Mental health and ethnic density among adolescents in England: a cross-sectional study.

Abstract

This paper determines the association of neighbourhood ethnic density on adolescent mental health and its interplay with ethnic minority status and neighbourhood deprivation. 4,145 cross-sectional responses to the 2009-2011 UK Household Longitudinal Study (UKHLS) youth self-completion questionnaire for youths aged 10-15 living in England were combined with household responses to the household UKHLS interview and 2011 Census data. Regression models were used to predict a Strengths and Difficulties Questionnaire (SDQ) score (range 0-40) with higher values indicating worse mental health. Ethnic density was operationalised using two distinct measures: co-ethnic density and diversity index. There was no difference in the mental health of ethnic minority youths by whether they lived in neighbourhoods of differing levels of ethnic density or neighbourhood deprivation. White British youths had poorer mental health when living in deprived neighbourhoods where their ethnic group was the vast majority. The difference compared to all other neighbourhoods was two points on the SDQ score. Interventions should seek to encourage adolescents living in white-working class neighbourhoods to explore ethnic diversity to determine whether it improves their mental health.

Keywords

Adolescent mental health; ethnic density, ethnic diversity, neighbourhood deprivation; UKHLS.

Introduction

Research shows that environmental factors play a role in adolescent mental health (Becares et al., 2017; Olives et al., 2013; Schofield et al., 2016). Kling (2004) argues that youths who grow up in disadvantaged neighbourhoods are more likely to face substantially worse health and socioeconomic outcomes compared to those who grew up in more affluent neighbourhoods. Furthermore, young people may be more influenced by their social surroundings than adults because adolescence is a period when peer relationships are important (Astell-Burt et al., 2012; Georgiades et al., 2013). The neighbourhood will be important to these relationships because, as De Clercq et al (2012) observed, younger people tend to spend a lot of time in their locality since their mobility and social autonomy are limited. The social network adolescents develop in their neighbourhood might be important because adolescence is a period of rapid brain development and because social interactions are important to this development (Blakemore, 2008; Blakemore and Choudhury, 2006). This critical period is vitally important because it is estimated that half of mental health conditions start by the age of 14, yet few are treated (WHO, 2018).

This paper is concerned with investigating the protective effects of ethnic density at the neighbourhood level on psychosocial wellbeing in adolescence. The "ethnic density hypothesis" is a proposition that members of ethnic minority groups have better mental health when they live in areas with higher proportions of people from the same ethnicity (Shaw et al., 2012) or in areas of higher ethnic diversity (Awaworyi Churchill et al., 2017). The reason behind this proposed protective effect is that greater ethnic density can relieve the stress of racial discrimination, low social status and socioeconomic disadvantage while providing a safety net of social support and sense of community that enhanced social capital (Becares et al., 2017; Hurd et al.,

2013). In the UK, there is evidence to suggest that sense of belonging to neighbourhood is greater among ethnic minority groups compared with the white majority (Finney and Jivraj, 2013). The empirical findings for an "ethnic density effect" on mental health, although mixed, generally support a protective effect in adults (Shaw et al., 2012). Here we briefly review the literature on adolescents, which is balanced towards no effect of ethnic density on mental health.

One of the main tensions in the empirical literature supporting or opposing a protective ethnic density effect in child or adult samples is the measurement of the exposure. The most common approach is a measure of own or co-ethnic group density, or what is referred to in much of the North American literature as racial congruence. Jonsson (2018) use nationally representative UK data to analyse change in a summary score of mental health by own group ethnic density of White British, Welsh, Other White and all other ethnic groups as a whole for young people aged 10-15. They find no evidence of a protective effect of co-ethnic density for any of the ethnic groups they measure. Jonsson (2018) do find that White British adolescents had poor mental health when residing in more deprived neighbourhoods. There was no association between neighbourhood deprivation and mental health in the other ethnic groups measured. Two studies focussing on young people in the UK's most ethnically diverse city, London, come to the same conclusion regarding own group ethnic density and mental health (Astell-Burt et al., 2012; Lenguerrand et al., 2012). Astell-Burt et al (2012) and Lenguerrand et al (2012) both use data at a very fine spatial scale to measure ethnic density and both use very similar measures of mental health. Astell-Burt et al (2012) also confirm the White British neighbourhood deprivation and mental health relationship. It is often difficult to disentangle the ethnic density effect from a neighbourhood deprivation effect on mental health and

other wellbeing outcomes since ethnic minorities are typically concentrated in the most deprived neighbourhoods (Jivraj and Khan, 2015).

One might argue that young people are less likely to see the distinction in ethnic minority groups as measured by censuses and surveys but rather focus on the coarse difference between all ethnic minorities and the ethnic majority. Charmaraman and Grossman (2010) in their mixed-method study reveal that young people find it hard to clearly define their ethnicity and their views of ethnicity are often clouded as they constantly borrow and exchange from multiple cultures. Astell-Burt et al (2012) respond to this challenge by testing whether mental health is associated with an ethnic diversity index that calculates whether ethnic groups are evenly distributed across neighbourhoods. They find no ethnic diversity association with mental health for any of the ethnic groups they measure: White UK, Indian, Pakistani and Bangladeshi (combined), Black Caribbean, Nigerian and Ghanaian (combined) and Other African.

