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Ethnic density effects on maternal and infant health in the Millennium Cohort Study☆

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ABSTRACT

Studies have suggested that members of ethnic minority groups might be healthier when they live in areas with a high concentration of people from their own ethnic group – in spite of higher levels of material deprivation typically found within such areas. We investigated the effects of area-level same-ethnic density on maternal and infant health, independent of area deprivation and individual socio-economic status, in five ethnic minority groups. The study was a cross-sectional analysis within the UK Millennium Cohort Study and included mothers in five ethnic minority groups (Black African $n = 367$, Bangladeshi $n = 369$, Black Caribbean $n = 252$, Indian $n = 462$ and Pakistani $n = 868$) and their 9-month-old infants. Outcome measures included: low birth weight, preterm delivery, maternal depression, self-rated health and limiting long-standing illness. Compared to those who live in areas with less than 5% of people from the same-ethnic minority population, Indian and Pakistani mothers were significantly less likely to report ever being depressed in areas with high same-ethnic density. There was a protective effect of ethnic density for limiting long-term illness among Bangladeshi mothers at 5–30% density and Pakistani mothers at all higher densities. Ethnic density was unrelated to infant outcomes and maternal self-rated health, and unrelated to any outcomes in Black African and Black Caribbean mothers and infants, possibly because no families in these groups lived at higher levels of same-ethnic density. Results were similar whether we examined smaller or larger residential areas. We conclude that, among ethnic minority mothers and infants in England, the relationship of ethnic density to health varies by ethnicity and outcome. For some measures of maternal health, in some ethnic groups, the psychosocial advantages of shared culture, social networks and social capital may override the adverse effects of material deprivation.

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Introduction

The neighbourhoods within which people live have received increasing attention as a possible cause of health inequalities. Numerous studies have shown that living in a deprived neighbourhood exerts a contextual effect on the health of individual residents, above and beyond their own socio-economic status (Pickett & Pearl, 2001; Riva, Gauvin, & Barnett, 2007). Both material aspects of poor neighbourhoods, such as lack of access to cheap, fresh food, and psychosocial characteristics, such as low levels of social capital or the status of the neighbourhood, have been linked to health. Multilevel studies of neighbourhood effects on health depend on there being a mix of different kinds of individuals in different kinds of neighbourhoods – without that heterogeneity there would be no possibility of distinguishing between the effects of context and composition. And yet poor people tend to live in poor neighbourhoods, and rich people in affluent neighbourhoods (Dorling, 2005).

In many societies, neighbourhoods are segregated by ethnicity, as well as economics, creating what Williams and Collins (2001) have called "distinctive ecological environments", often characterized by deprivation, under-investment, and limited educational and employment opportunities. Economic segregation becomes entrenched along ethnic lines: as Williams and Collins point out – although there are more poor White people than poor Black people in the USA, poor Whites tend not to be concentrated in poor areas

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to the same extent as poor Blacks. Both economic and ethnic segregation have been shown to be bad for health (Lobmayer & Wilkinson, 2002; Williams & Collins, 2001).

As people who live in deprived areas and people living in economically and ethnically segregated areas have worse health, it might seem paradoxical to suggest that members of ethnic minority groups might sometimes be healthier when they live in areas with a high concentration of same-ethnicity population (Halpern, 1993; Pickett & Wilkinson, 2008). Members of low-status ethnic minorities who live in areas where there are few like themselves are likely to be materially better off, have higher social status, and be living in more affluent neighbourhoods, than those who live in areas with a higher concentration (Dorsett, 1998; Halpern & Nazroo, 2000). However, through the eyes of the majority community, they may be made more aware of belonging to a low-status minority group (Charlesworth, Gilfillan, & Wilkinson, 2004). In areas with *lower* same-ethnic density, higher material standards and social status would tend to improve health, while the psychosocial effects of isolation may offset any advantage. In areas with *higher* same-ethnic density, more material deprivation would tend to have an adverse effect on population health, while shared culture, social networks and social capital might exert a protective effect. If ethnic density is, in fact, associated with better health, this shows that the effects of isolation, discrimination and stigma are sometimes powerful enough to override social and material advantage and/or the effects of social integration and connectedness are sometimes powerful enough to override low social status and material deprivation.

Our interest is in the possibility that ethnic density is protective for health as a consequence of reduced exposure to stigma and social discrimination. It is, therefore, important to consider social and demographic factors that may mask any protective effect of ethnic density for health, and factors or conditions that might produce spurious effects.

