

Do social interactions explain ethnic differences in psychological distress and the protective effect of local ethnic density? A cross-sectional study of 226 487 adults in Australia

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ABSTRACT

Background: A frequently proposed, but under-researched hypothesis is that ethnic density benefits mental health through increasing social interactions. We examined this hypothesis in 226 487 adults from 19 ethnic groups aged 45 years and older in Australia.

Methods: Multilevel logit regression was used to measure the association between ethnicity, social interactions, own-group ethnic density and scores of 22+ on the Kessler scale of psychological distress. Self-reported ancestry was used as a proxy for ethnicity. Measures of social interactions included a number of times in the past week were (i) spent with friends or family participants did not live with; (ii) talked to someone on the telephone; (iii) attended meetings of social groups and (iv) how many people could be relied upon outside their home, but within 1 h of travel. Per cent own-group ethnic density was measured at the Census Collection District scale.

Results: Psychological distress was reported by 11% of Australians born in Australia. The risk of experiencing psychological distress varied among ethnic minorities and by country of birth (eg, 33% for the Lebanese born in Lebanon and 4% for the Swiss born in Switzerland). These differences remained after full adjustment. Social interactions varied between ethnic groups and were associated with lower psychological distress and ethnic density. Ethnic density was associated with reduced psychological distress for some groups. This association, however, was explained by individual and neighbourhood characteristics and not by social interactions.

Conclusions: Social interactions are important correlates of mental health, but fully explain neither the ethnic differences in psychological distress nor the protective effect of own-group density.

INTRODUCTION

The existence of ethnic differences in mental health has long been reported, though not fully explained.^{1–3} It has been

ARTICLE SUMMARY

Article focus

- Ethnic differences in mental health, and the reportedly protective influence of own group ethnic density, are largely unexplained in previous studies.
- Social interactions are widely hypothesised as a mechanism linking ethnic density with more favourable mental health and may also explain ethnic differences more generally. However, few studies have empirically tested these hypotheses.
- We examined this hypothesis in 226 713 adults from 19 ethnic groups aged 45 years and older in Australia.

Key messages

- Ethnic differences in mental health persisted after full adjustment; they were not explained by four measures of social interactions or other individual and neighbourhood characteristics.
- Protective associations between ethnic density and mental health were largely explained by individual-level socioeconomic characteristics, not social interactions.

Strengths and limitations of this study

- Large samples allowed for the stratification of ethnic groups to investigate the differences in mental health, social interactions and ethnic density by country of birth.
- The use of a very small geographical scale than in previous work allowed for the ascertainment of local ‘pockets’ of ethnic density, which would otherwise have been hidden if the study had been dependent upon larger spatial units.
- Some of the remaining ethnic inequalities in mental health could be explained by systematic differences in the experience of racial discrimination which we were unable to control for.

suggested that living in areas of higher own group ethnic density reduces the risk of psychological distress, with increased social

support hypothesised to be one of the primary drivers.⁴ Social norms and support networks that promote resilience to material disadvantage and sources of psychosocial stress (eg, racism)⁵ are thought to be encouraged and maintained by this geographical clustering of ethnic groups⁶; even in deprived communities.^{7–9} However, there is very little empirical evidence on the extent that increased social support explains why some groups tend to report better mental health in ethnically dense neighbourhoods.

Only two studies have been identified that have examined this proposition, one in the UK and another in the USA, with equivocal results.^{10–11} More broadly, studies of ethnic density and mental health have been mostly based upon adolescents and adults of child-bearing age in European and North American datasets.^{10–18} Few studies have been conducted on adults in middle to older age. This is especially the case in Australia (with the exception of an earlier ecological study)¹⁹, which is surprising when one considers that, of the 22.6 million population, over one-quarter were born outside Australia²⁰ and 50% of whom originated from non-English-speaking countries.²¹

Australian cities are some of the most ethnically diverse cities in the world²² and often contain substantial residential clustering of ethnic groups.^{23–25} Contrasting migration histories and residential patterns of ethnic groups means that one cannot assume association between ethnic density and mental health reported in Europe and North America generalises to the Australian context. Therefore, more research is required not only to further understand the mechanisms underlying the ethnic density effects but also to identify the extent that the ethnic density may be beneficial to mental health in other ethnically diverse countries like Australia. In this paper, we attempt to achieve both of these aims, in addition to an examination of ethnic differences in mental health and the role of social support more generally through an analysis of a large number of ethnic groups and four measures of social interactions in an Australian cohort of adults.