Georgiades et al (2013) draw the same conclusion from the same index, but using nationally representative data on adolescents in the United States from the Longitudinal Study of Adolescent Health. However, Georgiades et al (2013) do find that co-ethnic density (measured by ethnic and immigrant status of students in schools) is related to better mental health in non-Hispanic White adolescents who were born in the United States and whose parents were born in the United States, and worse mental health in Asian adolescents who are first generation immigrants. The same model suggests greater proportions of immigrant young people was associated with better mental health in non-Hispanic White native young people with both parents born in the United States. These findings appear contradictory. One might argue Georgiades et al's (2013) findings are a consequence of their complicated measurement of individual ethnicity by combing racial category and immigrant

generation. Other localised studies based in the United States find that for African American (Hurd et al., 2013) and Chinese American (Lee et al., 2014) adolescents the association between co-ethnic density and mental health is mediated by perceived social support and parenting style (i.e. neighbourhood concentrations of these groups affect these factors which in turn affect mental health). In contrast, Lee (2014) finds a negative direct effect of Latino immigrant density (measured by a combination of Hispanic origin, foreign born status and English language ability) on depression onset for Latino adolescents who are immigrants. Comparison between US and UK should be made with caution given the greater variance in neighbourhood deprivation in the former.

The forms of social support that may bring about an ethnic density effect might not be restricted to the level of co-ethnic density or the diversity index. It could simply be the concentration of ethnic minority groups because children may well attend schools and community groups that provide support for ethnic minority young people from many different ethnic groups whether they are evenly distributed across measured groups or not. Gieling and Vollebergh (2010) find that externalising problems in minority adolescents in the Netherlands are lower in school classes with a higher proportion of ethnic minorities. By contrast, Abada et al (2007) find that minority adolescents living in neighbourhoods with high concentrations of ethnic minorities report more depressive symptoms. In the UK there is a very strong correlation between the diversity index and the proportion of ethnic minorities at the neighbourhood level (r=0.96).

The aim of this study is to investigate the relationship between ethnic density and adolescents' mental health among youths aged 10-15 years living in England. The literature to date is limited because studies often restrict themselves to one definition

of ethnic density without clear justification for their choice or overcomplicate the measure by immigrant and ethnic minority status, or are based on particular urban localities. There are no studies to our knowledge that attempt to interact the effect of neighbourhood deprivation and ethnic density. Our main research hypothesis is that higher ethnic density, whether measured by co-ethnic density or an ethnic diversity index, plays as a protective factor for youth mental health difficulties. Our secondary hypotheses are two-fold. First, the protective effect of higher ethnic density will be greater for ethnic minority adolescents compared with the majority ethnic group. Second, protective ethnic density is greater for those living in less deprived neighbourhoods compared with those living in more deprived neighbourhoods. The former is based on the assumption that ethnic density does not manifest protective effects on mental health for the ethnic majority because they do not experience racial discrimination. The latter is based on the assumption that the protective effect of exposure to ethnically diverse neighbourhoods will be reduced if the neighbourhood is more deprived because better resources in less deprived neighbourhoods may act as a buffer against poorer mental health.

Methods

Data

The analyses for the present study were based on data from wave 1 (2009-2011) of Understanding Society (UK Household Longitudinal Study [UKHLS]) and the 2011 Census. UKHLS is an annual survey of about 40,000 households in the UK collecting information on household and individual circumstances and changes in health, work, education, income and social ties. The data contain a general population sample collected through a two-stage random sampling design and an ethnic minority

boost sample collected from postcode sectors with more than 5% of five targeted groups: Indians, Pakistanis, Bangladeshis, Black Caribbeans and Black Africans. We use data from the youth self-completion questionnaire completed by those aged 10-15 in households that completed a main UKHLS interview. The youth questionnaire was completed by 4,895 youths (74% response rate). We use data on 4,145 youths living in England linked to 2011 Census data through Lower Super Output Area (LSOAs) codes to identify the co-ethnic density, ethnic density and deprivation levels in the youths' neighbourhoods. The 32,844 LSOAs at 2011 boundaries contained 1,600 residents, on average.

Measures

The outcome variable is the Strengths and Difficulties Questionnaire (SDQ) total score, which allows a screen to behavioural problems and mental wellness in children (Booker et al., 2013). The SDQ captures four areas of potential difficulty (emotional symptoms, conduct problems, hyperactivity-in-attention, and peer relationship problems) and one area of strength (prosocial behaviour). The sum of these subscales represents a total difficulty score (TDS) that ranges from 0 to 40—a higher number indicating increased mental health difficulties. Categories of the total SDQ score (referred to as youth mental health hereafter) are as follows: close to average (0-14), slightly raised (15-17), high (18-19), and very high (20-40) (Goodman, 1997).

Co-ethnic Density was defined as the proportion of people from the same ethnicity background living in the respondent's neighbourhood aggregated at LSOA level. The measure was calculated using the 18-group classification used to classify individual responses in the UKHLS and aggregate data in the 2011 Census. A higher

value indicates a higher proportion of people in the neighbourhood with the same ethnic group as a UKHLS youth living in England.

