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ORIGINAL PAPER

A systematic review and meta-analysis of the ethnic density effect in psychotic disorders

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Abstract
Purpose A number of studies have found an ethnic density effect in psychotic disorders, where the incidence for ethnic minorities increases as the neighbourhood proportional ethnic composition decreases [Morgan and Hutchinson, Psychol Med 40:705–709, (2010); Singh, Psychol Med 39:1402–1403, (2009); Schofield et al., Psychol Med 41:1263–1269, (2010)]. However, there is a mixed picture with some studies reporting no effect [Schofield et al., Psychol Med 41:1263–1269, (2010)]. 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 psychotic disorders?
Methods A systematic review and meta-analysis was conducted by two independent reviewers using PsychINFO, Web of Science and PubMed databases. Studies were measured against eligibility criteria and then pooled with any discrepancies discussed between reviewers. Studies were then assessed for quality using a standardised quality assessment.
Results In total, eight studies were included. A meta-analysis was conducted which found that the incidence of psychotic disorders was higher in low ethnic density areas than high ethnic density areas. A narrative synthesis reflected the complexity when results were broken down by individual ethnic groups where some ethnic groups had inverse or no associations with ethnic density. The synthesis also analysed methodological differences between studies.
Conclusions The review reports evidence of an overall ethnic density dose effect for ethnic minorities, but with more mixed results for individual ethnic groups. The possible mechanisms behind this effect are explored, including exposure to racism, social capital and social cohesion hypotheses. The wide-ranging implications of the review are discussed along with recommendations for future research to continue to inform public health policy.

Keywords Ethnic density · Ethnic minorities · Psychotic disorders

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Background

It has long been established that there are higher rates of psychotic disorders in ethnic minorities in countries with diverse ethnic compositions such as the United Kingdom (UK) and United States of America (USA) [1, 2]. The difference is as much as six times as much as the majority population and has been termed an 'epidemic [2 p. 1403].' With no evidence of a genetic basis [3], the variation in prevalence between ethnic groups has played a role in supporting the socio-environmental hypothesis in the aetiology of psychosis [4]. However, the cause of this difference has been the subject of much debate.

Historically, it was argued that the difference is due to the misdiagnosis of ethnic minorities due to institutional racism and negative cultural stereotypes [1 p. 705]. This is supported by evidence that people from ethnic minorities

are more likely to access services through the justice system and are more likely to be compulsorily admitted to hospital [1]. However, there has been more recent evidence to suggest that this is not sufficient in accounting for the disparity between ethnic minorities and the ethnic majority [3]. Morgan and Hutchinson [1] report on studies that have still found an elevated rate of psychotic disorders in ethnic minorities despite a standardised procedure for assessing symptoms and being blind to ethnicity. This supports the idea that the high prevalence rates are not purely a result of institutionalised racism and that the rates reflect a real phenomenon. Other studies have also found no elevation in prevalence in the countries of origin, such as in the Caribbean [1], ruling out any intrinsic individual difference. The Aetiology and Ethnicity in Schizophrenia and Other Psychoses (AESOP) study [5] built on this emerging evidence and linked high rates of psychotic disorders with high rates of child and adult disadvantage in the UK. They also found that social disadvantage is higher in ethnic minorities. Singh [2] argues that the historical focus on erroneous diagnosis has led to a neglect of the unmet needs of ethnic minorities and a lack of acknowledgement of the impact of social disadvantage on mental health.

Social disadvantage in ethnic minorities is thought to reflect inequitable and often discriminatory societal structures, which can restrict access to resources and opportunities [2]. The National Survey of Ethnic Minorities found that socio-economic position and the experience of discrimination are independent predictors of psychotic disorders [1]. Thus, ethnic minority individuals and groups may suffer from higher social disadvantage and more experiences of discrimination, which is likely to influence the risk of developing a psychotic disorder. Perceptions of disadvantage, racial discrimination and moving from sociocentric to individualistic cultures have also been found to be contributory factors in the elevated rates of psychotic disorders [4, 6]. Deprivation and poor access to health care in ethnic minority populations is thought to be a long-standing problem [2]; The Home Affairs Committee [7 p. 30], which explored overrepresentation of black people in the criminal justice system, reported that 'the first settlers in post-war Britain from the Caribbean were forced into ghettoes because of racial prejudice … resulting in them being stacked in deprived areas where schools were substandard, employment opportunities were minimal and long-term prospects to hold the family together were limited. The long-term impact on social stress and isolation is likely to be linked to the elevated prevalence of psychotic disorders [3].

It has been proposed that one of the protective factors that act as a buffer against these influences is the proportion of ethnic minorities in the local area. Although historically many ethnic minorities clustered in neighbourhoods due to discriminatory systems that restricted ethnic minorities to low-quality housing; there are other factors that have led to this development such as a protective function against racial abuse, the sharing of similar cultural, linguistic and religious values with neighbours [8] and an increase in social support [9]. A dose effect has been found where there is a negative association between the prevalence of psychotic disorders and the size of the local ethnic group relative to the total population [6]. Thus, the 'proportion of an ethnic group living in an area is inversely related to the risk of psychosis for members of that group [3 p. 1263].' This phenomenon has been termed the 'ethnic density effect.' Schofield et al. [3] report that in areas in the UK with high ethnic density, the risk of psychosis for ethnic minorities is no different from the majority white population. In areas with less ethnic density, the risk is over five times greater than the majority white population. This indicates a considerable influence on the risk of developing a psychotic disorder.