METHOD

Study population

The 45 and Up study²⁶ is a large-scale cohort of 267 151 residents aged 45 and over in New South Wales (NSW, the most populous state in Australia). A baseline questionnaire covering a range of health and social issues was distributed to a random sample of adults listed in the Medicare Australia database between 2006 and 2009 inclusive. Medicare Australia is the database through which national healthcare is provided to Australian citizens and permanent residents as well as to some temporary residents and refugees.²⁶ The response to the questionnaire was 18%, which is low, though previous research has suggested that results from the 45 and Up Study are broadly comparable to those derived from

'representative' samples.²⁷ The University of New South Wales Human Research Ethics Committee approved the 45 and Up Study. Further details including the baseline questionnaire are available for download from <http://www.45andUp.org.au>.

Ethnicity status was derived from the first (of up to two) responses to a question on self-reported ancestry ('*What is your ancestry?*'). Secondary responses to this question were not used in the definition of ethnicity as they were not available in our dataset. We focused on the 19 largest groups such as Australian, English, Scottish, Welsh, Irish, Danish, French, Swiss, German, Dutch, Spanish, Italian, Greek, Polish, Maltese, Lebanese, Croatian, Indian and Chinese. Large sample sizes allowed for the stratification of each group by country of birth (assessed by the question '*in which country were you born?*') to address healthy-migrant effects. We retained all participants born in Australia (n=179 712), all participants of Australian ethnicity born outside Australia (n=1336) and participants of non-Australian ethnic groups born in their ethnic-country of origin (n=33 739). The participants of non-Australian ethnic groups born elsewhere (ie, not Australia or their ethnic-country of origin) were omitted from the sample (n=33 574) for substantive and practical reasons. Non-Australian ethnic groups born overseas and not in the ethnic country of origin were heterogeneous by definition, which made it difficult to meaningfully interpret any results for these participants. Furthermore, in practical terms, the sample sizes of many of these groups were small, which also reduced the potential to draw reliable statistical inference. We also omitted all participants missing a post-code identifier (n=263) and those missing a valid outcome measure (n=7011). Missing data for independent variables were resolved via imputing the mean of the observed values, retaining an overall sample size of n=226 487.

Psychological distress

We used the Kessler Psychological Distress Scale (K10) to evaluate mental health status.^{28–29} K10 measures symptoms of psychological distress experienced over the past 4 weeks, including feeling tired for no reason, nervous, hopeless, restless, depressed, sad and worthless. The participants had 5 choices for each of the 10 questions (none of the time=1, a little of the time=2, some of the time=3, most of the time=4 and all of the time=5) and these were summed to give the overall score. K10 has been previously used to gauge levels of psychological distress across different countries and ethnic groups.^{29–32} We constructed a binary variable, wherein a score of 22 or more identified the participants with a high risk of psychological distress.³³ K10 has been used in this binary manner, with 22 as the cut-point, in the previously published analyses of the 45 and Up Study.^{34–36}

Other individual-level measures

Social interactions were measured using four questions from the shortened version of the Duke Social Support Index.³⁷ Three of the questions asked a number of

times over the past week were whether or not a participant (i) spent time with friends or family they did not live with; (ii) talked to someone (friends, relatives or others) on the telephone and (iii) attended meetings at social clubs or religious groups. The final question asked the participants how many people outside their home, but within 1 h travel-time, did they feel that they were close to or could rely on. The previous work has constructed a composite indicator of social support from responses to these questions,^{38–39} though we analysed each one separately in line with recent studies which have demonstrated that some are more important than others.⁴⁰

We also accounted for other individual-level variables (self-reported) which are known to correlate with mental health. These included age, gender, physical activity, smoking status, body mass index, highest educational qualifications, economic status, annual household income, couple status and whether language(s) other than English were spoken at home.