The roles of culture and acculturation for the health of ethnic minority populations are a separate issue. Processes of acculturation may have effects which mask, or could be mistaken for, the kinds of group density effects we discuss in this paper. Different ethnic minority groups may possess cultures that are either more or less salutary than that of the host society within which they reside. Over time, acculturation may diminish these health-related cultural differences as the minority group becomes more like the majority. If their own culture puts them at an initial health advantage, as a group they may well have better health when living at higher levels of their own ethnic density, but not due to any protective effect of lower exposure to stigma and prejudice. The health advantages of some ethnic minority groups, such as Hispanics within the USA, and many groups of economic migrants, are generally believed to be at least partially explained by cultural factors, with their health advantages diminishing with acculturation; as, for example, when second generation immigrants, or those who have adopted the language of the host country, are shown to have worse health than first generation immigrants or those who continue to speak their native language at home (Marmot, 1993). Cultural determinants of health will vary between ethnic groups and within ethnic groups in different places and at different times – the ethnic density effect we are seeking to understand is a more specific protective effect related to living in an enclave that provides shelter from the health impact of low social status.

As poverty and deprivation are common experiences for many ethnic minority groups, taking individual-level and area-level deprivation and socioeconomic status into account is also necessary for estimating an ethnic density effect. Similarly, we would not expect to find effects of ethnic density for ethnic groups with high social status relative to the majority population, as they will not be affected by downward prejudice and discrimination against which ethnic density may provide an enclave of social acceptability and social support. It is also likely that the effects of ethnic density are only apparent above a particular level of density, and studies should include (within groups) some people living at low levels of same-ethnic density and some at high enough densities to feel less stigmatized by their minority status. These methodological concerns have not been consistently addressed in previous studies.

Early studies of ethnic density effects on mental health were ecological studies of treated mental health – although they invariably found lower hospital admission rates for mental illness among ethnic minority populations living at higher same-ethnic densities, it seemed possible that ethnic differences in help-seeking behaviour, service provision and/or likelihood of being diagnosed as mentally ill were the underlying explanation (Faris & Dunham, 1939; Levy & Rowitz, 1973; Mintz & Schwartz, 1964; Muhlin, 1979; Rabkin, 1979; Wechsler & Pugh, 1967). More recently, multilevel studies of the true, rather than treated, prevalence of mental illness have produced more mixed evidence for a protective effect of ethnic density (Abada, Hou, & Ram, 2007; Fagg, Curtis, Stansfeld, & Congdon, 2006; Halpern & Nazroo, 2000; Henderson et al., 2005; Neeleman & Wessely, 1999; Ostir, Eschbach, Markides, & Goodwin, 2003; Wickrama, 2005).

Studies of ethnic density effects on physical health are more recent, and they have tended to be multilevel rather than ecological, looking at the impact of ethnic density within a neighbourhood after adjusting for both area-level and individual socioeconomic status. Some of these studies show a protective effect of ethnic density, others do not (Pickett & Wilkinson, 2008).

To contribute to the identification of ethnic density effects on maternal and infant health, and to try to clarify issues around acculturation, deprivation, and levels of density, we examined ethnic density effects on a range of maternal and infant health outcomes within five minority ethnic populations in the UK.

Methods

Data and study sample

Data are from the Millennium Cohort Study (MCS), a large prospective study of 18,819 infants and their 18,533 families born in 2000–2002 in the United Kingdom. Our study is a cross-sectional analysis of the first wave of data collection, which took place when the infants were around 9 months old. The sampling design for the MCS allowed for an over-representation of areas (electoral wards) where more than 30% of the population were identified as Black or Asian in the 1991 census, as well as over-representation of areas with high levels of child poverty. Infants born on eligible dates within eligible areas were identified in the Child Benefit Register (child benefit is a universal benefit, payable from birth); the response rate was 72%. Full details of the study design, sampling issues and field methods of the MCS have been published elsewhere (Dex & Joshi, 2005; Plewis, 2007; Shaw & Calderwood, 2004). Our study focuses on ethnic minority natural mother-singleton infant pairs in England and Wales.

Measurement of maternal ethnicity

Mother's were asked which ethnic identity category they felt they belonged to, corresponding to the categories used in the UK census (Office for National Statistics, 2003). For this study, we exclude mothers who identified their ethnicity as White (Census codes 1,2,3) or any of the Mixed (codes 4,5,6,7) and Other (codes 11,14,15,16) ethnicity categories, and include women who identified

their ethnicity as Black African (code 13), Bangladeshi (code 10), Black Caribbean (code 12), Indian (code 8), and Pakistani (code 9).

