence of	(Searches conducted between January, 1930 and November, 2012) **Conclusions/key points** "This review provides strong evidence for an overall ethnic density dose effect for ethnic minorities in the UK and The Netherlands. It also highlights the need for future research of individual ethnic groups to gain a better insight into the protective effects of ethnic

						psychotic disorders?" p.519	density, and to inform public health policy and service provision to prevent the neglect of at-risk groups in increasingly diverse societies." p.528-529 Ethnic minorities are not a homogenous group and effects vary between groups. Own group density may be the best measure of ethnic density. "Despite substantial evidence for an ethnic dose effect in psychotic disorders, the mechanism behind the effect is less clear." p.527 Future research needs to reflect differences within 'white' category. Ethnic density is likely to have a neighbourhood effect not a regional effect. **Concepts covered** The exclusion of white minority groups in UK studies, the mechanisms between ethnic density and psychotic disorders, differences in outcome by ethnic group (emphasised that ethnic minorities are not homogenous) **Pathways discussed** exposure to racism, social capital and social cohesion hypotheses **Limitations of reviewed literature/gaps** - "It would be useful for future systematic reviews to include immigrant status, to prevent the exclusion of possibly relevant

							studies" p.528 and include the density of other identity/social categories. -The mechanisms behind ethnic density remain unclear
11. Ethnic density effects for adult mental health: systematic review and meta-analysis of international studies	Bécares, L., Dewey, M.E. and Das-Munshi, J.	2018	Global (though mostly US, only 4 UK)	Meta-analysis and narrative synthesis	41 (12 in meta-analysis)	"The aim of the review and meta-analysis was to establish: (1) if ethnic density associations are evident, whether they are consistent across mental health outcomes including depression, anxiety and the common mental disorders (CMD), suicide, suicidality, psychotic experiences, and psychosis; (2) the nature and magnitude of ethnic density effects on mental disorders across and within countries, racial/ethnic groups, generational status, and by area-level deprivation." p.2055	(Searches performed until March 2016) **Conclusions/key points** "The findings support consistent protective ethnic density associations across countries and racial/ethnic minority populations as well as mental health outcomes" p.2054 "Assessment for a priori moderators indicated that these did not account for any observed heterogeneity across estimates" p.2066 "Racism and social support were the most commonly examined mechanisms" p.2066 "Where it was possible to assess adjustment for area-level deprivation, protective ethnic density associations became stronger or more apparent, and detrimental ethnic density associations reversed direction into a positive association" p.2066 **Concepts covered** The authors argue against the 'drift' hypothesis. They discuss the role of social environment on health, social exclusion, positive mental health impacts of density, and argues against dispersal programs **Pathways discussed** racism, social support, social cohesion, acculturation and stress briefly mentioned

							Limitations/gaps -The only studies included assessing ethnic density and CMD outcomes were from USA population studies -Only 4 studies looked at UK -Papers included in meta-analysis all from USA -The mechanisms underlying ethnic density effects are not yet fully understood -The studies included in meta-analysis are all cross sectional - "Future research should consider the development of mental health disorders and the exposure to socio-environmental stressors earlier in the life course" p.2069
12. Racial/ ethnic segregation and health disparities: Future directions and opportunities	Yang T C., Park K., Matthews S A.	2020	US only	Narrative synthesis	66	"This systematic review has three goals: First, to review the literature that has been published since 2003 that used a multilevel research framework to investigate the relationships between racial/ethnic segregation and health; second, to evaluate the extent to which racial/ethnic segregation may	(Search performed between 2003 and 2019) **Conclusions/key points** "found four major gaps in racial/ethnic segregation and health disparities: (a) the concept of segregation was rarely operationalized at the neighborhood level, (b) except for the evenness and exposure dimension, other dimensions of segregation are overlooked, (c) little attention was paid to the segregation between whites and non-black minorities, particularly Hispanics and Asians, and (d) mental health outcomes were largely absent." p.1 "Future directions and opportunities include: First, other segregation dimensions should be explored. Second, the spatial scales for segregation measures should be clarified. Third, the theoretical frameworks for black

						account for health disparities, and third, to discuss future research directions in this area." p.2	and non-black minorities should be tested. Fourth, mental health, substance use, and the use of mental health care should be examined. Fifth, the long-term health effect of segregation has to be investigated, and finally, other competing explanations for why segregation matters at the neighborhood level should be answered." p.1 "Regarding the health outcomes studied in our review, the literature mainly focused on maternal and infant health and obesity-related outcomes" p.19 **"**The majority of studies in our review (56 out of 66) reported that segregation adversely relates to health outcomes and/or widens racial/ethnic health disparities, particularly between blacks and whites" p.19 **Concepts covered** Segregation and different measures of segregation, geographical scale importance, **Pathways discussed** Structural racism, lack of services/poverty, employment and educational opportunities, unhealthy built environment, acculturation, social capital and social relationships **Limitations/gaps** **- "**Future research should clearly define and justify the main spatial scale of interest" p.21

							- “several important questions remained unanswered in the literature, such as whether the effect of segregation on health can be cumulative and whether, from the life course perspective, the segregation experience at a certain life stage (e.g., childhood) is more important than that at a different stage (e.g., adulthood).”p.24-25 - “it is also important to investigate whether the change in segregation over time within a neighborhood is associated with the health outcomes of the residents” p.25 -Factors relating to the built environment have been understudied -Lack of research from a longitudinal approach - “the concept of social capital should be better measured at the neighborhood level and included in future studies in order to test whether the protective effect of segregation on health among non-black minorities can be attributed to social capital.” p.25 -“ Two major shortcomings are prevalent in the literature. First, the definition of racial/ethnic health disparities is still focused on the differences between blacks and whites; the differences between whites and the two fast growing race/ethnicity groups, Hispanics and Asians, are largely overlooked. Second, urban sociologists have discussed the complexity of segregation and identified five unique dimensions (Massey & Denton, 1988),

							but few health scholars have taken this complexity into account" p.26
13. The ethnic density effect in psychosis: a systematic review and multilevel meta-analysis	Baker, S., Jackson, M., Jongsma, H. and Saville, C.W.	2021	Global	Narrative review and meta-analysis	Narrative synthesis: 32 Meta-analysis: 10	"To conduct a comprehensive systematic review and meta-analysis of the group density effect in psychosis and examine moderators." p.1 "we aim to conduct a comprehensive systematic review and meta-analysis of the group density effect in psychosis and examine potential moderators, particularly those associated with specific minority groups." p.1	(Searches performed in May 2019 and August 2020) **Conclusions/key points** "A 10 percentage-point decrease in own-group density was associated with a 20% increase in psychosis risk (OR = 1.20, 95% CI 1.09−1.32, P < 0.001). This was moderated by crudely defined minority groups (F6,68 = 6.86, P < 0.001), with the strongest associations observed in Black populations, followed by a White Other sample. Greater heterogeneity was observed when specific minority groups were assessed (F25,49 = 7.26, P < 0.001)." p.1 "…the risk of psychosis posed by lower own-group density varies across minority groups, with the strongest associations observed in Black individuals. Heterogeneity in effect sizes may reflect distinctive social experiences of specific minority groups" p.1 "Specific marginalised and minority groups have distinct social experiences, so investigating group density relationships in combined samples might mask important group differences" p.1 "In line with previous narrative reviews,10,17 we observed the strongest group density associations in Black individuals." p.6 **Concepts covered**

							The importance of socio-political context of understanding different effects across ethnic groups and across countries, using smaller ethnic groupings, MAUP, **Pathways discussed** Attenuated risk and impact of racism, anticipated discrimination from health services, stress of marginalisation (both minority ethnic groups and migrants), language barriers, minority stress model, social defeat model, social identity theory **Limitations of reviewed literature/gaps** "Most studies were conducted in similar settings and time periods; there is a dearth of research from outside Europe, for example" p.7 "most reviewed studies were cross-sectional … there is a clear need for further longitudinal studies to identify causal pathways." p.7 "…it is difficult to disentangle the contextual and compositional effects104 of own-group density. There is a clear need for longitudinal designs and demonstrations that associations persist across different settings and time periods." p.9 "Future work should also test for group density associations in minorities defined by other characteristics." p.9

10.3 PROSPERO study protocol

https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=137374

10.4 Search strategy example

Example search strategy (searched on 17/06/2019)