A number of studies in the UK and US have found evidence of an ethnic density effect in psychotic disorders [3, 8, 10–12]. These findings have been replicated in The Netherlands for migrants from Turkey and the Maghreb [13]. The phenomenon has also been replicated in Canada for French speaking residents [14] and in Northern Ireland for Roman Catholics [15]. However, the literature to date shows a somewhat mixed picture of the ethnic density effect [3]. A study by Cochrane and Bal [16] in the UK reported no ethnic density effect. The mixed picture is complicated by the differing definitions of ethnicity and ethnic density as well as debate about the level of the effect, from national [16] to neighbourhood level [3].

A narrative review [17] of the ethnic density effect in general mental health found considerable support for protective effects of high ethnic density. However, to date there has never been a systematic review or meta-analysis of the literature specifically for psychotic disorders. The aim of this review is to establish if there is a dose effect in the ethnic density effect, such that ethnic minorities in low ethnic density areas have higher rates of psychotic disorders and lower rates in high ethnic density areas, by answering the review question: is there an ethnic density dose effect in the prevalence of psychotic disorders?

Methods

Data source

The searches were conducted in three databases that are most suited to this subject area. The first two, 'PsychINFO' and 'Web of Science' are the largest databases for psychology journals. The third, 'PubMed' enabled the

inclusion of psychiatry journals that may otherwise have been missed. Searches were restricted to the English language, all journals and abstracts and using related terms. For 'Web of Science' it was also possible to exclude conferences and for 'PubMed' it was possible to refine the results to adolescents aged 13–18 and above. Searches were conducted between January, 1930 and November, 2012 and the final update was November 23rd, 2012.

A pilot preliminary search was conducted to identify the search terms, establish eligibility and quality criteria for the final search and assessment process.

Search strategy

The following search terms were used to search for studies. They were grouped by subject as follows:

(a) Terms that identify the target population: 'minorit*' OR 'ethnic*' OR 'rac*'
(b) Terms that identify the measured effect: 'density' OR 'neighbourhood' OR 'neighborhood' OR 'residential' OR 'isolation'
(c) Terms that identify the sample: 'mental' OR 'schizo*' OR 'psychos*' OR 'psychotic'

The three groups were then combined using the search command AND. This ensures that any article that uses one word from group (a), one from group (b) and one from group (c) as a keyword were picked up by the search.

The search was conducted independently by two reviewers using the same criteria and the search procedure outlined by Higgins and Green [18], which involves amalgamating all results, removing duplicates, removing irrelevant studies using title and abstracts and matching full texts with the eligibility criteria. Both reviewers used the software RefWorks (The Quorum, Cambridge, UK; http://www.refworks.com). Finally, studies were pooled and results discussed between reviewers. All discrepancies were discussed and final studies to include were agreed. Reference lists of included studies were then assessed by title, abstract or full text and inclusion agreed between reviewers.

Eligibility criteria

The studies were included based on the following inclusion criteria: the study must (a) measure the ethnic density effect, (b) include adolescents and adults ($\geq$13-year-old; as cases of psychotic disorders are most likely to present in this age group [12]), (c) include males and females, (d) include people with a diagnosis of a psychotic disorder (for example, schizophrenia, schizoaffective disorder or psychosis not otherwise specified), (e) be available in English, (f) use a quantitative measure of psychosis and of ethnicity and (g) be peer-reviewed and published.

Studies were excluded if they met the following exclusion criteria: the studies must not (a) include children, (b) include drug-induced psychosis and (c) include individuals who recently moved to the area (<6 months).

Validity criteria

In order to assess the studies for quality, a quality assessment checklist was used [19]. The checklist involves assessing quality on a scale of 0 (no)–2 (yes) on criteria such as rationale, methodology and sample size. The checklist was modified to better reflect the methodology of the population studies included by eliminating three criteria (criteria 5–7 for interventional research) that were not relevant to any of the studies. Studies were scored independently and then discussed with the second reviewer to improve the reliability of the process. The following factors were taken into consideration whilst completing the assessment checklist.

For internal validity, the studies must (a) control for confounding variables (namely, age, sex and area deprivation) and (b) use measures that have established reliability and validity. For external validity, the studies must (a) have a selection procedure free from bias and (b) have a sample size that takes into account neighbourhood level effects. Finally, for statistical validity the studies must (a) use an appropriate statistical test and (b) report an effect size.

Analysis

For the statistical analysis, studies were sorted by evidence found and methodology used and included in a tree map for an overall picture of the results. Statistical results that could be directly compared were then extracted for inclusion in a meta-analysis using the quality scores as a weighting factor. Finally, studies were analysed for overall results, ethnicity breakdown and methodological differences for a narrative synthesis.

Results

Study inclusion

In total, 1,273 studies were found, 45 from 'PsychINFO,' 335 from 'Web of Science' and 893 from 'PubMed.'. After the review process, seven were included. After a further assessment of the reference lists of included studies, one further study was included. Figure 1 shows the review process [20] in more detail.