Neighbourhood-level measures

This study used Census Collection Districts (CCD) to define neighbourhoods. With a mean of 225 residents,⁴¹ CCDs were the smallest geographical scale for which the 2006 Census data were made available.⁴² However, 9% of the participants in the 45 and Up Study were missing a valid CCD. In line with a previous study using the same data,⁴³ we assigned those missing a CCD with a pseudo-CCD according to the location of the population-weighted postcode centroid, as nearly 100% had a postcode identifier. Therefore, 100% of the sample could be assigned neighbourhood measures, and clustering within regression models could be operationalised at the CCD level.

We constructed the measure of own-group ethnic density from 2006 Census data. The Census question on ancestry (a surrogate for ethnicity in our study) was very similar to that used in the 45 and Up Study ('What is the person's ancestry?'). The number of people within a CCD pertaining to each participant's ethnic group was divided by the total usual resident population. For example, Chinese participants (regardless of their country of birth) were assigned the percentage of the population in their CCD who self-identified as Chinese.

Other neighbourhood measures included local affluence and geographical remoteness. We used the 'Index of Relative Socio-Economic Advantage/Disadvantage',⁴⁴ which is part of the Socio-Economic Index for Areas (SEIFA) and an indicator of local affluence. This is a variable derived by the Australian Bureau of Statistics using census variables which relate to the advantages and disadvantages, including household income and educational qualifications. This indicator was expressed in percentiles; higher percentiles indicate more affluent areas. Geographical remoteness was measured using the 'Accessibility/Remoteness Index of Australia' (ARIA).⁴⁵ ARIA is a score ranging from 0 to 15, with scores of 2.4

and over used to distinguish between urban and inner regions (<2.4) and rural or remote (>=2.4).

Statistical analysis

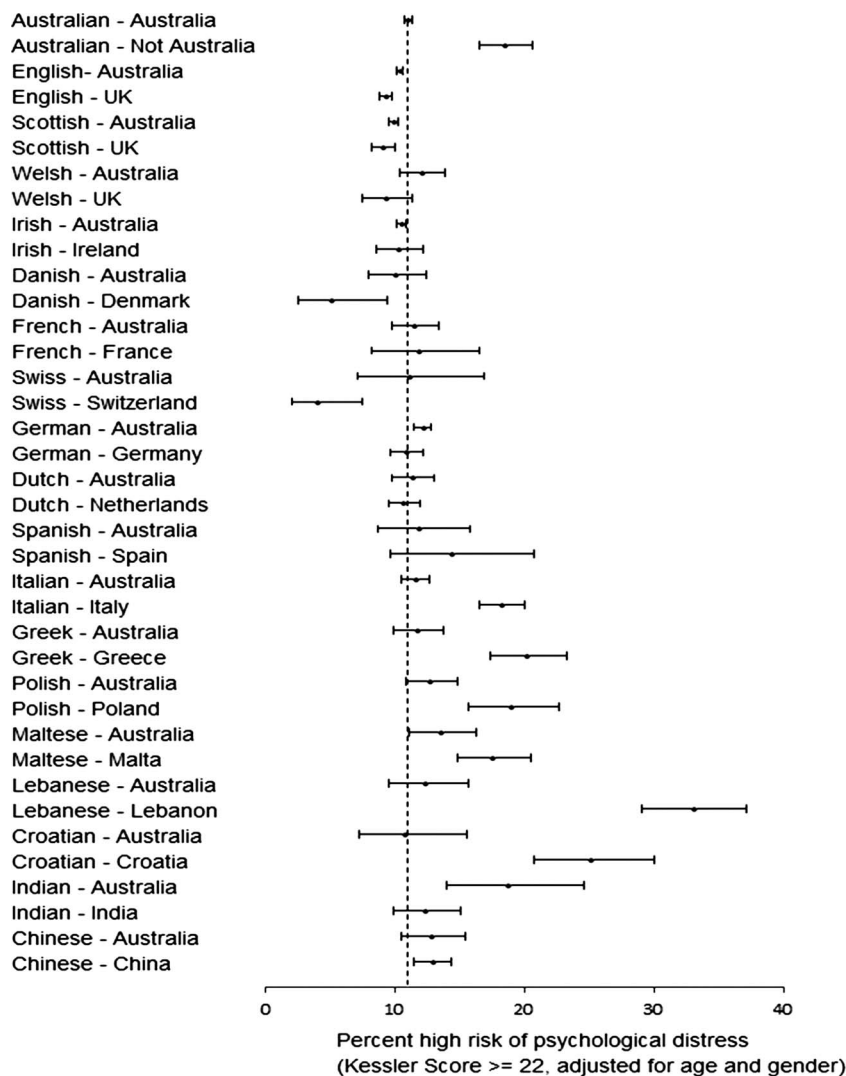
The study population was first assessed using descriptive statistics. Measures of ethnic density were mapped across NSW. To investigate ethnic differences in psychological distress, multilevel logistic regression was used to account for the clustering of participants within CCDs.⁴⁶ The sample was clustered within 11 621 CCDs (20 participants per CCD on average). CCDs accounted for 3.3% of the variation in psychological distress within a 'null' two-level multilevel model. A categorical variable identifying ethnic groups stratified by country of birth was fitted in this model, which was then adjusted for age and gender. We proceeded to test whether any ethnic differences in psychological distress remained significant after controlling for social interactions, other individual-level variables, local affluence and geographical remoteness. Multilevel logit regression was fitted to ethnic and country-of-birth-specific groups (ie, stratified models) to investigate the association between psychological distress and own-group ethnic density. To assess whether these associations could be explained by social interactions, we first tested the extent of correlation between each measure and own-group ethnic density using negative-binomial regression (to account for the skewed distribution of the social interaction variables). Social interactions were then fitted into the logit models, followed by individual-level variables, local affluence and geographical remoteness. Interaction terms were fitted to test for potential synergistic effects between ethnic density and other neighbourhood variables. Statistically significant associations were identified using the log-likelihood ratio test ($p < 0.05$). All analyses were conducted in STATA 12.