Web of Science core collection

((TS= ("ethnic composition" or "ethnic enclave" or "ethnic density" or "ethnic segregation" or "ethnic separation" or "ethnic concentration" or "ethnic homogeneity" or "group concentration" or "group density" or "minority concentration" or "minority density" or "racial composition" or "racial concentration" or "racial homogeneity" or "racial density" or "racial segregation" or "residential concentration" or "residential segregation" or "own group concentration" or "own group density" or "out-group" or "out-group density") AND TS=("well-being" or "wellbeing" or "well being" or schizophrenia or suicid* or "self harm" or "self-harm" or psychological or depression or anxiety or stress or DSH or "mental health" or "common mental disorders" or CMD or "psychotic experience*" or "psychotic episode*" or OCD or PTSD or psychosis or "severe mental illness*"))) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Article) AND (CU= (UK or England or Wales or Scotland or Ireland or Britain)) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Article)

10.5 Qualitative studies (including one mixed method study with a qualitative element)

Table 10-2 - Included qualitative studies

Authors	Year	Title	Data
Bécares L., Nazroo J.	2013	Social capital, ethnic density and mental health among ethnic minority people in England: a mixed-methods study	33 in-depth interviews
Campbell C., McLean C.	2002	Ethnic identities, social capital and health inequalities: factors shaping African-Caribbean participation in local community networks in the UK	25 open ended interviews
Ochieng B. M. N.	2011	The effect of kin, social network and neighbourhood support on individual well-being	Two-three interviews with each of the 10 household units (24 adolescents, 18 adults) for approximately seven hours each
Polling C., Woodhead, Harwood, H., Hotopf, M. and Hatch S L.	2020	"There Is So Much More for Us to Lose If We Were to Kill Ourselves": Understanding Paradoxically Low Rates of Self-Harm in a Socioeconomically Disadvantaged Community in London.	14 interviews and two focus groups (with 12 participants), ranging in length from between one and two hours
Schofield, P., Kordowicz, M., Pennycooke, E. and Armstrong, D.	2019	Ethnic differences in psychosis—Lay epidemiology explanations	35 participants and a total of four focus groups of different ethnic groups and of different sizes (between three and 14 participants)
Wainwright, J., McKeown, M. and Kinney, M.	2019	"In these streets": the saliency of place in an alternative black mental health resource centre	25 participants, one introductory meeting, four focus groups and two individual interviews
Whitley, R., Prince, M., McKenzie, K. and Stewart, R.	2006	Exploring the ethnic density effect: a qualitative study of a London electoral ward	32 residents participated in focus groups or in-depth interviews, plus participant observation

10.6 Understanding Society ethics statement

The University of Essex Ethics Committee has approved all data collection on Understanding Society main study and innovation panel waves, including asking consent for all data linkages except to health records. Requesting consent for health record linkage was approved at Wave 1 by the National Research Ethics Service (NRES) Oxfordshire REC A (08/H0604/124), at BHPS Wave 18 by the NRES Royal Free Hospital & Medical School (08/H0720/60) and at Wave 4 by NRES Southampton REC A (11/SC/0274). Approval for the collection of biosocial data by trained nurses in Waves 2 and 3 of the main survey was obtained from the National Research Ethics Service (Understanding Society - UK Household Longitudinal Study: A Biosocial Component, Oxfordshire A REC, Reference: 10/H0604/2).

10.7 Supplementary descriptive statistics – participants per area per ethnic group

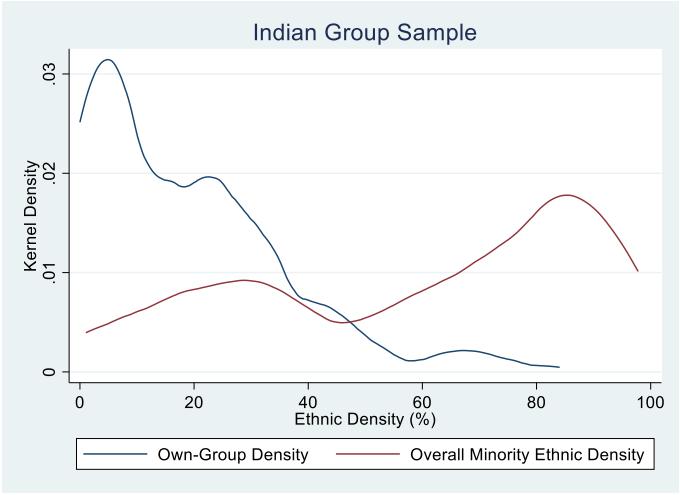
Table 10-3 - Participants per area unit and coverage of areas by ethnic group

	Participants per MSOA	Participants per LSOA Average (SD) Range	Number of MSOAs	Number of LSOAs
Whole sample	2.72 (2.64) 1 - 31	1.87 (1.37) 1 - 15	1,295	1,884
White British	1.47 (0.67) 1 – 5	1.45 (0.66) 1 – 5	293	297
Indian	2.20 (1.55) 1 – 10	1.91 (1.17) 1 - 8	270	311
Pakistani	2.67 (2.27) 1 – 16	2.00 (1.36) 1 - 8	187	250
Bangladeshi	3.61 (5.17) 1 – 29	2.42 (2.38) 1 - 15	94	140
Black Caribbean	1.58 (1.02) 1 – 7	1.29 (0.64) 1 - 5	265	326
Black African	1.63 (0.92) 1 – 5	1.45 (0.75) 1 - 5	262	294
Mixed	1.29 (0.64) 1 – 4	1.21 (0.54) 1 - 4	244	259
Other	1.45 (0.85) 1 – 6	1.32 (0.66) 1 - 5	347	381

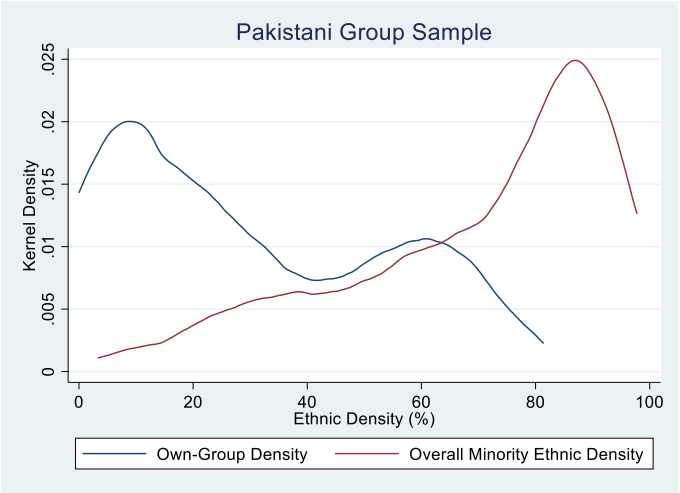
10.8 Distribution of ethnic density measures for separate ethnic groups and aggregated measures

Figure 10-1 - Kernel Density comparison graphs (all y axes scaled differently)