The level of agreement between the two reviewers was analysed using weighted Kappa [21] which found an

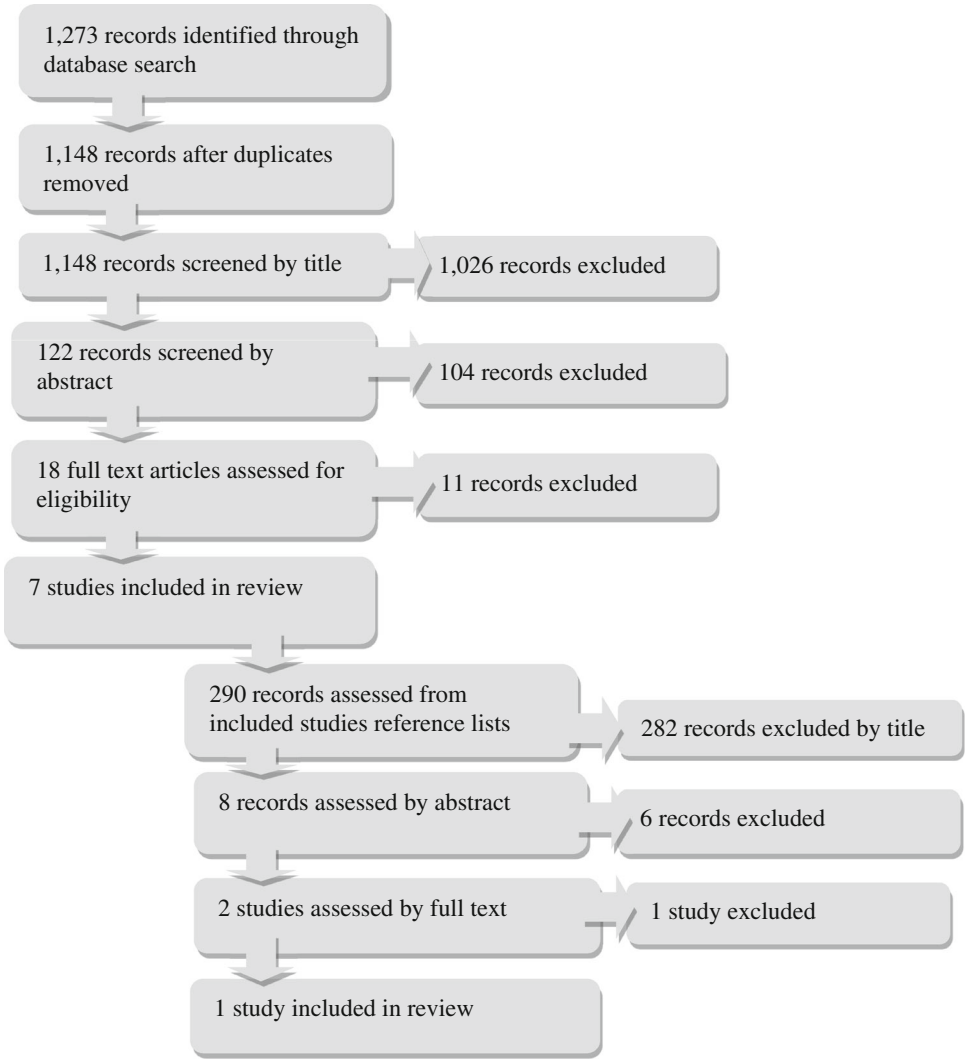

Fig. 1 Flowchart showing the review process

agreement level of 1, indicating a high level of agreement between the reviewers. A total of four studies were marked as unsure by one or both of the reviewers. One was excluded due to measuring immigration status rather than ethnicity [22], one due to no specific measure of ethnic density [23], one because only one feature of psychosis was measured [24] and one because individual ethnicity was not measured [25]. Table 1 shows a summary of the eight studies included in the review.

Quality categorisation

Studies were analysed based on the quality assessment using the checklist by Kmet et al. [19]. The main differences that affected the quality of the studies were the validity of measures used and the control of confounding variables. Sample size was evidently also important particularly in determining whether a study measured the effect at neighbourhood level.

As shown in Table 2, studies in the higher quality category used the Psychosis Screening Questionnaire and Clinical Interviews to measure psychosis as opposed to hospital admission reason in the lowest quality study. This is particularly problematic as admission rates are likely to be distorted by between-group differences such as differences in community responses to mental illness and in service accessibility [9]. Higher quality studies also used self-ascribed ethnicity categories as oppose to country of birth in the lowest quality study. In terms of controlling for confounding variables, higher quality studies controlled for age, sex, neighbourhood deprivation, social stress and experience of racism. Lower quality studies had no control for confounding variables. This is particularly salient for area deprivation, which is highest in high ethnic density areas [9] and could confound the results. The quality assessment was used as a weighting factor in the meta-analyses. Finally, as shown in Table 1, higher quality studies used the census/municipality to calculate ethnic