Measurement of ethnic density

The same-ethnic density for each mother's area of residence was derived from the small area statistics of the 2001 UK Census. This was measured as the percentage of residents in the mother's area who were of the same-ethnic group, and areas were categorized as having 0–5%, 5–30%, 30–50%, >50% same-ethnicity. These are compatible with previous UK studies and gave tractable distributions for analysis given the UK concentration of ethnic minority populations. We measured ethnic density at two geographic scales: Lower Super Output Area (LSOA) and Medium Super Output Area (MSOA) (Office for National Statistics). LSOAs have a minimum population of 1000, and a mean of 1500, MSOAs have a minimum population of 5000, with a mean of 7200.

Measurement of maternal and child outcomes

Infant outcomes included low birth weight (<2500 g) and preterm delivery (<37 weeks gestation). Maternal mental health was measured by two questions – whether or not a mother had felt low or sad for a period of two or more weeks since the baby was born (termed post-natal depression for this study), and whether or not she had ever been told by a doctor that she was depressed (ever depressed). Mothers were also asked whether or not they had any limiting longstanding illness, and were asked to rate their general health as excellent, good, fair or poor.

Measurement of area-level and individual-level confounding and moderating variables

Potential confounding factors are those associated with either mother's ethnicity or the ethnic density of the area in which she lives, as well as the maternal or child health outcome of interest. These included individual-level factors – mother's age (years), whether or not the infant was the mother's first-born, and her educational level (NVQ equivalence scale: no qualifications, NVQ 1 or 2, NVQ 3, NVQ 4 and 5). For some analyses of Bangladeshi and Black African mothers there were very small numbers with NVQ 4 or 5 level qualifications, and so the top three educational categories were collapsed. Marital status was categorized as married vs. other for Indian, Bangladeshi and Pakistani mothers, and as married, cohabiting, and other for Black African and Black Caribbean mothers. The social class of the mother's household was measured by usual occupation using the National Statistics Socio-Economic Classification (NS-SEC) (Office for National Statistics, 2005). We took the highest category of the mother or her resident partner and categorized social class as (1) managerial and professional occupations, (2) intermediate occupations, (3) routine and manual occupations, and (4) never worked. Socio-economic status was also indicated by whether or not the mother was receiving any low income-eligible welfare or benefits.

Area-level deprivation was measured using Carstair's score, combining selected variables from small area statistics from the 2001 Census. The index is designed to measure access to material resources and combines information on overcrowding, male unemployment, low social class and car ownership (Carstairs, 1995). At both LSOA and MSOA-level we classified deprivation with reference to national percentile ranks for Carstair's scores: low-moderate (0–75th percentile), high (75–95th percentile) and very high (>95th percentile).

Two maternal characteristics were investigated as potential moderators of any ethnic density effect – whether or not the mother was born in the UK or elsewhere (nativity), and whether or not the mother lived in a household where no English was spoken, a measure of acculturation.

Statistical analysis

Sample characteristics are described using means and proportions. Adjusted odds ratios are estimated for each maternal or infant outcome in relation to ethnic density, adjusting for individual-level socio-demographic characteristics and area-level deprivation. These contextual effects of area-level ethnic density are estimated in multilevel mixed-effects logistic regression, with a random intercept, using Stata version 10. All analyses were conducted at both LSOA and MSOA-level; as they did not differ substantially we present results for MSOA only. At this geographic scale, the sample included 367 Black African mothers in 80 MSOAs, 369 Bangladeshi mothers in 71 MSOAs, 252 Black Caribbean mothers in 82 MSOAs, 462 Indian mothers in 129 MSOAs and 868 Pakistani mothers in 125 MSOAs. Effect modifications by mother's nativity and language were tested by including interaction terms between these variables and ethnic density. For any outcome with a consistent relationship to ethnic density across all ethnic groups, to examine ethnic density effects independently of acculturation, we also conducted a pooled analysis, including all ethnic minority groups in one model, adjusting for nativity and language spoken at home.

Results

Table 1 shows maternal and infant outcomes by mother's ethnic group. Outcomes vary by ethnicity, even between groups that are commonly grouped together in epidemiological studies. For example, there are differences in the rate of low birth weight (7.7% vs. 10.3%) and maternal depression (7.6% vs. 17.5% ever depressed) between Black African and Black Caribbean mothers, respectively; and differences in maternal depression (9.8% vs. 14.6% ever depressed) between Bangladeshi and Pakistani mothers, respectively.

Table 2 shows the distribution of the socio-demographic characteristics by mother's ethnicity. Bangladeshi, Indian and Pakistani mothers are younger than Black African and Black Caribbean mothers. Bangladeshi and Pakistani mothers have lower levels of education than mothers in other ethnic minority groups; Indian mothers are much less likely to be receiving welfare benefits than mothers in the other groups.