Ethnic diversity was measured using the diversity index, which is often used in ecological studies for species diversity (Jivraj and Simpson, 2015). The index is calculated by taking the sum of square proportions of each ethnic group in a neighbourhood, with a score equal to proportion of all ethnic groups indicating complete diversity (Astell-Burt et al., 2012; Georgiades et al., 2013). Using the 18-group classification in the 2011 Census the value of even diversity (i.e. same number of people from each ethnic group) in a neighbourhood would be 0.06. Higher scores indicate progressively less ethnically diverse neighbourhoods. When the diversity index reaches 1, all people are from the same ethnic group in a neighbourhood (i.e. no ethnic diversity).

Neighbourhood deprivation was calculated using the Townsend Index, which is widely used in health research (Andrea et al., 2008; Jivraj et al., 2019). It is used to measure relative deprivation by aggregating standardised values for four variables: unemployment, non-car ownership, non-home ownership, and overcrowding (Norman, 2016; Norman and Darlington-Pollock, 2017).

Individual ethnicity was dichotomised into White British and ethnic minority to ensure sufficient sample size with which to compare across the neighbourhood variables. Our statistical models were replicated with more detailed ethnic groups as a sensitivity analysis and there were no significant differences compared to the White British ethnic group.

Covariates were measured that are known to be predictors of mental health in adolescents that might confound the relationship to ethnic density. Age of youth at the

interview was in years, gender was categorised as male or female. Country of birth of parents was categorised into both in the UK (or a single parent born in the UK), one parent born overseas, or both born overseas (or a single parent born overseas). Parental socioeconomic status was measured by the highest qualification (none, GCSE or equivalent, A-level or equivalent, lower degree, degree, other) of either parent, and household income. Family support was measured by a question asking how supportive youths feel by their family defined as people who live with them and dichotomised into most of the time and less often. The frequency of youth-parent communication was measured by two questions regarding the frequency of talking separately to mother and father about things that matter to them. Responses were categorised as most days, more than once a week, less than once a week, hardly ever and do not have a mother or does not have a father.

Statistical analysis

Linear regression models were fitted taking into account clustered standard errors of youths within households. This approach was preferred to multilevel modelling because there was not significant variation between neighbourhoods in a variance components model. The mean number of youths within households was 1.3 and youths within neighbourhood was 1.5 which meant it was not appropriate to estimate variance for most households or neighbourhoods. The multilevel models were refitted with coarser spatial units (middle level super output areas) to determine whether the high number of neighbourhoods containing one youth biased the variance estimate. The results were almost identical.

Variables were added to the model in a series of steps with models fitted separately for co-ethnic density and ethnic diversity. The first model contained main effects for youth ethnic group, neighbourhood deprivation and ethnic density (co-

ethnic density or diversity index). The second model added two-way interactions between youth ethnic density and youth ethnic group and ethnic density and neighbourhood deprivation. Three-way interactions between youth ethnic group, neighbourhood deprivation and ethnic density were tested but did not significantly improve model fit. The third model added the covariates known to predict youth mental health based on existing literature (age, gender, parental immigrant status, parental education, household income and family support and parental interaction).

An alternative model specification was tested to determine non-linear associations in the interaction between ethnic diversity and neighbourhood deprivation and their relationship to youth mental health. A four-category variable was created with neighbourhoods classified as *deprived and ethnically diverse* (20% most deprived and 20% most diverse nationally), *deprived* (20% most deprived, but not 20% most diverse nationally), *ethnically diverse but not deprived* (20% most diverse, but not 20% most deprived nationally) and *not deprived and not diverse* (not 20% most deprived or diverse nationally). The same stepwise procedure was applied, first including main effects, then an interaction with youth ethnic group and finally adjusting for covariates.

Multiple imputation by chained equations was used to replace missing values for all variables used in the main analysis by creating 25 imputed datasets. Almost a sixth of the sample was lost when using complete cases. Missingness was insubstantial (<3%) on all variables bar youth ethnicity (11%) (see Table 1). To understand the likely bias in missing youth ethnicity, a logistic model predicting missingness was fitted showing those youths who were younger, had parents with no formal qualification and living in more deprived neighbourhoods were more likely to have a missing ethnicity Co-ethnic density was imputed using the neighbourhood

value for the imputed ethnic group for those youths missing their ethnic group. A sensitivity analysis using the complete case sample showed the main substantive findings were unchanged (see Appendix A). Non-response sampling weights were used to adjust for youth non-response in the descriptive and statistical analyses. All analyses were conducted using Stata 15 using the *regress* command to fit linear models and *mi* command to produce values for missing cases.

Results

Table 2 shows that compared with White British youths their minority counterparts live in neighbourhoods with more diversity (diversity index mean 0.45 vrs 0.80) and considerably lower co-ethnic density (co-ethnic density mean 0.12 vrs 0.88). The mean co-ethnic density and mean ethnic diversity was similar across mental health categories for both White British and ethnic minority youths.