Table 1 Summary of included studies

Authors	Location	Area type	Area size	Psychotic disorders included	Ethnicities included
Schofield et al. [3]	London, England	Social output area	Average 1,500	Non-organic psychotic illness	Black, black British and white
Halpern and Nazroo [27]	England and Wales	Electoral ward	Estimated average 6,000	Psychotic symptoms[a]	White, Indian, Caribbean, Pakistani, African Asian, Bangladeshi and Chinese
Kirkbride et al. [12]	South East London, England	Electoral ward	Estimated average 6,000	ICD-10 schizophrenia and other non-affective psychoses	White British, black Caribbean, black African, Asian, mixed ethnicity, white other and other ethnicity
Bécares et al. [8]	England and Wales	Electoral ward	Average 5,327	Psychotic symptoms[a]	White, Caribbean, Indian, Pakistani and Bangladeshi
Boydell et al. [11]	South London, England	Electoral ward level	Estimated average 10,000	ICD-9 and ICD-10 psychotic illness	White and non-white (Caribbean, African and other)
Veling et al. [13]	The Hague, The Netherlands	Neighbourhood	Maximum 38,000	ICD-10 psychotic disorder[b]	Native Dutch, Moroccan, Surinamese and Turkish
Kirkbride et al. [26]	South London, England	Census area ward level	Average 6,000	Schizophrenia	White British and BME[c] (black Caribbean, black African, Asian, Chinese and other)
Cochrane and Bal [16]	England	Country and region	45,771,946 (region size not reported)	Schizophrenia	England, Ireland, India, Caribbean, Pakistan, Kenya, Italy, Poland, Cyprus and Hong Kong

[a] Includes mania, thought insertion, paranoia, strange experiences and hallucinations

[b] Includes schizophrenia, major depressive/bipolar disorder with psychotic features, delusional disorder, brief psychotic disorder and psychotic disorder not otherwise specified

[c] Black and minority ethnic groups

density at neighbourhood or electoral ward level, which constitutes a population of between 1,500 and 38,000. The highest rated quality study used theoretically justified socio-economically homogenous areas using primary care data rather than relying on more arbitrary electoral wards. The authors argue this is a more valid measure of a local neighbourhood and that the effect is likely to be prominent at neighbourhood rather than regional level [3]. The lowest quality study was conducted across an entire country that constitutes a population of 45,771,946.

Comparison of statistical results

Firstly, a tree map was conducted using all eight studies which shows whether statistical evidence was found for the ethnic density dose effect. Each box represents one study and the box size represents the proportionate weighting of each study (where 1 cm is equal to 10 % of the study's weight based on the quality scores). Studies are split between the use of categorical or continuous variables to reflect methodological differences. The categorical variable refers to the comparison of ethnic minorities and the ethnic majority in either low, medium or high ethnic density areas. The continuous variable refers to the comparison of ethnic minorities with the ethnic majority, as areas increase in ethnic density in 1–10 % intervals. The tree map is displayed in Fig. 2.

This shows that there is statistically significant evidence from six out of eight studies that there is an ethnic density dose effect for ethnic minorities. It also shows that the effect is found almost entirely in the higher quality studies and from studies that used categorical as oppose to continuous variables.

Secondly, a meta-analysis was completed using five high quality studies that reported incidence rate ratios (IRR) for ethnic minorities in high and low ethnic density areas compared to the majority population. The meta-analysis was conducted manually using Microsoft Excel (2010). The meta-analyses are displayed in Figs. 3 and 4 using ratios where statistical significance occurs if the confidence interval does not cross over 1. Heterogeneity across studies was ruled out using the I^2 statistic, which was 0 % for both high and low ethnic density area analyses. Finally, publication bias was also deemed unlikely using the classical fail-safe n statistic, which was 36 for ethnic high-density areas and 127 for low ethnic density areas. This means that 36–127 non-significant studies would be required to conclude an overall non-effect of the meta-analyses. Fail-safe n was calculated using Comprehensive Meta-Analysis software (Version 2.0).

Table 2 Comparison of methodologies and assigned quality score

Authors	Sample size	Measures	Statistical test	Confounders controlled for	Quality score
Schofield et al. [3]	277	Primary care database code and UK census, 2001	Poisson multilevel regression	Age, sex and area deprivation	21/22
Halpern and Nazroo [27]	8,063	Psychosis Screening Questionnaire and UK census, 1991	Multivariate regression models	Age, sex, hardship, migration and language	20/22
Kirkbride et al. [12]	218	Schedules for clinical assessment and individual interviews using the ICD-10, AESOP data and UK census, 2001	Poisson multilevel regression	Age, sex, area deprivation, voter turnout and ethnic fragmentation	20/22
Bécares et al. [8]	8,063	Psychosis Screening Questionnaire and UK census, 1991	Multilevel regression	Age, sex, individual socio-economic position, area deprivation, racism and the interaction between racism and ethnic density	19/22
Boydell et al. [11]	222	Hospital records 1988–1997, checklist for psychotic disorders and census, 1991	Poisson regression model	Age, sex and area deprivation	19/22
Veling et al. [13]	463	Instrument for the retrospective assessment of the onset of schizophrenia and The Hague municipality	Multilevel regression	Age, sex, marital status and neighbourhood socio-economic level	19/22
Kirkbride et al. [26]	4,231	AESOP data and survey questionnaires	Correlation matrix	None	18/22
Cochrane and Bal [16]	186,000	Hospital admission reasons and UK census, 1983 (census uses country of birth)	Correlation	None	7/22