Area-level same-ethnic density and deprivation by mother's ethnicity are given in Table 3. There is wide variation in ethnic density between ethnic groups: around a third of Pakistani mothers live in areas, both at LSOA and MSOA, where more than half of residents are also Pakistani, and two-thirds of them live in very deprived areas. Bangladeshi and Indian women are similar in the degree to which they live in areas with people from the same-ethnic group, around one-fifth live in LSOAs where they are in the majority – but they have very different distributions by area deprivation, three-quarters of Bangladeshi mothers live in the most deprived areas, compared to less than 30% of Indian mothers. No Black mothers, whether of African or Caribbean ethnicity, live in areas of greater than 50% same-ethnic density, and no Black Caribbean mothers live in areas with more than 30% Black Caribbeans. Black mothers are, nevertheless, more likely than Indian mothers to live in areas of very high deprivation.

Tables 4–6 present the results of multilevel analyses of the effect of MSOA same-ethnic density on health outcomes. Where results were substantively different when looking at the effect of LSOA ethnic density for any outcome, we note the difference in this

Table 1
Health outcomes of mothers and infants by mother's ethnicity in the Millennium Cohort Study.

Outcome	Black African $N=367$		Black Caribbean $N=252$		Bangladeshi $N=369$		Indian $N=462$		Pakistani $N=868$	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Low birth weight										
>2500 g	334	92.27	226	89.68	316	86.34	392	85.03	762	88.19
<2500 g	28	7.73	26	10.32	50	13.66	69	14.97	101	11.81
Preterm delivery										
Preterm birth	322	91.74	223	89.56	338	94.41	403	89.56	788	93.25
Term birth	29	8.26	26	10.44	20	5.9	47	10.44	57	6.75
Post-natal depression										
No	260	70.84	141	55.95	282	76.84	303	66.01	568	65.59
Yes	107	29.16	111	44.05	85	23.16	156	33.99	298	34.41
Ever depressed										
No	339	92.37	208	82.54	332	90.22	410	88.74	741	85.37
Yes	28	7.63	44	17.46	36	9.78	52	11.26	127	14.63
Limiting long-term illness										
No	325	88.55	224	88.89	332	89.97	428	92.84	784	90.32
Yes	42	11.44	28	11.11	37	10.03	33	7.16	84	9.68
Self-rated health										
Excellent or good	294	80.11	177	70.24	288	78.47	367	79.44	647	74.54
Fair or poor	73	19.89	75	29.76	79	21.53	95	20.56	221	25.46

section. All analyses were adjusted for maternal age, parity, marital status, maternal education, household social class, and receipt of benefits.

We found no significant associations between ethnic density and low birth weight or preterm delivery for any ethnic group, except for a lower risk of preterm delivery among Pakistani mothers living at Pakistani densities of 5–30% (OR = 0.35, $p = 0.043$) and a trend towards lower risk at 50%+ density (OR = 0.37, $p = 0.077$) (Table 4). Directions of effect varied by mother's ethnicity; risk of low birth weight was higher at higher levels of ethnic concentration for Black African, Bangladeshi and Indian women, but lower at higher ethnic density for Black Caribbean and Pakistani women. Although mostly not statistically significant, the pattern of effects for preterm delivery was of lower risk in areas with higher same-ethnic concentration for all ethnic groups.

Table 5 shows that there were no significant associations between ethnic density and post-natal depression for any ethnic group. Indian and Pakistani mothers were less likely to report having ever been depressed in areas with higher same-ethnic density and these associations were statistically significant for Indian mothers in areas of 5–30% same-ethnic density, and Pakistani mothers at 30–50% same-ethnic density. Although not significant, the direction of effect is the same for Black African mothers, but Bangladeshi and Black Caribbean mothers report

Table 2
Socio-demographic characteristics of mothers in the Millennium Cohort Study by ethnicity.