Figure 1 shows the distribution of co-ethnic density and ethnic diversity by neighbourhood deprivation quintile for White British and ethnic minority youths. The median co-ethnic density for White British youths was considerably lower in neighbourhoods of higher deprivation. For example, more than three quarters of White British youths in the least deprived quintile of neighbourhoods lived among residents who were more than 92% White British compared with White British youths in the most deprived quintile of neighbourhoods for whom more than half lived in neighbourhoods with less than 83% of residents who were the same ethnicity as them. In contrast to White British youths, ethnic minority youths were more likely to have a higher proportion of co-ethnic residents in their neighbourhood if their neighbourhood was more deprived. More than three quarters of ethnic minority youths in the two least deprived quintiles of neighbourhoods lived among less than 5% of their own

ethnic group, whereas more than half in the most deprived quintile lived in neighbourhoods where their ethnic group accounted for more than 10% of the resident population. For both White British and ethnic minority youths the variation in the co-ethnic density proportion was greatest in the most deprived quintile of neighbourhoods.

The median ethnic diversity was lower for White British and, more so, ethnic minority youths in more deprived neighbourhoods. This signifies greater ethnic diversity for youths living in deprived neighbourhoods compared with those living in less deprived neighbourhoods regardless of youth ethnicity. The median ethnic diversity index was 0.90 and 0.83 for White British and ethnic minority youths, respectively, living in the least deprived quintile of neighbourhoods compared with 0.70 and 0.22 for White British and ethnic minority youths, respectively, living in the most deprived quintile of neighbourhoods. The variation in the ethnic diversity index was greater for White British youths living in more deprived neighbourhoods. For example, the inter-quartile range was spread between 0.41 and 0.86 for those living in the most deprived quintile of neighbourhoods compared with between 0.85 and 0.93 for those living in the least deprived quintile.

Table 3 shows the model estimates predicting youth mental health for ethnic group, ethnic density (co-ethnic proportion and diversity index) and neighbourhood deprivation from the main effects (model 1), interaction (model 2) and fully-adjusted models (model 3). The full model results are available in Appendix B. The main effect estimates (model 1) showed that youths living in less ethnically diverse neighbourhoods and more deprived neighbourhoods had poorer mental health. The interaction estimates (model 2) allow a comparison of the ethnic density relationship to mental health by youth ethnic minority status and the ethnic density relationship to

mental health by neighbourhood deprivation. The mental health of White British youths is poorer when the co-ethnic density is greater, whereas mental health of ethnic minority youths is better under the same circumstances. This is shown in model 2 by the statistically significant main effect for co-ethnic density (representing the White British association) and the significant interaction between ethnic minority status and co-ethnic density (representing the ethnic minority association). The mental health of White British youths, but not ethnic minority youths is associated with ethnic diversity as shown by the statistically significant main effect for ethnic diversity and the non-significant interaction between ethnic minority status and ethnic diversity. The interaction with neighbourhood deprivation shows that White British youth mental health is poorer in more deprived neighbourhoods as the co-ethnic density increases and the ethnic diversity decreases. These findings were attenuated yet robust to further adjustment in model 3. The only exception was co-ethnic density did not predict lower mental health in ethnic minority youths in the final model. Figure 2 and 3 illustrate the magnitude of predictive effect on TDS by quintiles of neighbourhood deprivation over co-ethnic density and ethnic diversity, respectively. The considerably steeper slopes for more deprived quintiles of neighbourhoods represents a stronger association between co-ethnic density or ethnic diversity and mental health for youths living in more deprived neighbourhoods.

The alternative specification of the interaction between ethnic diversity and neighbourhood deprivation using a categorise measurement showed the same result (see Table 5). Youths living in the most deprived neighbourhoods with lower levels of ethnic diversity were predicted to have significantly poorer mental health compared with all other youths including those living in ethnically diverse, deprived neighbourhoods. The size of the independent association was almost 2 points on the

TDS, which was equivalent to the difference between those who talk to their father every day relative to those who do not have a father.

Conclusion

This paper set out to test whether ethnic density protects adolescents against poor mental health using an English sample of youths aged 10-15. We hypothesised that the association would be stronger in ethnic minority adolescents because ethnic density may operate as a shield against negative effects of racial discrimination. Our results do not find evidence to support this hypothesis. We find that mental health in White British ethnic majority youths in England is worse when they live in deprived, ethnically uniform neighbourhoods where their ethnic group is the vast majority. Ethnic minority youths do not appear to be protected either by ethnic diversity, co-ethnic density or lower neighbourhood deprivation after adjusting for known predictors of mental health.

The findings are broadly in support of much of the existing literature in England that suggests ethnic minority youths are not protected from poor mental health directly from ethnic density (Astell-Burt et al., 2012; Jonsson et al., 2018; Lenguerrand et al., 2012). The existing studies also suggest that the UK ethnic majority group's (White British) mental health is adversely affected by neighbourhood deprivation, which is not the case for ethnic minorities. The current study also confirms this. Our finding that the ethnic majority tend to have worse mental health when living in less diverse, deprived neighbourhoods is novel. This is perhaps because the existing literature in the UK or elsewhere does not separate the interaction effect of ethnic density and neighbourhood deprivation on adolescent mental health. Many existing studies are also limited by their study location in very

ethnically diverse contexts that exposes adolescents to a level of diversity not experienced by the vast majority of the population in the rest of the country (Astell-Burt et al., 2012; Lenguerrand et al., 2012). Our finding that the protective association of co-ethnic density on the mental health of ethnic minority youths is explained by known confounding is supported by the US-based literature that suggests the relationship is mediated by other factors including parenting style, social support and adolescent neighbourhood cohesion (Hurd et al., 2013; Lee et al., 2014).