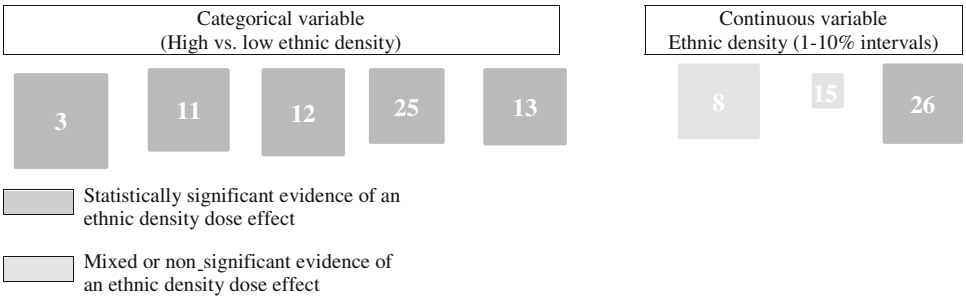

Fig. 2 Tree map showing evidence of an ethnic density dose effect

The meta-analyses show that in high-density areas there is little or no difference between ethnic minorities and the ethnic majority. Some significant results were found [11, 12, 26], but these were small effect sizes compared to low ethnic density areas. The analysis in low ethnic density areas shows that all studies reached statistical significance with two studies finding a significance level of $p < 0.001$, and that ethnic minorities are almost three to over six times more likely to have a psychotic disorder. One study [3] tested the difference between high and low ethnic density areas and found that ethnic minorities are almost two times more likely to have a psychotic disorder in low ethnic density areas (OR 5.24, 95 % CI 1.95–14.07, $p < 0.001$). No other studies tested for this.

The meta-analyses provide an overall picture of the ethnic density effect, but need to be interpreted with caution given the wide variety of control variables and measures. In order to capture the fuller complexity of the ethnic density effect, a narrative synthesis was also completed.

Narrative synthesis

In order to synthesise the data from the eight studies, the overall ethnic density dose effect, the breakdown between different ethnicities and the methodological differences were analysed.

The ethnic density dose effect for ethnic minorities overall

As the meta-analysis shows, a larger incidence of psychotic disorders was found for ethnic minorities in low

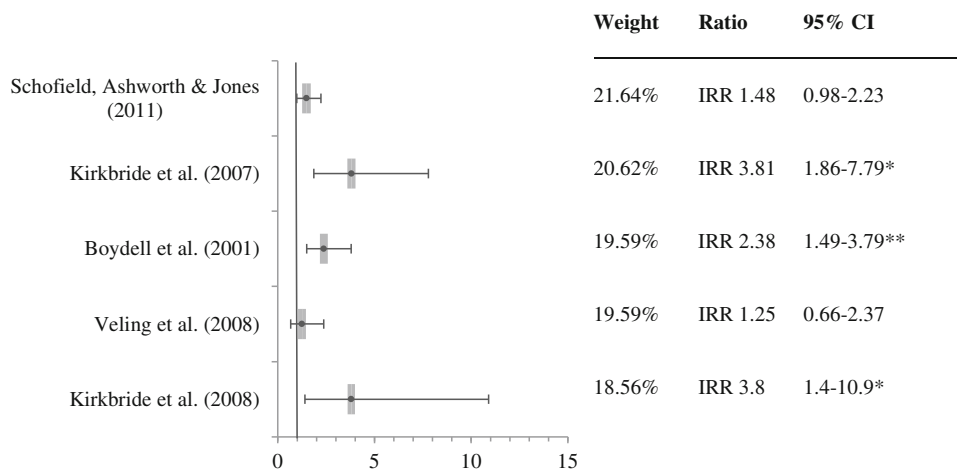

Fig. 3 Meta-analysis showing incidence of psychotic disorders in ethnic minorities compared to the ethnic majority

[1] Ethnic majority refers to either white British or white Dutch
[2] Defined, in order, as either the percentage of ethnic minorities in a neighbourhood as 56.4-74.3, 25-62, 23.2-57, >0.65 or the highest third (no data reported)
* $p<0.05$
** $p<0.001$

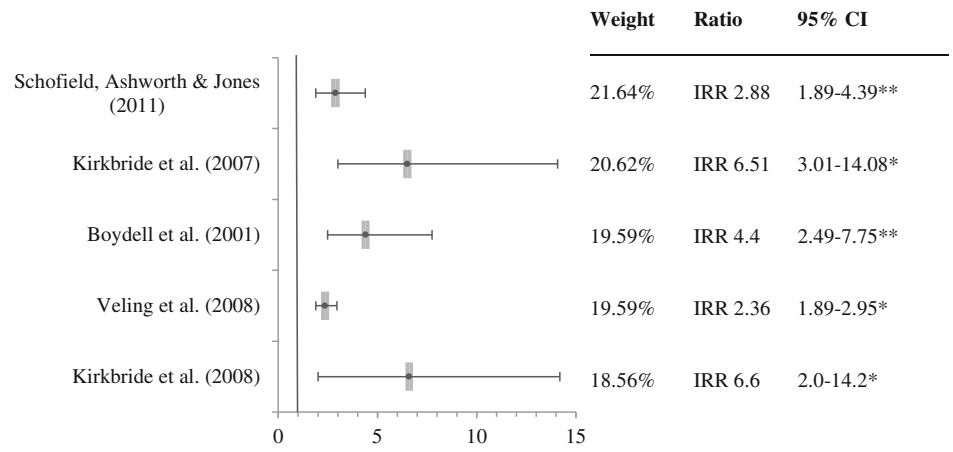

Fig. 4 Meta-analysis showing incidence of psychotic disorders in ethnic minorities compared to the ethnic majority