RESULTS

Figure 1 reports the differences in the age-adjusted and gender-adjusted prevalence of psychological distress by ethnicity and country of birth. The rate of high psychological distress was 11% for Australians born in Australia. In comparison, this risk was far higher for some groups, for example, 33% for the Lebanese born in Lebanon, but much lower for others, such as the Swiss born in Switzerland at 4%. There was no consistent effect of migrant status on the risk of psychological distress. For example, the prevalence of psychological distress among Croatians born in Croatia was 14.3% higher than their Australian-born Croatian peers. In contrast, no substantive difference in the prevalence of psychological distress was reported among the Chinese, whether born in Australia (12.8%) or China (12.9%), and the Danish born in Australia had twice the risk of their Danish-born contemporaries (10% and 5%, respectively).

Table 1 reports the percentage of each ethnic and country of birth group within the lowest quartile of the four social interaction measures. p-Values for

Figure 1 Ethnic and country of birth differences in the rate of psychological distress (Kessler scores of 22 and over), adjusted for age and gender.



comparisons between ethnic and country of birth groups for each social interaction variable were calculated using logistic regression. Compared to their Australian-born peers, those born within their ethnic country of origin tended to be more prevalent in the lowest quartile of every measure of social interactions. For the variable denoting how many people a person felt they could rely on, within-group differences were notably wide between the Australian-born and those born in the ethnic country of origin for the French (34.1%, 52%), Polish (37.8%, 51%), Lebanese (26.2%, 45.7%) and Chinese (32.8%, 56.7%).