Individual	Black African $N=367$		Black Caribbean $N=252$		Bangladeshi $N=369$		Indian $N=462$		Pakistani $N=868$	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Maternal age	31.17	5.83	30.09	6.86	26.85	4.85	29.24	5.07	27.29	5.34
	N	%	*N*	%	*N*	%	*N*	%	*N*	%
Parity of child										
Not first birth	261	71.12	157	62.30	271	73.44	266	57.58	582	67.05
First birth	106	28.88	95	37.70	98	26.56	196	42.42	286	32.95
Maternal education										
None + overseas	150	40.87	41	16.40	211	57.34	139	30.09	484	56.02
NVQ level 1 + 2	58	15.80	92	36.80	94	25.54	110	23.81	198	22.92
NVQ level 3	37	10.08	38	15.20	34	9.24	59	12.77	94	10.88
NVQ level 4 + 5	122	33.24	79	31.60	29	7.88	154	33.33	88	10.19
Marital status										
Married and living together	154	42.08	70	27.89	344	93.48	399	86.74	786	90.76
Cohabiting	44	12.02	40	15.94	3	0.82	7	1.52	5	0.58
Other	168	45.90	141	56.18	21	5.71	54	11.74	75	8.66
Household NS-SEC										
Salaried	82	22.53	80	32.26	49	13.35	166	36.17	120	13.94
Intermediate	67	18.41	79	31.85	88	23.98	135	29.41	271	31.48
Working	110	30.22	67	27.02	165	44.96	128	27.89	325	37.75
Not working	105	28.85	22	8.87	65	17.71	30	6.54	145	16.84
In receipt of income benefits										
No	148	40.33	93	37.20	117	31.88	324	70.28	330	38.19
Yes	219	59.67	157	62.80	250	68.12	137	29.72	534	61.81

Table 3
Area-level ethnic density and deprivation for mothers in the Millennium Cohort Study, by ethnicity.

Area	Black African		Black Caribbean		Bangladeshi		Indian		Pakistani	
	$N = 367$	%	$N = 252$	%	$N = 369$	%	$N = 462$	%	$N = 868$	%
LSOA										
Ethnic density										
0–5%	92	25.07	69	27.38	73	19.78	110	23.81	88	10.14
5–30%	242	91.01	183	72.62	186	50.41	147	31.82	286	32.95
30–50%	33	8.99	–	–	43	11.65	100	21.65	188	21.66
50+%	–	–	–	–	67	18.16	105	22.73	306	35.25
Deprivation based on national percentiles										
Low/moderate (0–75)	67	18.26	68	26.98	35	9.49	175	37.88	118	13.59
High (75–95)	107	29.16	73	28.97	58	15.72	152	32.9	172	19.82
Very high (95+)	193	52.59	111	44.05	276	74.8	135	29.22	578	66.59
MSOA										
Ethnic density										
0–5%	106	28.88	70	27.78	80	21.68	102	22.08	99	11.41
5–30%	232	63.22	182	72.22	184	49.86	168	36.36	304	35.02
30–50%[a]	29	7.90	–	–	105	28.46	68	14.72	193	22.24
50+%	–	–	–	–	–	–	124	26.84	272	31.34
Deprivation based on national percentiles										
Low/moderate (0–75)	66	17.98	70	27.78	35	9.49	170	36.8	119	13.71
High (75–95)	107	29.16	72	28.57	51	13.82	105	22.73	153	17.63
Very high (95+)	194	52.86	110	43.65	283	76.69	187	40.48	596	68.66

[a] Few Bangladeshi women were living at MSOA density above 50% – they have been included in the 30–50% category for analysis.

more lifetime depression at higher densities. At LSOA level this increased risk was significant for Bangladeshi mothers in areas where they were in the majority.

We found no associations between ethnic density and mothers' self-rated health (Table 6). There was a protective effect of ethnic density for limiting long-term illness among Bangladeshi mothers at 5–30% same-ethnic density (OR = 0.16, $p = 0.006$) and for Pakistani mothers at all densities higher than 5%.

We also examined interactions between ethnic density and whether or not women were born outside of the UK and between ethnic density and not speaking English at home (full models not shown). Very few Black African or Bangladeshi mothers were born in the UK, and very few Black Caribbean mothers were born outside of the UK so interaction models were not estimated for these groups. We found no significant interactions between nativity and ethnic density for any outcome.

Preterm delivery was the only outcome with a coherent relationship to ethnic density across all ethnic groups, with a pattern of lower risk with increasing ethnic density. In a pooled analysis to examine risk independent of acculturation, we included all ethnic

Table 4
Effects of same-ethnic density at MSOA-level on infant outcomes in the Millennium Cohort Study.[a]