[1] Ethnic majority refers to either white British or white Dutch
[2] Defined, in order, as either the percentage of ethnic minorities in a neighbourhood as ≤24%, ≤47.1%, the proportion ≤0.65 or simply the lowest third (no data reported)
* $p<0.05$
** $p<0.001$

ethnic density areas than in high-density areas [3, 11–13, 26]. Two studies found an effect at the $p < 0.001$ level in low-density areas [3, 11] which may be explained by their focus on a black African-Caribbean minority unlike the other studies, which included a number of different ethnic minorities as an overall ethnic minority category. Kirkbride et al. [12] differed from other studies by including 'white other' in the ethnic minority category. Despite the differences in selection, all the studies found an effect even if just at the $p < 0.05$ level and all studies adjusted for at least age, sex and area deprivation except Kirkbride et al. [26].

However, as the tree map shows, other studies that used a continuous variable tended not to find an effect [8, 16]. Bécares et al. [8] did initially find an effect (OR 0.96, 95 % CI 0.92–0.99, $p < 0.05$) where the odds ratio shows the risk of psychotic symptoms per increase in 10 % ethnic density, but this was no longer significant when adjusted for age, sex, individual socio-economic position, area deprivation, racism and the interaction between racism and ethnic density. Equally, Cochrane and Bal [16] found an effect but only for men ($p = 0.70$, $p < 0.05$). Some of the studies that did find an effect controlled for less confounders than Bécares et al. [8], namely Halpern and

Nazroo [27] who adjusted for only age, sex, hardship, migration and language.

Only three studies also looked at the effect for the majority population (white British) [3, 26, 27]. Halpern and Nazroo [27] found a significant negative correlation for own-group ethnic density for white British people ($r = -0.071$, $p < 0.001$) when adjusted for confounders. However, Schofield et al. [3] and Kirkbride et al. [26] did not find an effect for the white majority when comparing lower and higher minority ethnic density areas (IRR 2.3, 95 % CI 0.9–5.8; OR 1.47, 95 % CI 0.35–6.18).

The ethnic density dose effect for different ethnic minorities

Five out of the eight studies explored the effect between different ethnicities [8, 12, 13, 16, 27]. Halpern and Nazroo [27] found significant negative correlations for Indian ($r = -0.125$, $p < 0.001$), Caribbean ($r = -0.058$, $p < 0.05$) and Bangladeshi ($r = -0.140$, $p < 0.001$) people, but not for Pakistani ($r = 0.043$), African Asian ($r = 0.043$) or for Chinese ($r = 0.044$) people in the UK. Equally, Bécares et al. [8] found significant odds ratios that schizophrenia increases as ethnic density decreases for Indian (OR 0.85, 95 % CI 0.74–0.99, $p < 0.05$) and Bangladeshi (OR 0.77, 95 % CI 0.60–0.99, $p < 0.05$) people, but not when adjusted for confounding variables (Indian OR 0.90, 95 % CI 0.76–1.24; Bangladeshi OR 0.81, 95 % CI 0.62–1.06). No effect was found for Caribbean people (OR 0.83, 95 % CI 0.66–1.04) and a significant but inverse relationship was found for Pakistani people (OR 1.22, 95 % CI 1.07–1.39, $p < 0.01$) which was even more significant when adjusted for confounding variables (OR 1.44, 95 % CI 1.23–1.69, $p < 0.001$). This is, therefore, the second finding that an increase in minority ethnic density is not a protective factor for Pakistani people, though one of these studies was not statistically significant [27].

In the Netherlands, Veling et al. [13] found a larger incidence of psychotic disorders in low compared to high ethnically dense areas for Moroccans (IRR 4.43, 95 % CI 3.28–5.97, $p < 0.05$; IRR 1.56, 95 % CI 0.75–3.21), Surinamese (IRR 1.88, 95 % CI 1.42–2.50, $p < 0.05$; IRR 1.19, 95 % CI 0.58–2.44) and Turkish (IRR 1.74, 95 % CI 1.16–2.60, $p < 0.05$; IRR 1.12, 95 % CI 0.55–2.30) people when comparing to the 'native Dutch' ethnic majority indicating a clear ethnic density dose effect across the minorities in the Netherlands. Finally, Cochrane and Bal [16] in the UK found a significant ethnic density dose effect for Irish men ($p = 0.86$, $p < 0.01$) only and not for any other minority (no data reported). Interestingly, Irish was not a category in more recent UK studies though Kirkbride et al. [12] may have included Irish people in the 'white other' category without reporting the data separately.