Should these findings be replicated elsewhere, the implications for policy are that neighbourhood-based interventions should aim to improve the mental health of White British youths living in what are often described as "white working class" neighbourhoods (Beider, 2011; Garner, 2011). There is related work that suggests young people regardless of their own ethnic group benefit from ethnically diverse friendship groups (Bhui et al., 2005). These studies are often based on very diverse contexts (e.g. London) and perhaps reflect availability of these friendships that exposes young people to other cultures regardless as to whether they make friends with other young people from different ethnic groups. White British youths living in less deprived neighbourhoods where their ethnic group is the majority are likely to experience greater ethnic diversity since the pattern of ethnic minority dispersal is generally of the more socially advantaged minorities to less deprived places (Catney and Simpson, 2010; Jivraj and Simpson, 2015). White British youths living in the deprived neighbourhoods where their ethnic group is the majority are unlikely to experience this potential protective effect. To determine the causality of experience of ethnic diversity as a protective factor for adolescent mental health, attempts could be made to link schools in white working class neighbourhoods to more diverse contexts.

This study benefits from a nationally representative sample that enables generalisation to a population much broader than much of the existing research testing the protective effect of ethnic density on adolescent mental health. The sample is sufficiently large to test differences in the ethnic majority group in England (White British) and ethnic minorities as a whole. The use of multiple measures of ethnic density sets this study apart from most of the existing literature that focuses on co-ethnic density. Our measure of ethnic diversity enables a broader test of whether exposure to different people of different cultural backgrounds can lead to better mental health in young adolescence. This is plausible given the fluidity with which many young people in 21st Century England view ethnicity, which is less distinctive than the official census categorisations. The sufficiency of the sample size and variation in the sample in the two broad ethnic groups across the ethnic density and neighbourhood deprivation distributions allowed a test of the interaction between ethnic density and neighbourhood deprivation for the two ethnic groups. This has not been tested in the existing literature as far as we understand.

There are a number of limitations that the current study should be set against. The use of an ethnic group dichotomy (White British or ethnic minority) does not enable a nuanced picture to emerge as to whether particular cultural backgrounds benefit more or less from ethnic density and its interplay with neighbourhood deprivation. We did fit models for individual ethnic groups as measured in the study sample and found no statistically significant differences. This finding should be treated with the upmost caution given the small sample size in most of these individual ethnic minority groups. Two further limitations are that the analysis is cross-sectional and did not enable detection of direction of causality. It could be the case that poorer White British youths are constrained to white working class

neighbourhoods because of residential selection, rather than these places effecting their mental health. Longitudinal analysis using the more mature UKHLS in the future could test this further. The age group that completed information about their mental health from the youth self-completion questionnaire, who were aged 10-15, also limited the current study. It might be the case that neighbourhood context (ethnic density and neighbourhood deprivation, and their interplay) is stronger once young people reach ages of greater independence in terms of the interactions they make with their neighbourhood as they enter their later teenage years.

In summary, ethnic density was not associated with mental health among ethnic minority youths aged 10-15 in England. White British youth's mental health was worse when living in ethnically homogenous, deprived neighbourhoods where their ethnic group dominants the population.

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Tables and figures

Table 1. Complete case sample characteristics

	Mean (SD) or %	% Sample missing
Outcome		
SDQ score	11.09 (5.56)	1.16%
Neighbourhood exposures		
Co-ethnic density	0.75 (0.32)	11.12%
Ethnic diversity	0.73 (0.24)	0%
Townsend deprivation	-1.37 (2.88)	0%
Youth ethnic group		
White British	82.34%	11.12%
Ethnic minority	17.66%	
Age	12.52 (1.71)	0%
Gender		
Male	51.37%	0%
Female	48.63%	
Parental immigrant status		
Both parents native	81.45%	2.32%
One parent native	5.95%	
Both parents immigrants	12.60%	
Parental education		
None	11.38%	2.39%
Other	1.73%	
GCSE	35.07%	
A level	10.24%	
Lower degree	14.78%	
Degree	26.81%	
Household income	3877.25 (2853.34)	
Family support		
Supported most of the time	79.66%	.31%
Supported some or none of time	20.34%	
Talk to dad		
Most days	17.35%	1.83%
More than once a week	17.91%	
Less than once a week	20.46%	
Hardly ever	37.90%	
Don't have a father	6.37%	
Talk to mum		
Most days	37.01%	.92%
More than once a week	25.13%	
Less than once a week	17.86%	
Hardly ever	19.89%	
Don't have a mother	0.87%	

Adjusted using UKHLS sample weights.

Table 2. Mean co-ethnic density and mean ethnic diversity index by total difficulties scores and youth ethnicity

	Mean co-ethnic density			Mean diversity index			N		
	White	Minority	Total	White	Minority	Total	White	Minority	Total
Total difficulties									
Close to average	0.88	0.12	0.74	0.8	0.45	0.73	1710	868	2578
Slightly raised	0.88	0.1	0.75	0.8	0.43	0.73	338	152	490
High	0.87	0.11	0.79	0.79	0.47	0.76	229	67	296
Very high	0.88	0.15	0.79	0.8	0.51	0.76	217	67	284
Total	0.88	0.12	0.75	0.8	0.45	0.74	2494	1154	3648

Note: adjusted using UKHLS sample weights.