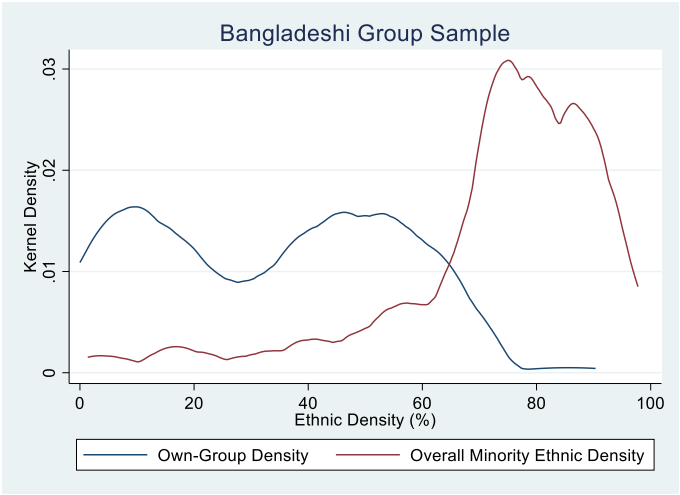
Indian



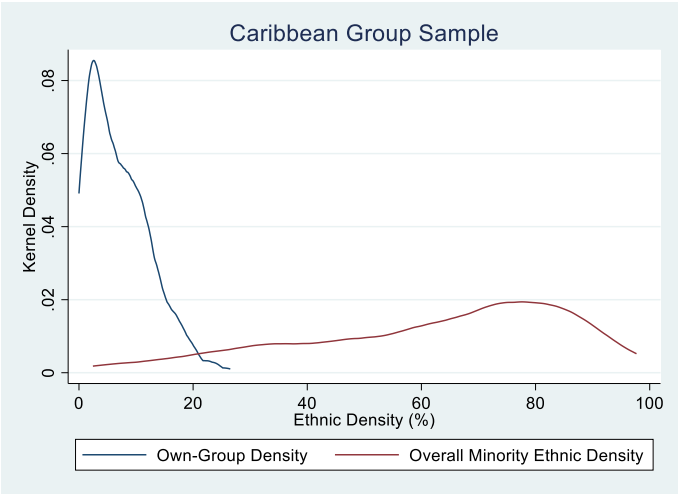
Pakistani



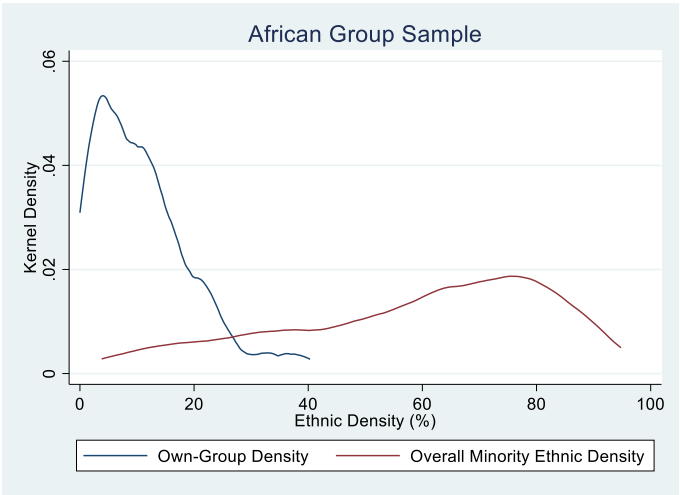
Bangladeshi



Black Caribbean



Black African



Analytical sample

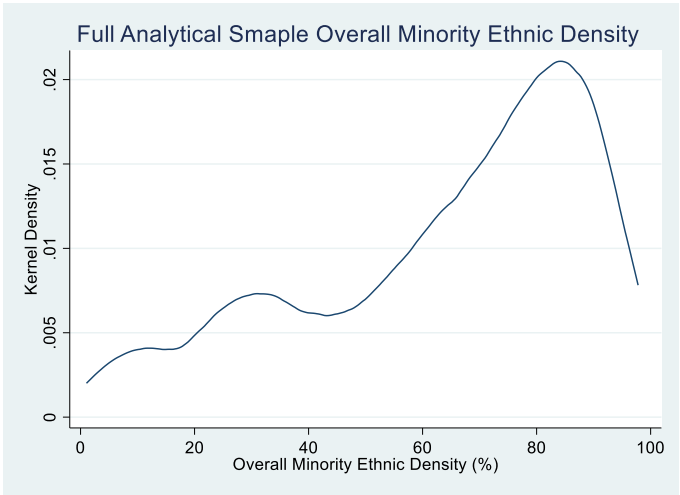


Table 10-4 - South Asian ethnic density

Ethnic group	South Asian Density	
	mean (SD)	Range
Indian	29.23 (22.88)	0.00-86.94
Pakistani	43.18 (25.19)	0.19-90.55
Bangladeshi	44.72 (21.51)	0.00-94.31
All South Asian minority ethnic groups	37.92 (24.47)	0.00-94.31

Figure 10-2 - South Asian ethnic density Kernel Density plot

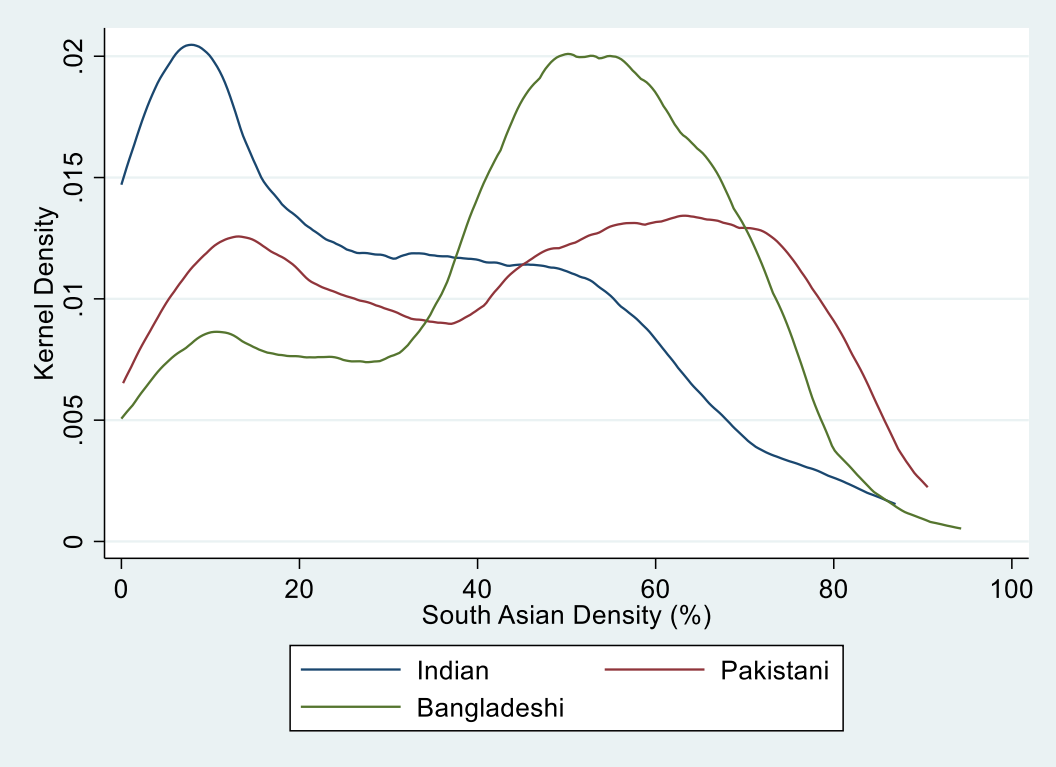
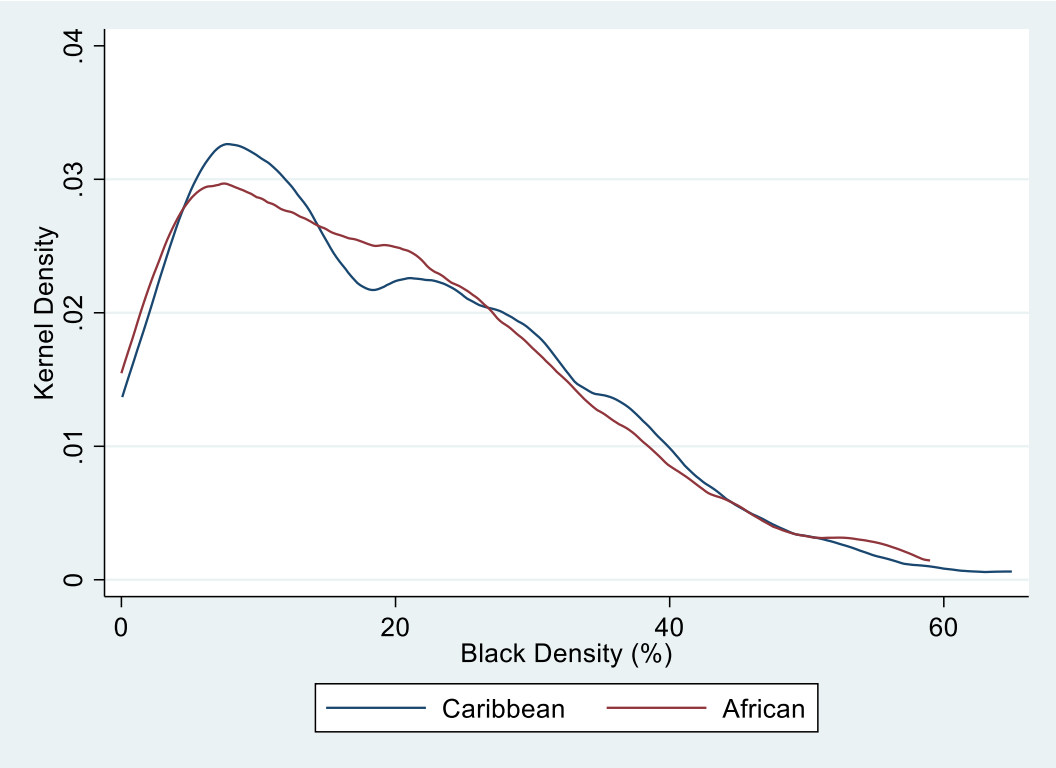


Table 10-5 - Black ethnic density

Ethnic group	Black Density	
	mean (SD)	Range
Black Caribbean	19.33 (13.43)	0.06-64.96
Black African	19.09 (13.51)	0.00-59.00
All Black minority ethnic groups	19.21 (13.46)	0.00-64.96

Figure 10-3 - Black ethnic density Kernel Density plot



10.9 Association between minority ethnic density and area level deprivation

Table 10-6 - Association between overall minority ethnic density and EID for the pooled analytical sample

	Model 1	Model 2	Model 3
Coefficient (SE)	228.97*** (9.28)	199.97*** (9.05)	204.72*** (8.89)