Table 2 reports results from multilevel logit regression. Model 1 reports ethnic and country-of-birth differences in psychological distress, adjusted for age and gender (sensu figure 1). We adjusted this model for each social interaction variable individually and then simultaneously (Model 2). Higher quartiles of each social interaction variable were associated with a lower risk of psychological distress, especially those denoting the number of people who can be relied on (highest quartile OR 0.36, 95% CI 0.34 to 0.38). Social interactions fully explain

the higher risk of psychological distress experienced by the Chinese born in China (as denoted by statistical significance). However, there were other instances where ORs were attenuated, though remained significant, and this was often for people born outside Australia, such as the Lebanese born in Lebanon (OR=3.97 to 3.67) and the Croatians born in Croatia (OR=2.70 to 2.30). Adjusting for all other individual-level characteristics, neighbourhood affluence and geographical remoteness (Model 3) had a more substantive effect on the ethnic differences (OR=3.67 to 2.11 for the Lebanese born in Lebanon; OR=2.30 to 1.84 for the Croatians born in Croatia).

Figure 2 illustrates the ethnic and country of birth group differences in own-group ethnic density. Regardless of whether participants were born in Australia or the UK, those identified as Australian (32.6%) or English (35.1%) ethnicities lived in the most ethnically dense neighbourhoods. Compared to the Australians and the English, clustering of other ethnic groups in NSW was much lower. The highest mean ethnic density for non-Australian and non-English

Table 1 Ethnic and country of birth differences in social interactions; percentage in the lowest quartile for each measure of social interactions