Table 3. Regression estimates for total difficulties scores by co-ethnic density

	Model 1	Model 2	Model 3
Co-ethnic density	**1.488 [0.00625,2.970]**	**2.966 [1.137,4.794]**	**2.185 [0.445,3.925]**
Ethnic minority youth (ref: White British)	-0.557 [-1.722,0.607]	0.83 [-0.787,2.447]	0.794 [-0.738,2.325]
Neighbourhood deprivation	**0.202 [0.125,0.280]**	-0.0601 [-0.199,0.079]	-0.083 [-0.212,0.045]
Ethnic minority youth * co-ethnic density		**-4.111 [-7.139,-1.083]**	-2.646 [-5.677,0.386]
Neighbourhood deprivation * co-ethnic density		**0.452 [0.260,0.643]**	**0.371 [0.190,0.551]**

95% confidence intervals in brackets. Bold estimates significant at 5% level. Model 3 adjusted for age, gender, parental immigrant status, parental education, household income and family support and parental interaction.

Table 4. Regression estimates for total difficulties scores by ethnic diversity

	Model 1	Model 2	Model 3
Diversity index	**2.246 [1.071,3.420]**	**1.964 [0.565,3.363]**	**1.447 [0.105,2.788]**
Ethnic minority youth (ref: White British)	**-1.087 1.695,-0.478]**	-1.138 [-2.488,0.212]	-0.5 [-1.821,0.821]
Neighbourhood deprivation	**0.269 [0.180,0.357]**	-0.002 [-0.214,0.210]	-0.059 [-0.254,0.137]
Ethnic minority youth * diversity index		0.252 [-1.945,2.450]	0.052 [-1.961,2.065]
Neighbourhood deprivation * diversity index		**0.382 [0.103,0.662]**	**0.344 [0.083,0.606]**

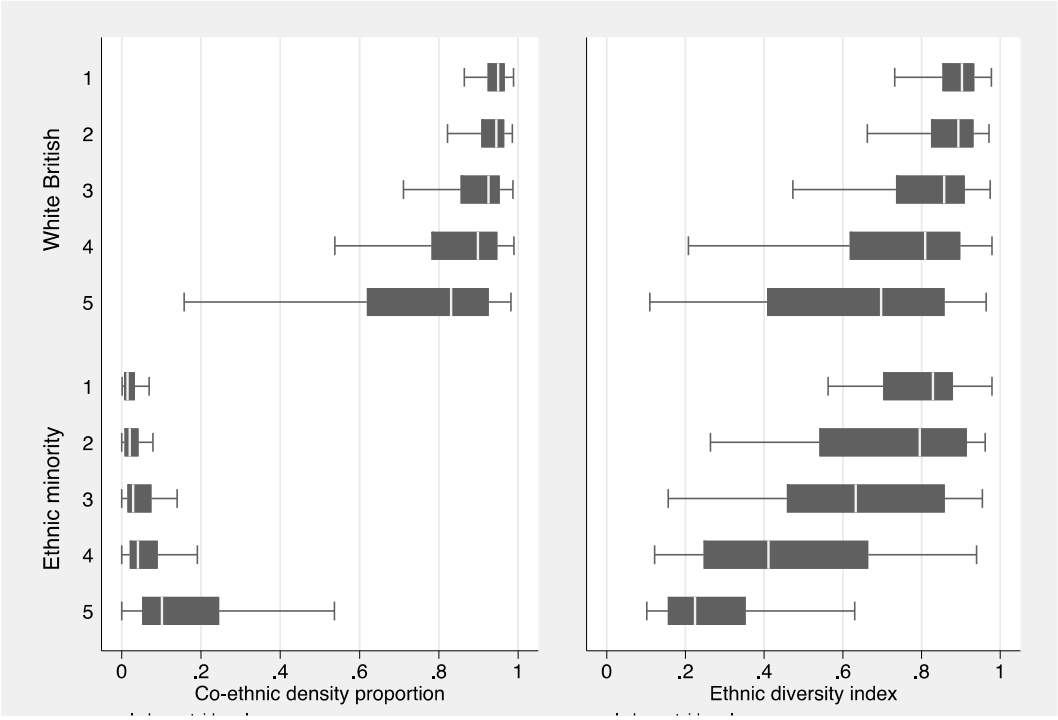
95% confidence intervals in brackets. Bold estimates significant at 5% level. Model 3 adjusted for age, gender, parental immigrant status, parental education, household income and family support and parental interaction.

Table 5. Regression estimates for total difficulties scores by neighbourhood deprivation and diversity classification

	Model 1	Model 2	Model 3
Deprived and not diverse	Reference	Reference	Reference
Not deprived or diverse	**-2.284 [3.043,1.526]**	**-2.472 [-3.295,-1.648]**	**-1.951 [-2.755,-1.146]**
Not deprived and diverse	**-2.480 [3.487,1.472]**	**-2.608 [-3.917,-1.300]**	**-1.966 [-3.192,-0.740]**
Deprived and diverse	**-2.130 [3.070,1.190]**	**-2.138 [-3.475,-0.802]**	**-1.667 [-2.961,-0.373]**
Ethnic minority youth (ref: White British)	**-1.077 [1.661,0.494]**	**-2.511 [-4.434,-0.588]**	**-1.885 [-3.650,-0.120]**
Ethnic minority youth * not deprived or diverse		1.781 [-0.330,3.892]	1.721 [-0.171,3.613]
Ethnic minority youth * not deprived and diverse		1.365 [-0.938,3.669]	1.215 [-0.875,3.304]
Ethnic minority youth * deprived and diverse		1.215 [-1.054,3.483]	1.031 [-1.042,3.104]