*p<0.05 ** p<0.01 *** p<0.001
Separate linear regression models. Full controls: age, sex, marital status, country of birth, household income, highest qualification, and area deprivation.
Model 1 = no controls, Model 2 = full controls, Model 3 = full controls + ethnic group

10.10 Descriptive table for each question of Buckner's social cohesion

Table 10-7 - Descriptive table of individual social cohesion scale items

		Minority ethnic	Indian	Pakistani	Bangladeshi	Black Caribbean	Black African
Belonging	Missing	1 (0.04)	1 (0.15)	-	-	-	-
	Strongly agree	404 (15.75)	96 (14.70)	91 (15.96)	77 (19.54)	74 (16.12)	66 (13.50)
	Agree	1,287 (50.18)	329 (50.38)	305 (53.51)	220 (55.84)	196 (42.70)	237 (48.47)
	Neither	664 (25.89)	184 (28.18)	127 (22.28)	79 (20.05)	143 (31.15)	131 (26.79)
	Disagree	154 (6.00)	31 (4.75)	31 (5.44)	15 (3.81)	38 (8.28)	39 (7.98)
	Strongly disagree	55 (2.14)	12 (1.84)	16 (2.81)	3 (0.76)	8 (1.74)	16 (3.27)
Friends	Missing	4 (0.16)	2 (0.31)	-	-	1 (0.22)	1 (0.20)
	Strongly agree	348 (13.57)	81 (12.40)	77 (13.51)	65 (16.50)	59 (12.85)	66 (13.50)
	Agree	1,168 (45.54)	319 (48.85)	292 (51.23)	201 (51.02)	178 (38.78)	178 (36.40)
	Neither	803 (31.31)	198 (30.32)	155 (27.19)	104 (26.40)	165 (35.95)	181 (37.01)
	Disagree	176 (6.86)	39 (5.97)	31 (5.44)	19 (4.82)	44 (9.59)	43 (8.79)
	Strongly disagree	66 (2.57)	14 (2.14)	15 (2.63)	5 (1.27)	12 (2.61)	20 (4.09)
Advice	Missing	4 (0.16)	2 (0.31)	-	-	1 (0.22)	1 (0.20)
	Strongly agree	348 (13.57)	81 (12.40)	77 (13.51)	65 (16.50)	59 (12.85)	66 (13.50)
	Agree	1,168 (45.54)	319 (48.85)	292 (51.23)	201 (51.02)	178 (38.78)	178 (36.40)
	Neither	803 (31.31)	198 (30.32)	155 (27.19)	104 (26.40)	165 (35.95)	181 (37.01)
	Disagree	176 (6.86)	39 (5.97)	31 (5.44)	19 (4.82)	44 (9.59)	43 (8.79)
	Strongly disagree	66 (2.57)	14 (2.14)	15 (2.63)	5 (1.27)	12 (2.61)	20 (4.09)
Favours	Missing	-	-	-	-	-	-
	Strongly agree	197 (7.68)	52 (7.96)	49 (8.60)	44 (11.17)	18 (3.92)	34 (6.95)
	Agree	750 (29.24)	190 (29.10)	197 (34.56)	141 (35.79)	108 (23.53)	114 (23.31)
	Neither	617 (24.05)	189 (28.94)	142 (24.91)	90 (22.84)	90 (19.61)	106 (21.68)
	Disagree	650 (25.34)	160 (24.50)	118 (20.70)	85 (21.57)	141 (30.72)	146 (29.86)
	Strongly disagree	351 (13.68)	62 (9.49)	64 (11.23)	34 (8.63)	102 (22.22)	89 (18.20)
Work together	Missing	1 (0.04)	1 (0.15)	-	-	-	-
	Strongly agree	457 (17.82)	96 (14.70)	89 (15.61)	72 (18.27)	85 (18.52)	115 (23.52)
	Agree	1,412 (55.05)	366 (56.05)	330 (57.89)	218 (55.33)	255 (55.56)	243 (49.69)

		Minority ethnic	Indian	Pakistani	Bangladeshi	Black Caribbean	Black African
	Neither	521 (20.31)	149 (22.82)	109 (19.12)	80 (20.30)	91 (19.83)	92 (18.81)
	Disagree	121 (4.72)	32 (4.90)	25 (4.39)	20 (5.08)	22 (4.79)	22 (4.50)
	Strongly disagree	53 (2.07)	9 (1.38)	17 (2.98)	4 (1.02)	6 (1.31)	17 (3.48)
Plan to stay	Missing	-	-	-	-	-	-
	Strongly agree	431 (16.80)	111 (17.00)	101 (17.72)	65 (16.50)	85 (18.52)	69 (14.11)
	Agree	1,106 (43.12)	319 (48.85)	259 (45.44)	206 (52.28)	153 (33.33)	169 (34.56)
	Neither	614 (23.94)	149 (22.82)	127 (22.28)	78 (19.80)	119 (25.93)	141 (28.83)
	Disagree	286 (11.15)	58 (8.88)	56 (9.82)	32 (8.12)	67 (14.60)	73 (14.93)
	Strongly disagree	128 (4.99)	16 (2.45)	27 (4.74)	13 (3.30)	35 (7.63)	37 (7.57)
Similar to others	Missing	2 (0.08)	1 (0.15)	-	-	-	1 (0.20)
	Strongly agree	295 (11.50)	71 (10.87)	76 (13.33)	52 (13.20)	44 (9.59)	52 (10.63)
	Agree	1,213 (47.29)	346 (52.99)	288 (50.53)	217 (55.08)	170 (37.04)	192 (39.26)
	Neither	701 (27.33)	164 (25.11)	137 (24.04)	85 (21.57)	163 (35.51)	152 (31.08)
	Disagree	264 (10.29)	55 (8.42)	40 (7.02)	30 (7.61)	66 (14.38)	73 (14.93)
	Strongly disagree	90 (3.51)	16 (2.45)	29 (5.09)	10 (2.54)	16 (3.49)	19 (3.89)
Talk	Missing	-	-	-	-	-	-
	Strongly agree	361 (14.07)	79 (12.10)	85 (14.91)	63 (15.99)	74 (16.12)	60 (12.27)
	Agree	1,238 (48.27)	327 (50.08)	297 (52.11)	196 (49.75)	216 (47.06)	202 (41.31)
	Neither	591 (23.04)	152 (23.28)	124 (21.75)	85 (21.57)	107 (23.31)	123 (25.15)
	Disagree	297 (11.58)	75 (11.49)	48 (8.42)	37 (9.39)	51 (11.11)	86 (17.59)
	Strongly disagree	78 (3.04)	20 (3.06)	16 (2.81)	13 (3.30)	11 (2.40)	18 (3.68)

10.11 Full MG-MSEM results table including control variables

Table 10-8 - Full MG-MSEM model (including covariate estimates)

	Indian beta (SE) N_i = 653 N_j= 320	Pakistani beta (SE) N_i = 570 N_j= 255	Bangladeshi beta (SE) N_i =394 N_j= 143	Black Caribbean beta (SE) N_i =459 N_j= 311	Black African beta (SE) N_i =489 N_j= 305
Individual level					
Factor loadings					
(Belong)- Belong	0.551*** (0.092)	0.551*** (0.092)	0.551*** (0.092)	0.551*** (0.092)	0.551*** (0.092)
(Belong)- Friends	0.705*** (0.030)	0.705*** (0.030)	0.705*** (0.030)	0.705*** (0.030)	0.705*** (0.030)
(Social Capital)- Advice	0.721*** (0.192)	0.721*** (0.192)	0.721*** (0.192)	0.721*** (0.192)	0.721*** (0.192)
(Social Capital)- Favours	0.544** (0.181)	0.544** (0.181)	0.544** (0.181)	0.544** (0.181)	0.544** (0.181)
(Social Capital)- Talk	0.502*** (0.080)	0.502*** (0.080)	0.502*** (0.080)	0.502*** (0.080)	0.502*** (0.080)
Regression paths					
Racism -> GHQ-12	2.634*** (0.869)	3.813** (1.255)	0.911 (1.234)	-1.242 (0.512)	-0.751 (0.963)
Belong -> GHQ-12	2.937 (8.087)	-7.336 (33.436)	-0.156 (11.201)	7.758 (24.237)	7.999 (27.190)
Social Capital -> GHQ-12	-1.692 (7.125)	-1.33 (34.072)	2.063 (12.247)	-6.524 (23.341)	-6.999 (26.467)
Control variable paths					
Age -> belonging	-0.007* (0.003)	-0.006 (0.004)	-0.015** (0.005)	-0.017*** (0.004)	-0.012** (0.004)
Sex -> belonging	-0.185** (0.068)	-0.019 (0.094)	0.083 (1.03)	0.206* (0.104)	0.072 (0.114)
Nativity -> belonging	0.390*** (0.111)	0.103 (0.119)	-0.137 (0.163)	0.064 (0.131)	0.346 (0.231)
Household income -> belonging	1.002* (0.504)	-0.098 (0.628)	-0.131 (0.628)	0.416 (0.486)	0.011 (0.362)
Highest qualification -> belonging	-0.087 (0.054)	-0.111* (0.051)	-0.049 (0.053)	0.041 (0.054)	0.049 (0.060)
Age -> social capital	-0.010 (0.006)	-0.015* (0.006)	-0.020* (0.009)	-0.017* (0.008)	-0.015* (0.007)
Sex -> social capital	-0.199 (0.112)	0.070 (0.101)	0.099 (0.129)	0.050 (0.118)	0.024 (0.127)
Nativity -> social capital	0.143 (0.153)	0.047 (0.125)	-0.010 (0.192)	0.056 (0.146)	0.177 (0.215)
Household income -> social capital	1.002* (0.504)	0.542 (0.784)	-0.204 (0.744)	1.077 (0.797)	0.564 (0.486)