Ethnic group, country of birth	n (%)	Social interactions			
		Less likely to spend time with friends/family	Less likely to talk to someone	Less likely to go to social clubs	Few people can depend on
Australia, Australia	61 848 (27.3)	35.9 (35.51 to 36.30)	26.1 (25.72 to 26.45)	42.1 (41.68 to 42.51)	30.5 (30.10 to 30.88)
Australian, not Australia	1383 (0.6)	37.9 (35.37 to 40.54)	30.2 (27.85 to 32.73)***	37.9 (35.37 to 40.59)***	36.7 (34.15 to 39.28)***
English, Australia	50 480 (22.3)	35.6 (35.16 to 36.03)	25.5 (25.06 to 25.86)*	41.3 (40.89 to 41.80)*	30.1 (29.64 to 30.49)
English, UK	16 356 (7.2)	41.4 (40.66 to 42.21)***	28.5 (27.82 to 29.24)***	43.9 (43.15 to 44.73)***	37.9 (37.17 to 38.71)***
Scottish, Australia	21 745 (9.6)	35.1 (34.47 to 35.78)*	24.6 (24.06 to 25.24)***	40.5 (39.86 to 41.21)***	29.2 (28.57 to 29.81)***
Scottish, UK	3759 (1.7)	37.8 (36.28 to 39.43)*	27.8 (26.32 to 29.23)*	42.9 (41.28 to 44.53)	35.8 (34.26 to 37.37)***
Welsh, Australia	1265 (0.6)	36.6 (33.99 to 39.38)	25.0 (22.67 to 27.51)	40.3 (37.58 to 43.11)	30.0 (27.48 to 32.58)
Welsh, UK	835 (0.4)	42.4 (39.06 to 45.87)***	28.9 (25.89 to 32.12)	44.6 (41.14 to 48.05)	38.0 (34.68 to 41.35)***
Irish, Australia	33 360 (14.7)	35.0 (34.52 to 35.58)**	24.1 (23.58 to 24.53)***	39.7 (39.20 to 40.30)***	30.4 (29.91 to 30.94)
Irish, Ireland	1048 (0.5)	40.9 (37.89 to 43.92)***	27.5 (24.90 to 30.34)	36.7 (33.71 to 39.69)***	36.3 (33.37 to 39.25)***
Danish, Australia	695 (0.3)	36.4 (32.84 to 40.09)	24.7 (21.58 to 28.11)	37.7 (34.11 to 41.46)*	30.2 (26.88 to 33.74)
Danish, Denmark	178 (0.1)	49.0 (41.63 to 56.43)***	34.2 (27.55 to 41.57)*	55.3 (47.76 to 62.56)***	42.3 (35.15 to 49.78)***
French, Australia	1195 (0.5)	37.9 (35.18 to 40.77)	26.3 (23.78 to 28.92)	44.1 (41.20 to 46.95)	34.1 (31.46 to 36.87)**
French, France	237 (0.1)	47.1 (40.76 to 53.58)***	29.9 (24.30 to 36.10)	53.4 (46.92 to 59.85)***	52.0 (45.51 to 58.36)***
Swiss, Australia	163 (0.1)	40.9 (33.48 to 48.67)	23.5 (17.62 to 30.70)	49.7 (41.86 to 57.48)	34.5 (27.59 to 42.20)
Swiss, Switzerland	224 (0.1)	49.6 (43.01 to 56.23)***	35.8 (29.66 to 42.36)***	51.1 (44.46 to 57.77)***	45.1 (38.62 to 51.76)***
German, Australia	9894 (4.4)	36.1 (35.18 to 37.11)	26.4 (25.49 to 27.27)	41.4 (40.41 to 42.41)	31.0 (30.12 to 31.97)
German, Germany	2073 (0.9)	48.0 (45.82 to 50.19)***	35.4 (33.33 to 37.54)***	50.6 (48.38 to 52.79)***	45.8 (43.63 to 47.99)***