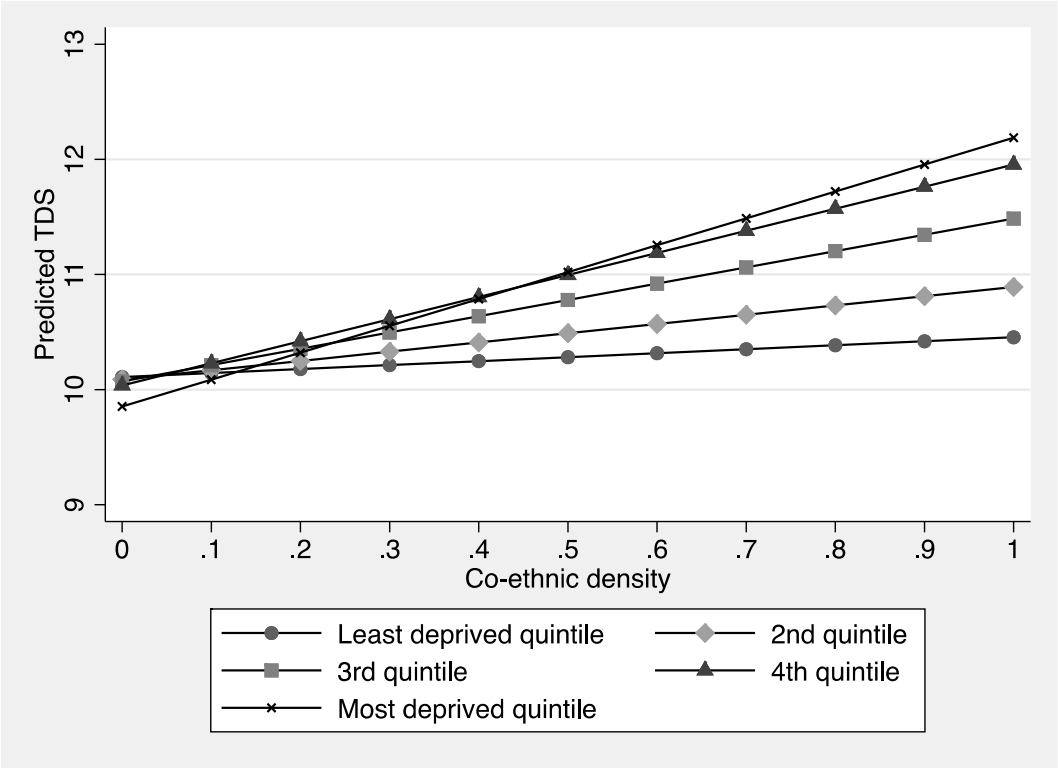
95% confidence intervals in brackets. Bold estimates significant at 5% level. Model 3 adjusted for age, gender, parental immigrant status, parental education, household income and family support and parental interaction.

Figure 1. Distribution of youths across co-ethnic density proportion and ethnic diversity index by minority status and neighbourhood deprivation quintile



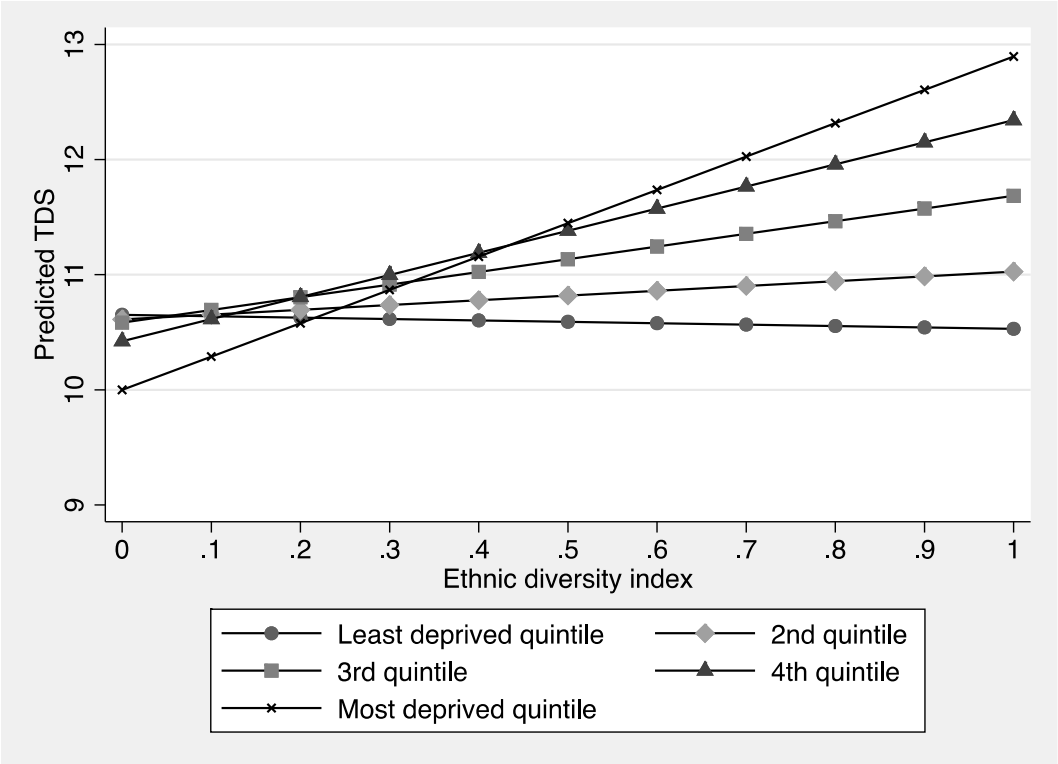
Notes: 1-5 denotes Townsend neighbourhood deprivation quintile, 1=least deprived; 5=most deprived. Adjusted using UKHLS sample weights.