	Low birth weight			Preterm birth		
	OR	95% CI	p	OR	95% CI	p
Black African						
0–5%	1					
5–30%	0.77	(0.29–2.04)	0.593	0.81	(0.28–2.36)	0.701
30–50%	1.33	(0.24–7.27)	0.739	0.74	(0.14–3.88)	0.719
Black Caribbean						
0–5%	1			1		
5–30%	0.92	(0.32–2.68)	0.883	0.78	(0.26–2.32)	0.651
Bangladeshi						
0–5%	1			1		
5–30%	1.71	(0.54–5.40)	0.357	0.81	(0.16–4.20)	0.800
30+%	1.87	(0.53–6.58)	0.328	0.76	(0.08–7.60)	0.814
Indian						
0–5%	1					
5–30%	1.12	(0.53–2.35)	0.769	0.62	(0.28–1.38)	0.243
30–50%	1.46	(0.61–3.49)	0.399	0.81	(0.30–2.14)	0.667
50+%	1.44	(0.61–3.38)	0.400	0.71	(0.25–2.04)	0.530
Pakistani						
0–5%	1					
5–30%	0.63	(0.30–1.32)	0.218	0.35	(0.13–0.97)	0.043
30–50%	0.56	(0.23–1.37)	0.207	0.45	(0.16–1.33)	0.150
50+%	0.80	(0.34–1.91)	0.619	0.37	(0.12–1.12)	0.077

[a] Results are from multilevel logistic regression models, adjusted for maternal age, parity, education, marital status, social class, benefits and area deprivation.

Table 5
Effects of same-ethnic density at MSOA-level on maternal mental health in the Millennium Cohort Study.[a]

	Post-natal depression			Ever depressed		
	OR	95% CI	p	OR	95% CI	p
Black African						
0–5%	1			1		
5–30%	0.86	(0.41–1.79)	0.680	0.89	(0.33–2.36)	0.811
30–50%	1.27	(0.28–5.80)	0.760	0.46	(0.05–4.50)	0.506
Black Caribbean						
0–5%	1			1		
5–30%	1.29	(0.65–2.53)	0.467	1.17	(0.48–2.86)	0.727
Bangladeshi						
0–5%	1			1		
5–30%	0.95	(0.42–2.17)	0.902	0.77	(0.19–3.09)	0.714
30+%	0.90	(0.37–2.17)	0.807	2.82	(0.69–11.50)	0.149
Indian						
0–5%	1			1		
5–30%	0.79	(0.46–1.36)	0.396	0.34	(0.15–0.76)	0.009
30–50%	1.28	(0.66–2.51)	0.467	0.44	(0.16–1.26)	0.127
50+%	1.15	(0.61–2.18)	0.666	0.88	(0.36–2.16)	0.787
Pakistani						
0–5%	1					
5–30%	1.24	(0.72–2.16)	0.435	0.52	(0.26–1.01)	0.054
30–50%	0.94	(0.50–1.78)	0.851	0.34	(0.15–0.77)	0.010
50+%	1.01	(0.53–1.92)	0.977	0.58	(0.26–1.27)	0.170

[a] Results are from multilevel logistic regression models, adjusted for maternal age, parity, education, marital status, social class, benefits and area deprivation.

Table 6
Effects of same-ethnic density at MSOA-level on maternal health in the Millennium Cohort Study.[a]

	Self-rated health			Limiting longstanding illness		
	OR	95% CI	*p*	OR	95% CI	*p*
Black African						
0–5%	1			1		
5–30%	0.96	(0.51–1.79)	0.886	0.66	(0.30–1.43)	0.292
30–50%	0.31	(0.06–1.54)	0.151	0.55	(0.10–3.09)	0.498
Black Caribbean						
0–5%	1			1		
5–30%	1.04	(0.46–2.37)	0.930	1.01	(0.37–2.76)	0.987
Bangladeshi						
0–5%	1					
5–30%	0.75	(0.32–1.75)	0.506	0.16	(0.04–0.59)	0.006
30+%	1.61	(0.66–3.93)	0.292	1.68	(0.55–5.18)	0.363
Indian						
0–5%	1					
5–30%	0.87	(0.46–1.67)	0.683	1.15	(0.44–3.03)	0.780
30–50%	1.07	(0.48–2.39)	0.865	1.09	(0.30–3.87)	0.900
50+%	1.61	(0.77–3.37)	0.210	0.87	(0.24–3.17)	0.834
Pakistani						
0–5%	1			1		
5–30%	0.98	(0.55–1.73)	0.932	0.33	(0.14–0.78)	0.011
30–50%	0.89	(0.46–1.73)	0.733	0.24	(0.08–0.68)	0.007
50+%	0.57	(0.29–1.12)	0.104	0.30	(0.10–0.88)	0.027

[a] Results are from multilevel logistic regression models, adjusted for maternal age, parity, education, marital status, social class, benefits and area deprivation.

minority groups in one model and adjusted for nativity and language spoken at home. We found that same-ethnic density greater than 50% was associated with a significantly lower risk of preterm delivery (OR = 0.49, 95% CI: 0.24–0.99, $p = 0.047$), independent of any effects of acculturation.