Methodological comparison

The two studies that found very little evidence for the ethnic density dose effect [8, 16] were the studies who used the largest sample sizes (8,063 and 186,000 respectively) except for Halpern and Nazroo [27] who used the same sample of 8,063. Both Bécares et al. [8] and Halpern and Nazroo [27] used electoral ward level, unlike Cochrane and Bal [16] who used country level, but Halpern and Nazroo [27] controlled for less variables. Bécares et al. [8] controlled not only for racism and area deprivation, but also the interaction between racism and ethnic density which may reflect the reason for the different results. The studies that found the strongest evidence for the ethnic density effect [3, 11–13, 26] had similar smaller sample sizes ($n = 277$–$4{,}321$) and used neighbourhood or ward level. However, although most of the studies [3, 11–13] controlled for age, sex and area deprivation none of them controlled for racism or the interaction between racism and ethnic density unlike Bécares et al. [8].

Discussion

This review aimed to determine the existence of a dose effect for the ethnic density effect in psychotic disorders. The meta-analyses provide strong evidence for the existence of an overall dose effect where there is lower incidence of psychotic disorders for ethnic minorities in high ethnic density areas compared to the ethnic majority and higher incidence in low-density areas. The effect was particularly strong for studies [3, 11] that focused on black African-Caribbean people reflecting an evidence from the past research that this group is the most affected by social disadvantage in the UK [3]. The strength in the results of these studies may reflect the pronounced effect in this population. Over half of the studies [3, 8, 11–13, 27] continued to find an effect even when adjusted for hardship or area deprivation indicating that deprivation does not explain between-group differences.

However, studies using a continuous density variable and a between-group breakdown painted a more mixed picture. Bécares et al. [8] no longer found a significant dose effect when adjusted for confounders, which included racism and the interaction between ethnic density and racism, variables not controlled for by any other study. There is evidence of high rates of racism for black people in the UK [4], which may also explain the strength of Schofield et al. [3] and Boydell et al. [11] findings, as they did not control for racism. The results could reflect the increased racism black people experience in low ethnic density areas. A breakdown of the ethnic minority categorisation showed continuing evidence of a dose effect for Indian and Bangladeshi people

in the UK [8, 27] and for Moroccans, Surinamese and Turkish people in the Netherlands, [13] though no evidence was found for African Asian or Chinese people [27] and mixed results found for Caribbean and Pakistani people in the UK [8, 27]. Preliminary evidence was found that increased ethnic minority density is not protective and may actually be harmful for Pakistani people in the UK [8, 27]. This may be explained by a real difference where some ethnic groups are better able to protect the mental health of members of that group [27]. It may also be explained by the studies' use of a homogenous 'ethnic density' measure rather than own-group density, as this measure assumes that any ethnic minority density increase will be protective for any minority. The variance in the findings for different ethnic minorities within and across studies is testament to the notion that ethnic minorities are not a homogenous group. This is a particular strength of Schofield et al. [3] study who concentrated entirely on one main minority group. Kirkbride et al. [12] recognises that it is a limitation of their study that they operationalized ethnic density as one category rather than own-group ethnic density. This is equally true for the limited evidence that the effect is present in the ethnic majority. The only study [27] that found a significant effect was the only study that used own-group density as a measure. This may explain why other studies did not find a significant effect and supports the idea that a more complex ethnicity breakdown coupled with a more appropriate ethnic density measure is far more ecologically valid.

Finally, some evidence was found for a strong effect for Irish people in the UK though this was from a low-quality study and is quite dated [16]. Interestingly, an 'Irish' category was not included in any other, more recent, UK studies. This may reflect a re-focus in the UK on which groups are defined as ethnic minorities, which may exclude groups who were historically at a higher risk of psychotic disorders. In the more recent studies, Irish people may have been included with the ethnic majority which indicates that either the studies no longer consider Irish people as an at-risk group (despite evidence that the non-British white population is at higher risk of schizophrenia [6]), or that there is a move towards a definition of ethnicity as closer to race where Irish people would fit with the majority 'white' category. Only one study [12] included a 'white other' category within the ethnic minority category and only three studies [3, 26, 27] examined the dose effect in the majority white population. A focus on ethnicity as a self-ascribed identity that encompasses a shared 'community of sentiment and cultural heritage' is likely to be a better reflection of reality than a focus on race, a concept that is widely regarded as a term developed by colonial Europeans as a means of 'social, political and economic domination [28 pp. 124–126].'

Limitations

This review has certain limitations that need to be taken into account when interpreting the findings. Firstly, the review excluded studies that measured ethnic density in migrants rather than in ethnic minorities as a migrant measure would exclude second and more generations of people. However, this led to a possible bias where studies that claimed to measure ethnicity [16] but used country of birth were included and studies that claimed to measure migration, but included second and third generation migrants were excluded [22]. Secondly, almost half the studies included in the review [3, 11, 13, 16] relied on data from health services which make it difficult to distinguish between actual prevalence rates and differences in health seeking behaviour. However, there is substantial evidence that ethnic minorities are less likely to access health services [29] and therefore incidence rates, if anything, are likely to be an underestimation of the effect in low-density areas.