Figure 2. Predicted total difficulties scores by co-ethnic density proportion and neighbourhood deprivation quintiles



Notes: adjusted for age, gender, parental immigrant status, parental education, household income and family support and parental interaction.

Figure 3. Predicted total difficulties scores by ethnic divesity index and neighbourhood deprivation quintiles



Notes: adjusted for age, gender, parental immigrant status, parental education,

household income and family support and parental interaction.

Appendix A. Complete case model 3 results

	Co-ethnic density	Ethnic diversity index
Co-ethnic density	**2.211 [0.284,4.139]**	
Diversity index		**1.499 [0.0349,2.963]**
Ethnic minority youth (ref: White British)	0.746 [-0.954,2.447]	-0.693 [-2.117,0.732]
Neighbourhood deprivation	-0.091 [-0.233,0.0499]	-0.022 [-0.238,0.194]
Ethnic minority youth * co-ethnic density	-2.677 [-5.977,0.624]	
Ethnic minority youth * diversity index		0.294 [-1.808,2.395]
Neighbourhood deprivation * co-ethnic density	**0.388 [0.192,0.583]**	
Neighbourhood deprivation * diversity index		**0.305 [0.0196,0.591]**

95% confidence intervals in brackets. Bold estimates significant at 5% level. Adjusted for age, gender, parental immigrant status, parental education, household income and family support and parental interaction.

Appendix B. Full model 3 estimates

		Co-ethnic density	Ethnic diversity index
Co-ethnic density		2.19*	
		[0.45,3.93]	
Diversity index			1.45*
			[0.11,2.79]
Ref: White British	Ethnic minority youth	0.79	-0.50
		[-0.74,2.33]	[-1.82,0.82]
Neighbourhood deprivation		-0.08	-0.06
		[-0.21,0.045]	[-0.25,0.14]
Ethnic minority youth * co-ethnic density		-2.65	
		[-5.68,0.39]	
Ethnic minority youth * diversity index			0.05
			[-1.96,2.07]
Neighbourhood deprivation * co-ethnic density		0.37***	
		[0.19,0.55]	
Neighbourhood deprivation * diversity index			0.34**
			[0.08,0.61]
Age		-0.22***	-0.22***
		[-0.32,-0.11]	[-0.32,-0.11]
Ref: Male		-0.23	-0.23
	Female	[-0.59,0.13]	[-0.59,0.13]
Ref: Both parents native		-0.15	-0.17
	One parent native	[-0.87,0.58]	[-0.89,0.56]
		-1.17***	-1.20***
	Both parents immigrants	[-1.85,-0.48]	[-1.89,-0.51]
Ref: Degree		0.77*	0.79*
	None	[0.05,1.49]	[0.07,1.51]
		0.45	0.34
	Other	[-1.14,2.03]	[-1.29,1.96]
		0.69**	0.69**
	GCSE	[0.19,1.19]	[0.20,1.19]
		0.14	0.14
	A level	[-0.50,0.79]	[-0.50,0.79]
		0.42	0.43
	Lower degree	[-0.18,1.02]	[-0.17,1.03]
Gross household income/1000		0.01	0.01
		[-0.08,0.10]	[-0.08,0.10]
Ref: Supported most of the time		3.64***	3.65***
	Supported some or none of the time	[3.19,4.10]	[3.20,4.11]
		0.48	0.46
	More than once a week	[-0.19,1.15]	[-0.22,1.13]

Ref: Talk to dad most days		0.58	0.53
	Less than once a week	[-0.09,1.25]	[-0.14,1.20]
		1.49***	1.48***
	Hardly ever	[0.84,2.15]	[0.82,2.14]
		1.98***	1.96***
	Don’t have a father	[1.03,2.92]	[1.02,2.90]
Ref: Talk to mum most days		-0.42	-0.41
	More than once a week	[-0.93,0.09]	[-0.92,0.11]
		-0.61*	-0.60*
	Less than once a week	[-1.18,-0.04]	[-1.17,-0.03]
		-0.15	-0.15
	Hardly ever	[-0.76,0.47]	[-0.77,0.46]
		0.93	0.92
	Don’t have a mother	[-1.52,3.38]	[-1.53,3.36]
	Constant	11.16***	11.91***
		[9.06,13.25]	[10.11,13.72]

95% confidence intervals in brackets
* p<0.05, ** p<0.01, *** p<0.001