	Indian beta (SE) N_i = 653 N_j= 320	Pakistani beta (SE) N_i = 570 N_j= 255	Bangladeshi beta (SE) N_i =394 N_j= 143	Black Caribbean beta (SE) N_i =459 N_j= 311	Black African beta (SE) N_i =489 N_j= 305
Highest qualification -> social capital	-0.085 (0.052)	-0.146** (0.054)	-0.053 (0.066)	0.052 (0.064)	0.077 (0.061)
Age -> racism	-0.001 (0.001)	-0.001 (0.001)	0.00 (0.001)	-0.001 (0.001)	0.000 (0.001)
Sex -> Racism	-0.022 (0.021)	-0.052* (0.025)	0.007 (0.001)	-0.027 (0.023)	0.006 (0.024)
Nativity -> Racism	0.001 (0.027)	-0.022 (0.026)	0.022 (0.027)	0.012 (0.025)	-0.002 (0.035)
Household income -> Racism	0.021 (0.095)	-0.003 (0.165)	-0.130 (0.217)	-0.177** (0.067)	-0.139* (0.065)
Highest qualification -> Racism	-0.005 (0.010)	-0.018 (0.010)	-0.013 (0.013)	0.008 (0.010)	0.005 (0.011)
Age -> GHQ-12	0.062* (0.025)	0.175 (0.349)	0.064 (0.089)	0.019 (0.041)	0.012 (0.106)
Sex -> GHQ-12	1.560*** (0.437)	0.956 (3.055)	1.157 (0.743)	-0.461 (3.986)	0.077 (1.447)
Nativity -> GHQ-12	0.209 (2.057)	0.638 (2.142)	-0.195 (1.617)	0.622 (0.943)	-1.428 (4.742)
Household income -> GHQ-12	-5.995* (2.339)	-13.449 (26.045)	-6.967* (3.430)	1.294 (17.951)	1.597 (16.279)
Highest qualification -> GHQ-12	0.424 (0.249)	0.759 (1.467)	-0.312 (0.277)	0.407 (0.501)	0.762 (0.937)
Covariances					
Belong with Social Capital	0.956*** (0.185)	0.956*** (0.185)	0.956*** (0.185)	0.956*** (0.185)	0.956*** (0.185)
Advice with Favours	0.192* (0.075)	0.192* (0.075)	0.192* (0.075)	0.192* (0.075)	0.192* (0.075)
Area-level					
Factor loadings					
(Social Cohesion)- Belong	0.283 (0.236)	0.283 (0.236)	0.283 (0.236)	0.283 (0.236)	0.283 (0.236)
(Social Cohesion)- Friends	0.243*** (0.069)	0.243*** (0.069)	0.243*** (0.069)	0.243*** (0.069)	0.243*** (0.069)
(Social Cohesion)- Advice	0.334 (0.234)	0.334 (0.234)	0.334 (0.234)	0.334 (0.234)	0.334 (0.234)
(Social Cohesion)- Favours	0.357 (0.247)	0.357 (0.247)	0.357 (0.247)	0.357 (0.247)	0.357 (0.247)
(Social Cohesion)- Talk	0.319*** (0.082)	0.319*** (0.082)	0.319*** (0.082)	0.319*** (0.082)	0.319*** (0.082)
Regression paths					
Minority density -> Social Cohesion	0.002 (0.045)	0.002 (0.045)	0.002 (0.045)	0.002 (0.045)	0.002 (0.045)
Deprivation -> GHQ-12	-2.097 (1.850)	1.333 (2.111)	-0.327 (3.252)	4.205 (2.424)	2.365 (2.451)
Minority density -> Racism	-0.016** (0.005)	0.000 (0.005)	-0.011 (0.010)	-0.013* (0.005)	-0.020** (0.007)

	Indian beta (SE) N_i = 653 N_j= 320	Pakistani beta (SE) N_i = 570 N_j= 255	Bangladeshi beta (SE) N_i =394 N_j= 143	Black Caribbean beta (SE) N_i =459 N_j= 311	Black African beta (SE) N_i =489 N_j= 305
Covariances					
Racism with Social Cohesion	0.027* (0.012)	0.027* (0.012)	0.027* (0.012)	0.027* (0.012)	0.027* (0.012)
Minority density with Deprivation	0.150*** (0.010)	0.150*** (0.010)	0.150*** (0.010)	0.150*** (0.010)	0.150*** (0.010)

*p<0.05 ** p<0.01 *** p<0.001
AIC= 59763.489 BIC= 60919.481
(Monte Carlo integration, MLR estimator)