Very few Black Caribbean mothers spoke languages other than English at home but for the other ethnic groups we examined interactions between language at home and ethnic density. For Pakistani mothers there were significant interactions between language and ethnic density in relation to low birth weight (p-value = 0.03). For English-speaking Pakistani mothers, higher levels of ethnic density were protective for low birth weight, whereas for Pakistani mothers who did not speak English, higher ethnic density was associated with an increased risk of low birth weight.

Discussion

In summary, few Black African or Black Caribbean mothers lived in areas with high same-ethnic density and we found no evidence of significant effects of ethnic density for these groups. Bangladeshi women did live at higher levels of ethnic density, which appeared to be protective for limiting long-term illness at densities of 5–30%, but detrimental in areas in which they are in the majority – in those areas there was a non-significant trend towards reporting having ever been depressed. As Bangladeshi women are the most deprived ethnic minority community of these we studied, it may be that in areas where they are in the majority, effects of poverty beyond those captured in our models may outweigh any protective effects of higher ethnic density. Indian mothers living in areas with higher densities of Indians were less likely to have ever been depressed. Ethnic density had more associations with health outcomes for Pakistani mothers than for other minority ethnic groups; at higher densities they were less likely to have preterm deliveries, a history of depression, or limiting long-term illness. Among English-speaking Pakistani mothers, ethnic density was associated with a lower risk of low birth weight.

To our knowledge, this is the first study of ethnic density in relation to maternal and child health in the UK. Previous studies conducted in the USA have produced conflicting findings. As early as the 1950s, Yankauer found that areas of New York City with a high proportion of non-White births had high rates of infant mortality and that segregated areas were characterized by unsanitary conditions and high rents (Yankauer, 1950; Yankauer & Allaway, 1958). Multilevel studies looking at the effects of ethnic density, independent of area-level deprivation and individual-level socioeconomic status are needed to unravel the meaning of these early findings.

In a study of neighbourhood factors related to low birth weight in Chicago, Roberts (1997) found that risk was lower for infants born to African-American mothers living in neighbourhoods with higher proportions of African-Americans, after controlling for maternal education, as well as neighbourhood-level economic hardship, socio-economic status, median rent, overcrowding and proportion of young residents. As Ellen (2000) found the opposite in an analysis of low birth weight risk in relation to the proportion of African-Americans within large metropolitan areas, it is possible that ethnic density in small areas is beneficial but becomes detrimental within larger areas.

Three recent US studies have examined Black ethnic density and pregnancy outcomes at the level of the census tract. In Minnesota (Baker & Hellerstedt, 2006) and North Carolina (Mason, Messer, Laraia, & Mendola, 2009), researchers found small but significant increased risks for Black women living in areas with higher Black density, but neither controlled for area-level deprivation and ethnic density was below 33% for all the Minnesota census tracts. In contrast, in Chicago, Masi, Hawkley, Piotrowski, and Pickett (2007) found a non-significant trend for increased birth weight and lower risk of preterm delivery with higher proportions of Black residents, after adjustment for tract deprivation. As deprivation and minority ethnic density tend to be closely correlated, it is critical to control for deprivation when trying to identify an independent effect of ethnic density.

It also appears that the beneficial effects of better relative socioeconomic status (positive income incongruity) for pregnancy outcomes among African-American women reported by Collins, Herman, and David (1997) are restricted to mothers living in areas with high African-American density (Pickett, Collins, Masi, & Wilkinson, 2005; Vinikoor, Kaufman, MacLehose, & Laraia, 2008).

Studies of ethnic density need to be differentiated from studies of segregation. There have been several studies of the impact of racial and ethnic segregation on maternal and child health (see for example, Baker & Hellerstedt, 2006; Bell, Zimmerman, Almgren, Mayer, & Huebner, 2006; Grady, 2006; Grady & McLafferty, 2007). Residential segregation has been defined as the extent to which two or more groups live separately from one another, and is a characteristic of one group vis-à-vis another, whereas same-ethnic density is the degree to which an individual's neighbourhood contains people like herself. These are overlapping but distinct concepts, and it may be that each operates in different fashions and at different geographical scales. As an example, Bell et al. (2006) found no effect of the proportion of Black residents in metropolitan areas on pregnancy outcomes but did find that a measure of racial isolation (the probability that an African-American mother would encounter other African-Americans in random daily encounters) was associated with worse outcomes (decreased birth weight and increased risk of preterm birth and fetal growth restriction), whilst a measure of racial clustering (the extent to which predominantly African-Americans metropolitan areas are contiguous) was linked to better outcomes (higher birth weight and lower risk of preterm delivery and fetal growth restriction).