Dutch, Australia	1487 (0.7)	35.0 (32.61 to 37.43)	27.8 (25.57 to 30.11)	41.6 (39.09 to 44.15)	31.2 (28.93 to 33.65)
Dutch, Netherlands	2451 (1.1)	40.8 (38.88 to 42.85)***	30.7 (28.87 to 32.57)***	42.4 (40.39 to 44.43)	37.7 (35.78 to 39.68)***
Spanish, Australia	316 (0.1)	40.8 (35.42 to 46.36)	28.6 (23.72 to 33.93)	46.6 (41.05 to 52.22)	30.0 (25.15 to 35.25)
Spanish, Spain	158 (0.1)	45.5 (37.82 to 53.48)*	31.4 (24.55 to 39.12)	53.9 (45.89 to 61.72)**	47.3 (39.57 to 55.25)***
Italian, Australia	3259 (1.4)	35.5 (33.88 to 37.18)	25.8 (24.33 to 27.34)	41.2 (39.49 to 42.93)	32.0 (30.42 to 33.66)
Italian, Italy	1922 (0.9)	37.4 (35.21 to 39.62)	29.5 (27.48 to 31.58)***	48.1 (45.84 to 50.43)***	36.5 (34.36 to 38.75)***
Greek, Australia	1072 (0.5)	34.1 (31.36 to 37.03)	21.2 (18.92 to 23.75)***	44.0 (40.98 to 47.03)	30.1 (27.44 to 32.96)
Greek, Greece	696 (0.3)	38.6 (35.02 to 42.39)	30.5 (27.14 to 34.09)**	45.8 (42.01 to 49.61)	44.4 (40.63 to 48.14)***
Polish, Australia	1111 (0.5)	39.0 (36.14 to 41.91)*	28.7 (26.05 to 31.41)	41.8 (38.86 to 44.72)	37.8 (34.94 to 40.70)***
Polish, Poland	471 (0.2)	47.5 (42.98 to 52.12)***	38.7 (34.31 to 43.27)***	46.4 (41.80 to 51.06)	51.0 (46.37 to 55.52)***
Maltese, Australia	675 (0.3)	35.0 (31.53 to 38.66)	28.8 (25.49 to 32.29)	41.1 (37.47 to 44.93)	29.2 (25.94 to 32.79)
Maltese, Malta	715 (0.3)	38.7 (35.19 to 42.43)	30.1 (26.78 to 33.57)*	38.9 (35.29 to 42.59)	38.9 (35.31 to 42.57)***
Lebanese, Australia	461 (0.2)	34.0 (29.83 to 38.49)	23.5 (19.81 to 27.54)	37.5 (33.16 to 42.06)*	26.2 (22.35 to 30.39)*
Lebanese, Lebanon	567 (0.3)	30.9 (27.24 to 34.78)*	29.6 (25.99 to 33.43)	41.4 (37.34 to 45.56)	45.7 (41.56 to 49.89)***
Croatian, Australia	218 (0.1)	37.3 (31.12 to 43.93)	22.9 (17.83 to 28.92)	44.9 (38.34 to 51.74)	34.3 (28.32 to 40.93)
Croatian, Croatia	349 (0.2)	43.4 (38.20 to 48.74)**	40.8 (35.63 to 46.14)***	47.3 (42.00 to 52.68)	48.0 (42.75 to 53.36)***
Indian, Australia	213 (0.1)	39.0 (32.60 to 45.72)	20.8 (15.90 to 26.69)	43.6 (36.97 to 50.42)	32.3 (26.38 to 38.90)
Indian, India	668 (0.3)	47.7 (43.91 to 51.61)***	26.3 (23.12 to 29.66)	26.5 (23.29 to 29.88)***	39.4 (35.66 to 43.18)***
Chinese, Australia	690 (0.3)	39.3 (35.68 to 43.03)	28.7 (25.41 to 32.24)	40.5 (36.80 to 44.23)	32.8 (29.36 to 36.41)
Chinese, China	2250 (1.0)	53.5 (51.40 to 55.62)***	40.5 (38.42 to 42.57)***	42.5 (40.42 to 44.59)	56.7 (54.62 to 58.82)***