10.12 MG-MSEM results diagrams

Figure 10-4 - Indian MG-MSEM results

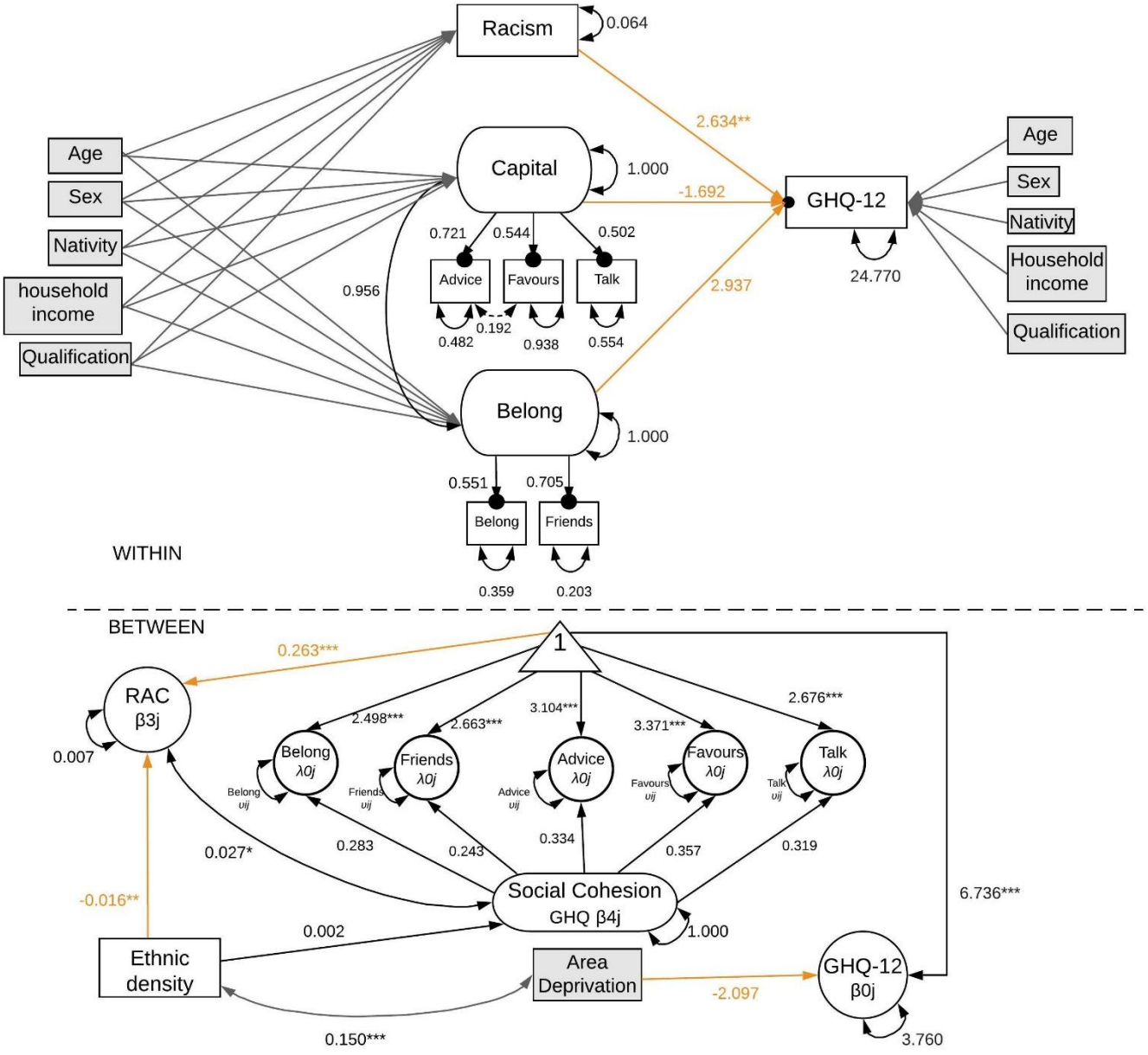


Figure 10-5 - Pakistani MG-MSEM results

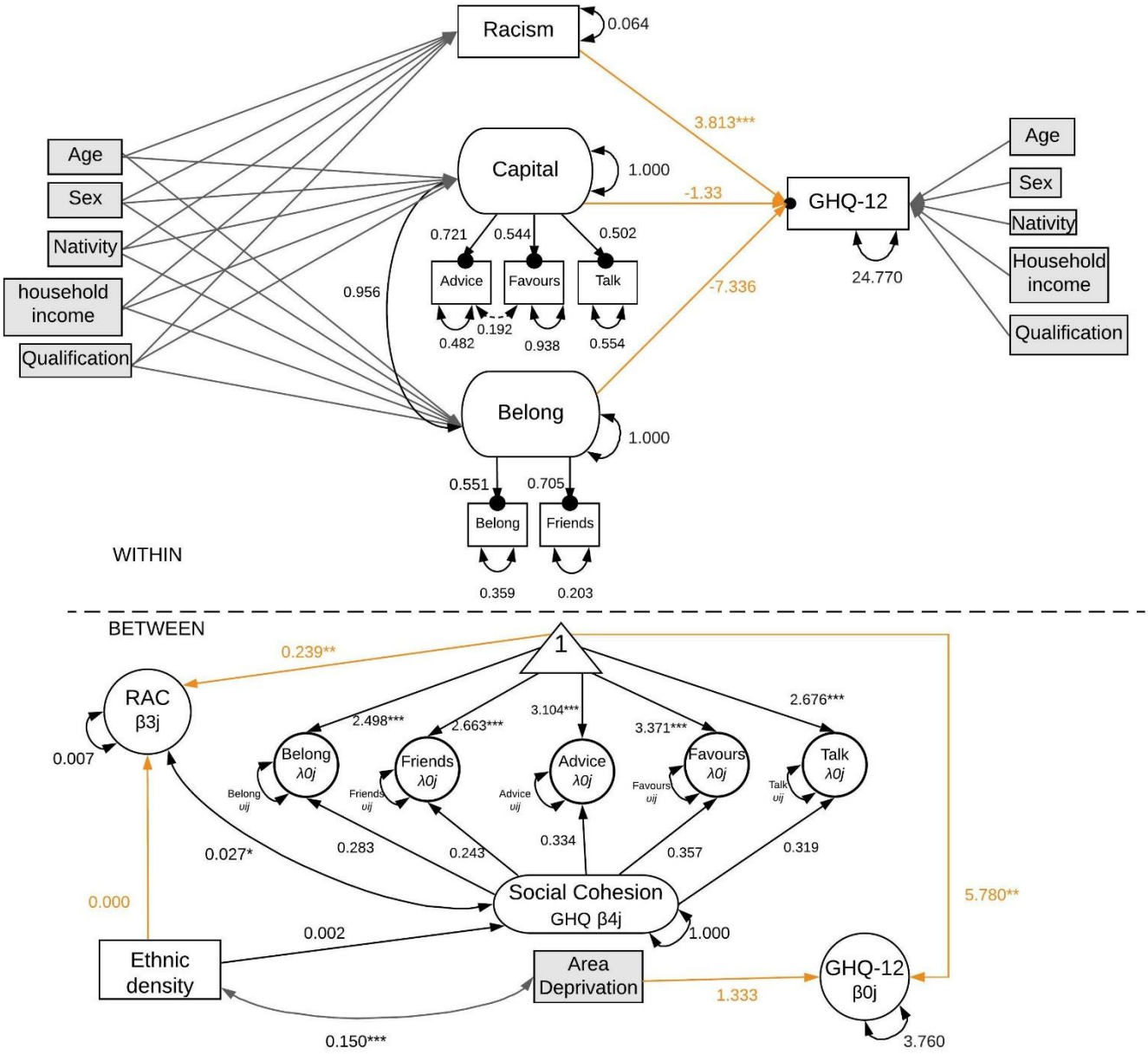


Figure 10-6 - Bangladeshi MG-MSEM results

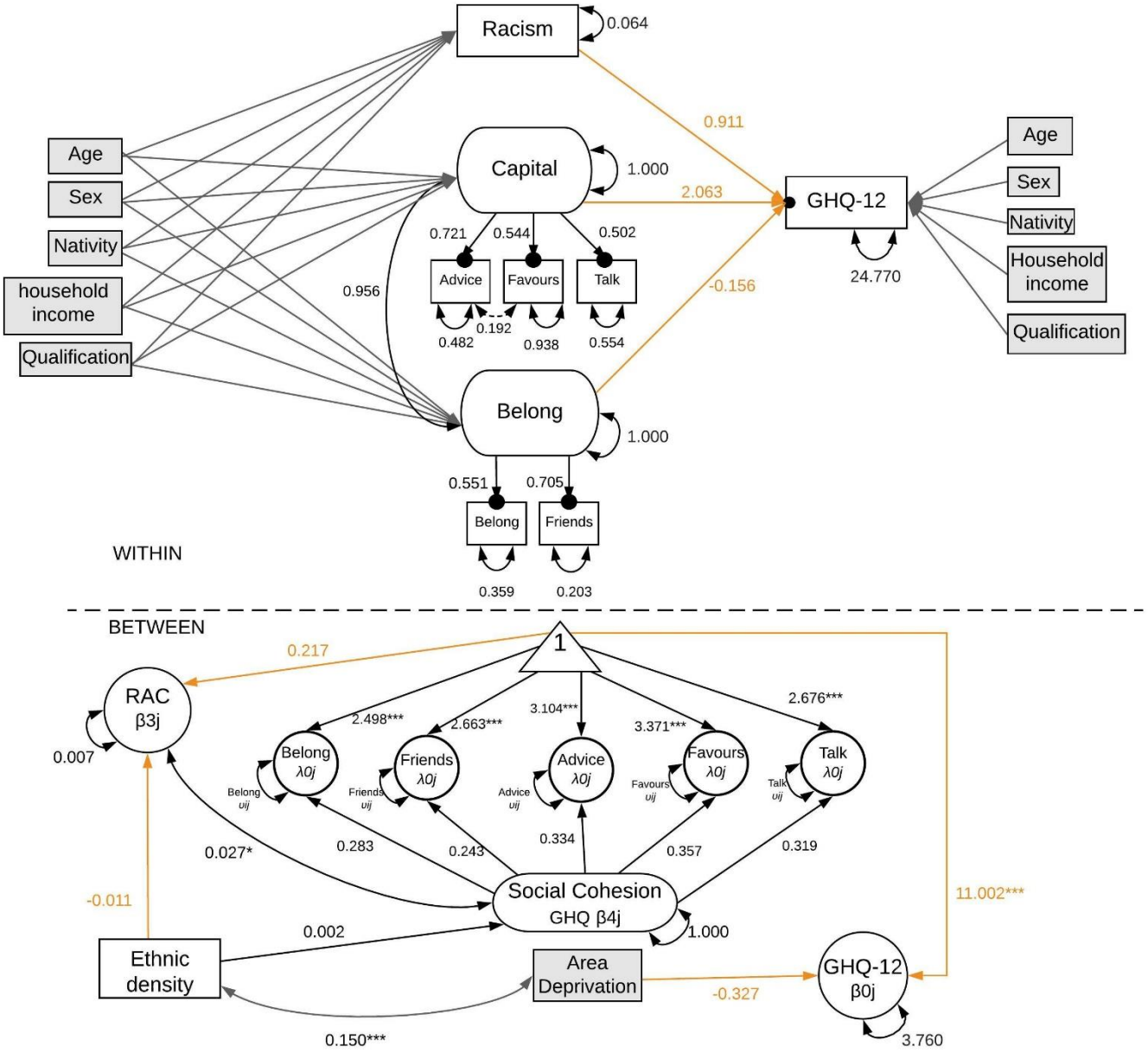


Figure 10-7 – Black Caribbean MG-MSEM results

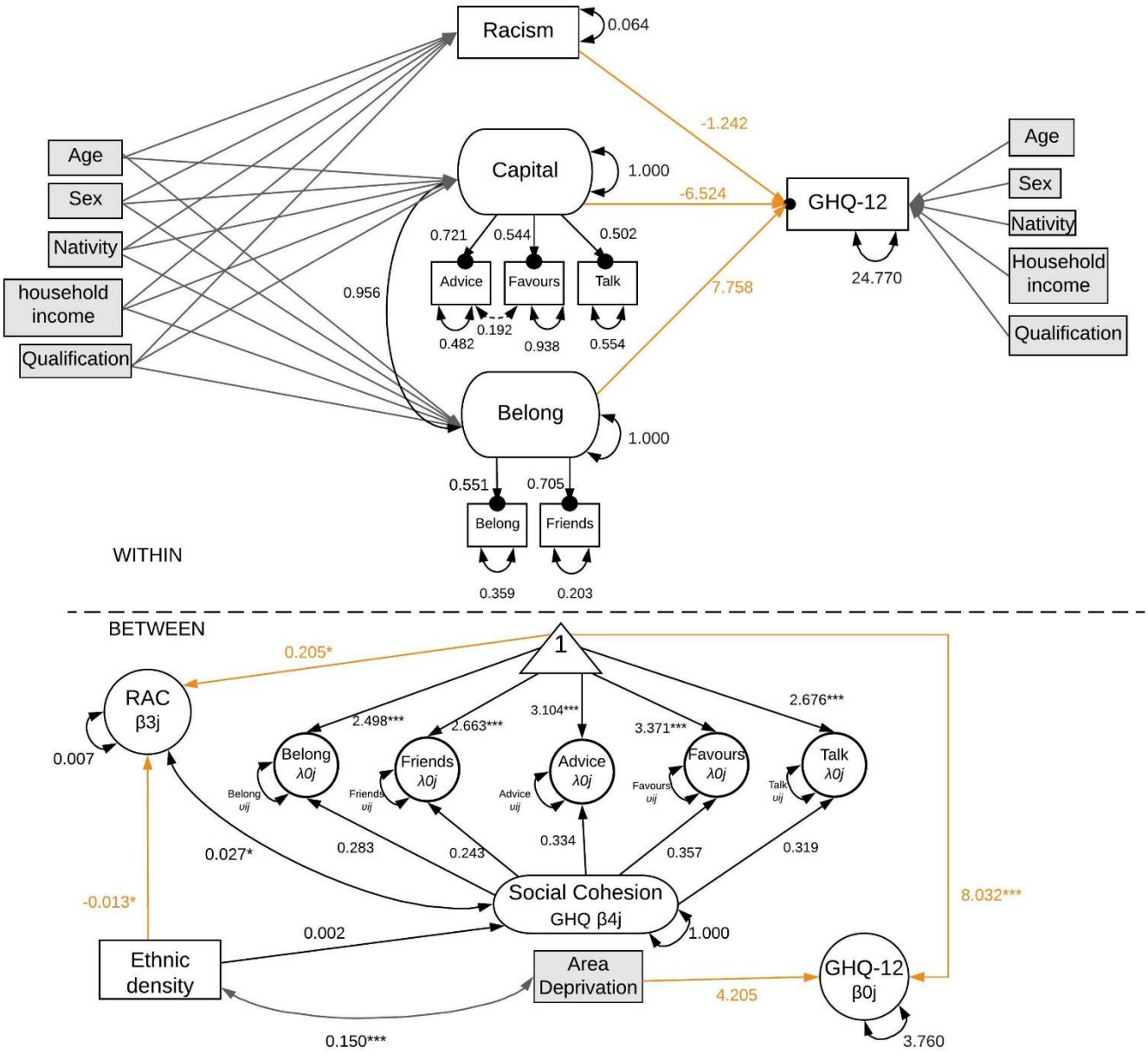
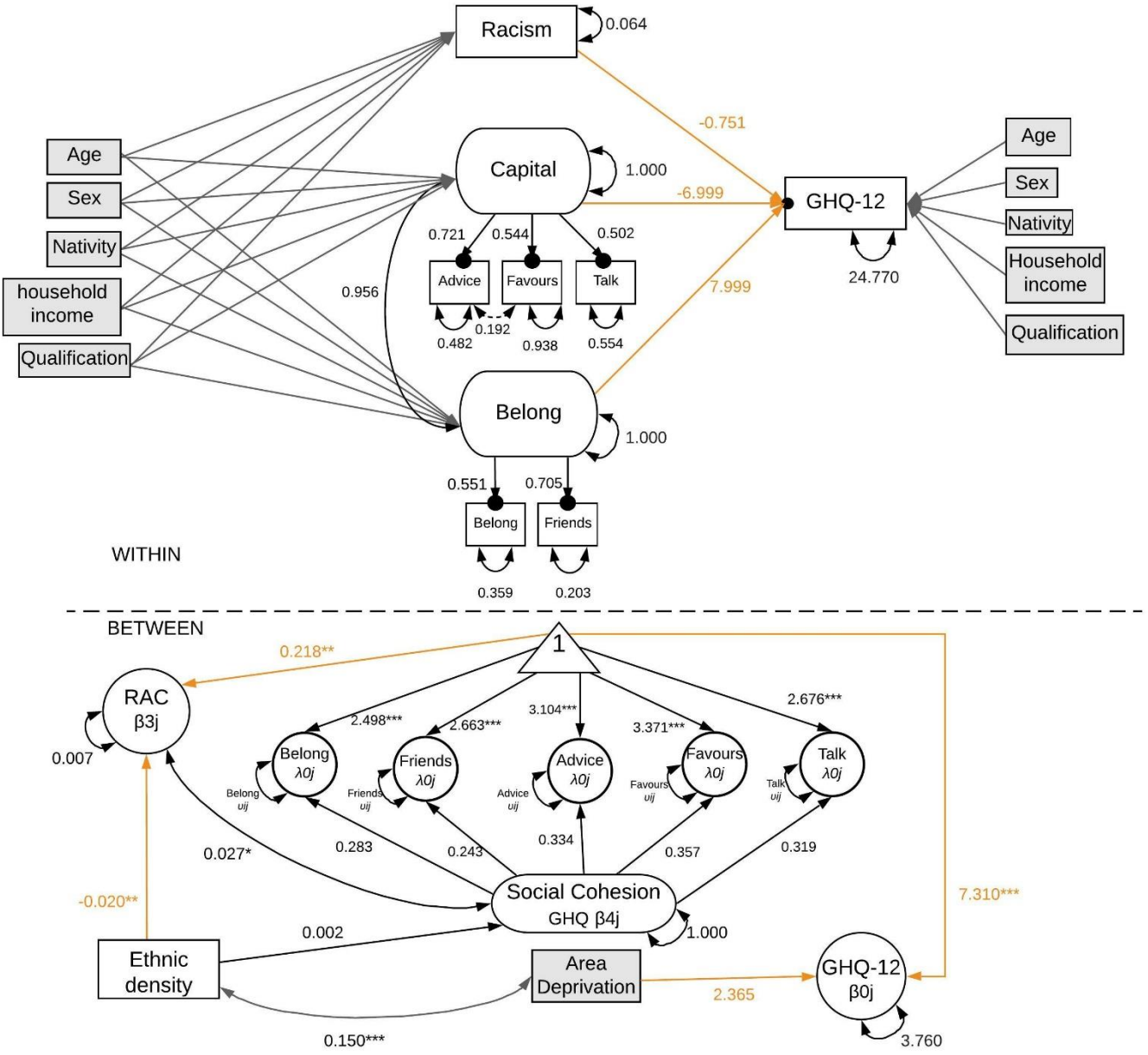


Figure 10-8 – Black African MG-MSEM results



10.13 MSEM sensitivity analysis: Separate ethnic group models

Table 10-9 - Individual ethnic group multilevel model vs. MG-MSEM results

Path	Individual group model Estimate (s.e.)	Multigroup model Estimate (s.e.)
Indian		
Within		
Racism -> GHQ	**2.560** (0.877)**	**2.634*** (0.869)**
cohesw1 -> GHQ	1.367 (0.865)	2.937 (8.087)
cohesw2 -> GHQ	-0.581 (0.942)	-1.692 (7.125)
Between		
Density -> racism	**-0.015** (0.005)**	**-0.016** (0.005)**
Pakistani		
Within		
Racism -> GHQ	**2.928* (1.319)**	**3.813** (1.255)**
cohesw1 -> GHQ	3.623 (10.709)	-7.336 (33.436)
cohesw2 -> GHQ	-2.477 (10.731)	-1.33 (34.072)
Between		
Density -> racism	0.002 (0.005)	0.000 (0.005)
Bangladeshi		
Within		
Racism -> GHQ	0.514 (1.567)	0.911 (1.234)
cohesw1 -> GHQ	1.221 (0.921)	-0.156 (11.201)
cohesw2 -> GHQ	0.775 (0.945)	2.063 (12.247)
Between		
Density -> racism	-0.009 (0.049)	-0.011 (0.010)

*p<0.05 ** p<0.01 *** p<0.001

Models adjusted for: age, sex, nativity, household income (equivalised) and highest qualification.