Effects of ethnic density clearly vary by ethnic group. Although the studies of Black Americans cited above can be viewed as having

mixed results, studies of US Hispanics all show a positive impact of Hispanic density. Jenny et al. found that Mexican-American infant mortality was lower in Western counties with higher proportions of Mexican-American births, although this protective effect was only seen for infants of US-born Mexican-American mothers, and not for those with foreign-born mothers (Jenny, Schoendorf, & Parker, 2001). In Chicago, Masi et al. (2007) and Morenoff (2000) report that birth weight for Mexican-Americans increases in neighbourhoods with more Mexican-American residents.

Setting our findings within the context of these previous studies, the fact that we found no protective effects of ethnic density for Black African and Black Caribbean mothers is congruent with the lack of findings in the one US study of African-Americans that did not include mothers living in areas of high same-ethnic density. The fact that US studies more consistently report a positive effect for ethnic density among Hispanics than among African-Americans may be related to the histories by which each population became settled in the United States. The well-known "Hispanic paradox", in which Hispanics have better health than expected from their low socioeconomic status, is believed to be related to positive aspects of Hispanic culture and social cohesion; effects are strongest among those who do not speak English and those who have migrated most recently (Franzini, Ribble, & Keddie, 2001). However, cultures of recent migrants may not always be protective for health; in our study, we found that less acculturated Pakistani women were more likely to have low birth weight infants in areas with high same-ethnic density.

An explanation of our inconsistent findings may be sample sizes. Despite a sampling strategy designed to increase the representation of ethnic minority families in the Millennium Cohort Study, sample sizes for the five groups we studied were modest. We found most significant effects of ethnic density within the largest, Pakistani, sample. However, it is important in studies of ethnicity and health to not merge disparate groups, simply to increase sample size. Although some previous studies of ethnic density in relation to adult health in the UK have merged Pakistani, Indian and Bangladeshi groups into a South Asian group, and/or grouped Black Caribbean and Black Africans together, our results show that ethnic density is related to maternal and child health very differently between ethnic groups. For example, ethnic density is related to less depression among Black African mothers and more depression among Black Caribbean mothers.

But what are the physiological pathways that might link ethnic density to maternal and child health? Social status (Marmot, 2004), social support and friendship (Berkman & Glass, 2000) are known to be powerful determinants of health throughout life and it has been suggested that the underlying cause is social anxiety and that, knowing ourselves through the eyes of others, whether or not we feel valued or stigmatized by our position in society and our social relationships is a powerful source of either stress or resilience (Wilkinson & Pickett, 2009). In a study of health in Central Harlem, Mullings and Wali (2001) found that 99% of residents said that living in a Black community was a 'positive aspect' of their lives. Middle class residents of Harlem reported that working with White people was a cause of stress and that they could only relax when they came home. As well as being a well-recognized risk factor for poor mental and physical health in general, maternal stress is also a well-established risk factor for both preterm delivery and low birth weight (Chrousos, 1998; Collins et al., 1998; Copper et al., 1996; Dunkel-Schetter, 1998; Hickey et al., 1995; Hoffman & Hatch, 1996; Sandman, Wadhwa, Chicz-DeMet, Dunkel-Schetter, & Porto, 1997). The biology of chronic stress provides a plausible causal explanation of why women in ethnic minorities might be protected from poor health when they live in areas with more people like themselves.

A limitation of our study is that we do not know how the neighbourhoods in which women live are changing, in terms of ethnic composition. If women from ethnic minorities are living in areas with rapidly changing populations, the ways in which those neighbourhoods change may be important for their health. Areas in economic decline or that are becoming gentrified, or areas in which the mother's own ethnic group is declining or growing may moderate any overall impact of ethnic density. We are unaware of any longitudinal studies of ethnic density and maternal and child health. However, in a San Francisco study, risk of preterm delivery among African-American women increased in areas that had seen either a 10-year decline or increase in the proportion of African-American residents, compared to neighbourhoods with more stable proportions (Pickett, Ahern, Selvin, & Abrams, 2002).

In conclusion, we find that ethnic density is protective for some measures of maternal and child health, but not consistently across ethnic minority groups in the UK. The fact that we find any positive effects of ethnic density may be a demonstration of the power of psychosocial factors in determining health in the face of poverty and material hardship. However, the picture is inevitably complicated by the involvement of other important influences on health, such as health selection among migrant groups, culture and acculturation, and the way language and religious differences may protect against some of the effects of low social status.

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