Mechanisms

Despite substantial evidence for an ethnic dose effect in psychotic disorders, the mechanism behind the effect is less clear. Attempts have been made to explain the mechanisms and a brief summary has been included here. Exposure to racism has been repeatedly reported as a possible mechanism; there is evidence of high rates of racism in the UK [9] and The Netherlands [30] with considerable impacts on psychological well-being [8], including a direct effect on the risk of psychosis [12]. There is evidence [8] that racism is significantly higher in areas of lower ethnic density, and that the dose effect between ethnic density and schizophrenia is no longer significant when controlling for racism. Higher ethnic density areas have been proposed to be protective against racism in a number of ways. Firstly, racial harassment may be more likely to be perceived as a discriminatory assault rather than internalised as an innate flaw by minority individuals if there is the opportunity for discussion with others [8]. Secondly, social isolation and experiences of racism may perpetuate paranoid attributional styles that could lead to psychotic symptoms [12] and lastly, high ethnic density areas offer a wider range of culturally and religiously appropriate services [31]. Therefore, living in a high ethnic density area may act as a buffer against the impact of racism. The inverse relationship found for Pakistani people [8] could be explained by increased experiences of racism that could still be present in high ethnic density areas that are not own-group. This is particularly relevant as the study that found this effect was conducted after the 9/11 attacks, which led to an increase in interpersonal racism against Muslim people [32]. It cannot be assumed that living in high overall ethnic density areas will

be protective for every ethnic minority group [8]. This is supported by research that found that increases in neighbourhood ethnic diversity have a negative impact on social capital [33] indicating that ethnic density is not necessarily protective per se, unless it is own-group density.

Another proposed mechanism suggests that social capital acts as a mediator in that minorities isolated from shared cultural, religious and values are at greater risk [12]. Social capital refers to community factors such as 'civic participation, social networks and trust…that shape the quality and quantity of social interactions…that underpin society [26, p. 1083].' There is, therefore, less opportunity to protect oneself from social stress. This hypothesis is supported by findings that an increase in ethnic fragmentation [12], low social cohesion [26] and marginal social membership [12] significantly increase the risk of psychotic disorders. This may interact with the racism hypothesis in that increased social capital may protect from the harmful effects of racism. This is supported by research that found that ethnic minority individuals experience less prejudice and higher social support in high ethnic density areas [26]. Minorities may also have access to normalizing explanations of anomalous experiences in areas with higher levels of social support [14], which is widely regarded as protective for individuals at risk of developing psychotic disorders [34]. However, the link between social capital and schizophrenia has been found to be non-linear and it is suggested that it may interact with individual risk factors [26].

The ethnic density effect also provides a rare test of the selection versus causation hypotheses [9]. A selection hypothesis proposes that high incidence of psychotic disorders in deprived neighbourhoods can be explained by downward social drift and would therefore predict that an individual belonging to an ethnic minority living in an affluent area would be less at risk of a psychotic disorder regardless of ethnic density. The social causation hypothesis proposes that neighbourhood factors contribute to the aetiology of psychotic disorders and would therefore predict that the individual would be more likely to have a psychotic disorder, because they are not provided with the social and psychological protection of a high ethnic density area, regardless of individual or neighbourhood affluence. This review has found evidence for the latter, particularly in studies that controlled for area deprivation and individual socio-economic position. It is also supported by studies that found the highest rates of schizophrenia were in the most disorganised neighbourhoods as opposed to the poorest [35].

Implications and future research

The implications of a clearer understanding of this effect are threefold. Firstly, there are theoretical implications in terms of our understanding of the importance of societal structures in providing protection against the risk of psychotic disorders and the neighbourhood level influences on the aetiology of psychosis. Secondly, there are clinical implications in terms of additional knowledge of protective factors in the risk of developing a psychotic disorder. The insight into social risk factors indicates the need to work systemically with this population rather than through purely individual treatment. Finally, there are policy level implications in terms of preventing and mitigating the effects of the cascade of social disadvantage [1]. The overall protective effects of high ethnic density areas for most minority groups are quite clear and highlight factors that need to be considered at local government level for the protection of minority individuals in low ethnic density areas. Further research into particularly vulnerable groups such as preliminary findings for Pakistani people, may also help inform local health service provisions. Singh [2, p. 1403] warns that the continued neglect of this issue risks engendering a 'paralysing sense of impotence and a sullen acceptance of the status quo' which he calls a 'public health tragedy.'

In terms of future research, there are some clear recommendations from the outcomes of this review. Measures of ethnicity and ethnic density need to reflect the complexity of ethnic minority groups such as drawing on both objective and subjective measures to overcome the limitation of each [36]. It should aim to reflect group power disparities rather than concentrating on race or colour, which only serve to reinforce the idea of a homogenous ethnic minority group with innate psychological differences [37]. There is also a need to reflect differences within the 'white' category such as analysing any possible differences between Irish people in the UK and the white British ethnic majority. There are a number of recommendations in the literature [8, 13, 27] to separate ethnic groups and avoid merging; for example, Bangladeshi and Pakistani groups, to get a better insight into the mechanism of this effect. Further research that reflects a breakdown of ethnicities compared to own-group density may also shed further light in the inverse relationship found for Pakistani people in the UK, and for the existence of the effect in the ethnic majority. Future studies also need to reflect that this is likely to be a neighbourhood level effect rather than a national or regional level effect. It would be useful for future systematic reviews to include immigrant status, to prevent the exclusion of possibly relevant studies, and to expand criteria to other groups such as lesbian, gay, bisexual and transgender people for which some studies have already found a density effect [38].

Conclusions

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 density, and to inform public health policy and service provision to prevent the neglect of at-risk groups in increasingly diverse societies.

Conflict of interest The authors declare that they have no conflict of interest.

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