10.14 MG-MSEM sensitivity analysis: Desire to move results

Table 10-10 - MG-MSEM sensitivity analysis results: Desire to move

	Indian beta (SE) N_i = 653 N_j= 320	Pakistani beta (SE) N_i = 570 N_j= 255	Bangladeshi beta (SE) N_i =394 N_j= 143	Black Caribbean beta (SE) N_i =459 N_j= 311	Black African beta (SE) N_i =489 N_j= 305
Individual level					
Factor loadings					
(Belong)- Belong	0.571*** (0.025)	0.571*** (0.025)	0.571*** (0.025)	0.571*** (0.025)	0.571*** (0.025)
(Belong)- Friends	0.659*** (0.024)	0.659*** (0.024)	0.659*** (0.024)	0.659*** (0.024)	0.659*** (0.024)
(Social Capital)- Advice	0.680*** (0.033)	0.680*** (0.033)	0.680*** (0.033)	0.680*** (0.033)	0.680*** (0.033)
(Social Capital)- Favours	0.500** (0.037)	0.500** (0.037)	0.500** (0.037)	0.500** (0.037)	0.500** (0.037)
(Social Capital)- Talk	0.523*** (0.028)	0.523*** (0.028)	0.523*** (0.028)	0.523*** (0.028)	0.523*** (0.028)
Regression paths					
Racism -> GHQ-12	2.895*** (0.793)	3.601** (1.255)	1.001 (1.060)	-1.421 (1.852)	-0.534 (0.924)
Belong -> GHQ-12	3.872 (3.518)	11.819 (9.982)	-1.473 (9.529)	9.173 (7.323)	
Social Capital -> GHQ-12	-2.525 (3.488)	-10.912 (9.979)	3.446 (9.610)	-7.865 (7.227)	
Control variable paths					
Age -> belonging	-0.006 (0.003)	-0.006 (0.004)	-0.007 (0.005)	-0.022*** (0.004)	-0.015** (0.004)
Sex -> belonging	-0.167* (0.071)	-0.014 (0.097)	0.209 (0.139)	0.005 (0.111)	0.051 (0.109)
Nativity -> belonging	0.331** (0.116)	0.172 (0.108)	0.160 (0.173)	-0.154 (0.148)	0.255 (0.168)
Household income -> belonging	0.860* (0.34)	-0.240 (0.655)	0.439 (0.812)	-0.057 (0.532)	0.086 (0.385)
Highest qualification -> belonging	-0.049 (0.046)	-0.068 (0.051)	-0.015 (0.051)	-0.008 (0.054)	0.061 (0.062)
Desire to move -> belonging	0.630*** (0.114)	0.639*** (0.123)	0.439*** (0.114)	0.641*** (0.120)	0.467*** (0.108)
Age -> social capital	-0.009* (0.004)	-0.014** (0.004)	-0.011 (0.006)	-0.024*** (0.005)	-0.019*** (0.005)
Sex -> social capital	-0.202* (0.089)	0.103 (0.104)	0.209 (0.139)	-0.146 (0.130)	-0.050 (0.121)
Nativity -> social capital	0.078 (0.136)	0.117 (0.126)	0.160 (0.173)	-0.157 (0.156)	0.069 (0.179)
Household income -> social capital	1.135* (0.479)	0.577 (0.826)	0.439 (0.812)	0.695 (0.728)	0.580 (0.373)

	Indian beta (SE) N_i = 653 N_j= 320	Pakistani beta (SE) N_i = 570 N_j= 255	Bangladeshi beta (SE) N_i =394 N_j= 143	Black Caribbean beta (SE) N_i =459 N_j= 311	Black African beta (SE) N_i =489 N_j= 305
Highest qualification -> social capital	-0.047 (0.053)	-0.097 (0.055)	0.008 (0.061)	-0.009 (0.060)	0.068 (0.065)
Desire to move -> social capital	0.613*** (0.128)	0.527*** (0.135)	0.388* (0.160)	0.312* (0.133)	0.412*** (0.116)
Age -> racism	-0.001 (0.001)	-0.001 (0.001)	0.000 (0.001)	-0.001 (0.001)	0.000 (0.001)
Sex -> Racism	-0.022 (0.021)	-0.053* (0.025)	0.007 (0.027)	-0.032 (0.203)	0.005 (0.024)
Nativity -> Racism	-0.002 (0.027)	-0.019 (0.026)	0.032 (0.035)	0.007 (0.767)	-0.008 (0.035)
Household income -> Racism	0.014 (0.098)	-0.006 (0.163)	-0.125 (0.213)	-0.185** (0.067)	-0.131* (0.066)
Highest qualification -> Racism	-0.005 (0.011)	-0.015 (0.010)	-0.012 (0.013)	0.010 (0.010)	0.007 (0.011)
Desire to move -> Racism	0.011 (0.025)	0.043 (0.026)	0.191 (0.749)	0.053* (0.021)	0.043 (0.025)
Age -> GHQ-12	0.061** (0.021)	0.004 (0.094)	0.071 (0.050)	0.013 (0.040)	-0.004 (0.057)
Sex -> GHQ-12	1.509** (0.493)	3.037 (1.551)	1.010 (0.829)	-0.672 (1.542)	-0.530 (1.358)
Nativity -> GHQ-12	-0.207 (0.975)	-0.447 (1.162)	-0.458 (1.759)	0.654 (1.079)	-2.093 (2.204)
Household income -> GHQ-12	-5.864** (2.147)	-0.467 (10.685)	-7.520* (3.646)	2.158 (6.742)	2.452 (5.515)
Highest qualification -> GHQ-12	0.424 (0.249)	0.136 (0.547)	-0.413 (0.386)	0.453 (0.451)	0.592 (0.516)
Desire to move -> GHQ-12	0.614 (0.510)	-0.289 (1.445)	0.191 (0.749)	-1.016 (2.524)	-1.015 (1.164)
Covariances					
Belong with Social Capital	0.969*** (0.035)	0.969*** (0.035)	0.969*** (0.035)	0.969*** (0.035)	0.969*** (0.035)
Advice with Favours	0.172*** (0.024)	0.172*** (0.024)	0.172*** (0.024)	0.172*** (0.024)	0.172*** (0.024)
Area-level					
Factor loadings					
(Social Cohesion)- Belong	0.188* (0.090)	0.188* (0.090)	0.188* (0.090)	0.188* (0.090)	0.188* (0.090)
(Social Cohesion)- Friends	0.252*** (0.055)	0.252*** (0.055)	0.252*** (0.055)	0.252*** (0.055)	0.252*** (0.055)
(Social Cohesion)- Advice	0.415*** (0.074)	0.415*** (0.074)	0.415*** (0.074)	0.415*** (0.074)	0.415*** (0.074)
(Social Cohesion)- Favours	0.360*** (0.076)	0.360*** (0.076)	0.360*** (0.076)	0.360*** (0.076)	0.360*** (0.076)
(Social Cohesion)- Talk	0.282** (0.089)	0.282** (0.089)	0.282** (0.089)	0.282** (0.089)	0.282** (0.089)
Regression paths					

	Indian beta (SE) N_i = 653 N_j= 320	Pakistani beta (SE) N_i = 570 N_j= 255	Bangladeshi beta (SE) N_i =394 N_j= 143	Black Caribbean beta (SE) N_i =459 N_j= 311	Black African beta (SE) N_i =489 N_j= 305
Minority density -> Social Cohesion	-0.001 (0.023)	-0.001 (0.023)	-0.001 (0.023)	-0.001 (0.023)	-0.001 (0.023)
Deprivation -> GHQ-12	-2.256 (1.774)	0.210 (2.100)	-0.431 (3.213)	3.282 (2.178)	2.673 (2.425)
Minority density -> Racism	0.019 (0.012)	-0.001 (0.005)	-0.013 (0.010)	-0.014* (0.005)	-0.020** (0.007)
Covariances					
Racism with Social Cohesion	0.031 (0.022)	0.031 (0.022)	0.031 (0.022)	0.031 (0.022)	0.031 (0.022)
Minority density with Deprivation	0.150*** (0.010)	0.150*** (0.010)	0.150*** (0.010)	0.150*** (0.010)	0.150*** (0.010)

AIC= 60172.910, BIC= 61189.467
*p<0.05 ** p<0.01 *** p<0.001

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