***p<0.001.

**p<0.01.

*p<0.05 (from Australian, Australia).

Table 2 Ethnic and country of birth group differences in the risk of psychological distress, adjusted for social interactions variables and other individual and neighbourhood characteristics

	Model 1	Model 2	Model 3
Ethnicity, country of birth	OR (95% CI)		
Australian, Australia	1	1	1
Australian, not Australia	1.83 (1.59 to 2.10)***	1.73 (1.50 to 1.99)***	1.57 (1.36 to 1.82)***
English, Australia	0.93 (0.90 to 0.97)***	0.94 (0.90 to 0.98)***	0.96 (0.92 to 1.00)*
English, UK	0.83 (0.78 to 0.88)***	0.75 (0.71 to 0.80)***	0.82 (0.77 to 0.87)***
Scottish, Australia	0.89 (0.84 to 0.93)***	0.90 (0.86 to 0.95)***	0.96 (0.91 to 1.01)
Scottish, UK	0.81 (0.72 to 0.90)***	0.76 (0.68 to 0.85)***	0.82 (0.73 to 0.92)***
Welsh, Australia	1.10 (0.93 to 1.31)	1.12 (0.94 to 1.33)	1.19 (1.00 to 1.42)
Welsh, UK	0.82 (0.65 to 1.04)	0.75 (0.60 to 0.95)*	0.84 (0.66 to 1.07)
Irish, Australia	0.95 (0.91 to 0.99)*	0.96 (0.92 to 1.01)	0.99 (0.95 to 1.04)
Irish, Ireland	0.93 (0.76 to 1.13)	0.87 (0.71 to 1.06)	0.92 (0.75 to 1.12)
Danish, Australia	0.90 (0.70 to 1.15)	0.91 (0.71 to 1.17)	0.94 (0.73 to 1.21)
Danish, Denmark	0.43 (0.22 to 0.84)*	0.36 (0.18 to 0.71)**	0.38 (0.19 to 0.77)**
French, Australia	1.04 (0.87 to 1.24)	1.01 (0.84 to 1.21)	0.99 (0.83 to 1.19)
French, France	1.08 (0.73 to 1.60)	0.87 (0.58 to 1.29)	1.00 (0.67 to 1.51)
Swiss, Australia	1.01 (0.62 to 1.65)	1.00 (0.61 to 1.63)	1.14 (0.69 to 1.88)
Swiss, Switzerland	0.33 (0.17 to 0.65)***	0.27 (0.14 to 0.53)***	0.33 (0.17 to 0.65)***
German, Australia	1.12 (1.05 to 1.19)***	1.11 (1.04 to 1.19)***	1.10 (1.02 to 1.17)**
German, Germany	0.98 (0.86 to 1.13)	0.82 (0.71 to 0.94)**	0.87 (0.75 to 1.00)*
Dutch, Australia	1.03 (0.88 to 1.22)	1.02 (0.87 to 1.20)	1.07 (0.90 to 1.27)
Dutch, Netherlands	0.96 (0.85 to 1.09)	0.88 (0.78 to 1.01)	0.91 (0.80 to 1.04)
Spanish, Australia	1.08 (0.77 to 1.52)	1.08 (0.76 to 1.52)	0.92 (0.64 to 1.33)
Spanish, Spain	1.35 (0.87 to 2.11)	1.14 (0.73 to 1.79)	1.06 (0.67 to 1.67)
Italian, Australia	1.05 (0.94 to 1.18)	1.04 (0.93 to 1.17)	1.07 (0.96 to 1.21)
Italian, Italy	1.79 (1.59 to 2.02)***	1.68 (1.49 to 1.89)***	1.46 (1.29 to 1.65)**
Greek, Australia	1.07 (0.88 to 1.29)	1.08 (0.89 to 1.30)	1.11 (0.91 to 1.35)
Greek, Greece	2.04 (1.69 to 2.46)***	1.81 (1.50 to 2.19)***	1.33 (1.10 to 1.62)**
Polish, Australia	1.17 (0.98 to 1.40)	1.10 (0.92 to 1.32)	1.15 (0.95 to 1.39)
Polish, Poland	1.89 (1.51 to 2.37)***	1.54 (1.22 to 1.94)***	1.64 (1.30 to 2.08)***
Maltese, Australia	1.26 (1.01 to 1.57)*	1.27 (1.01 to 1.59)*	1.11 (0.88 to 1.41)
Maltese, Malta	1.71 (1.41 to 2.09)***	1.59 (1.30 to 1.94)***	1.19 (0.97 to 1.46)
Lebanese, Australia	1.13 (0.85 to 1.50)	1.22 (0.92 to 1.62)	1.31 (0.98 to 1.75)
Lebanese, Lebanon	3.97 (3.30 to 4.76)***	3.67 (3.04 to 4.42)***	2.11 (1.73 to 2.57)***
Croatian, Australia	0.97 (0.63 to 1.49)	0.94 (0.61 to 1.46)	1.00 (0.64 to 1.56)
Croatian, Croatia	2.70 (2.11 to 3.46)***	2.30 (1.78 to 2.96)***	1.84 (1.42 to 2.39)***
Indian, Australia	1.86 (1.31 to 2.63)***	1.88 (1.33 to 2.68)***	1.64 (1.14 to 2.35)**
Indian, India	1.13 (0.89 to 1.43)	1.07 (0.84 to 1.36)	1.43 (1.12 to 1.83)**
Chinese, Australia	1.18 (0.94 to 1.48)	1.16 (0.92 to 1.45)	1.18 (0.93 to 1.50)
Chinese, China	1.19 (1.05 to 1.35)**	0.90 (0.79 to 1.02)	1.05 (0.92 to 1.20)
Number of occasions spent with friends or family			
Quartile 1 (low)		1	1
Quartile 2 (low-to-moderate)		0.77 (0.74 to 0.81)***	0.78 (0.75 to 0.82)***
Quartile 3 (moderate-to-high)		0.80 (0.77 to 0.83)***	0.78 (0.75 to 0.81)***
Quartile 4 (high)		1.00 (0.97 to 1.04)	0.89 (0.85 to 0.92)***
Number of telephone conversations			
Quartile 1 (low)		1	1
Quartile 2 (low-to-moderate)		0.77 (0.74 to 0.80)***	0.82 (0.79 to 0.85)***
Quartile 3 (moderate-to-high)		0.79 (0.76 to 0.82)***	0.83 (0.80 to 0.87)***
Quartile 4 (high)		0.78 (0.75 to 0.81)***	0.85 (0.82 to 0.88)***
Number of visits to social clubs			
Quartile 1 (low)		1	1
Quartile 2 (low-to-moderate)		0.75 (0.72 to 0.78)***	0.86 (0.83 to 0.90)***
Quartile 3 (moderate-to-migh)		0.77 (0.74 to 0.80)***	0.88 (0.84 to 0.91)***
Quartile 4 (high)		0.95 (0.92 to 0.98)**	1.01 (0.97 to 1.04)

Continued

Table 2 Continued

	Model 1	Model 2	Model 3
Ethnicity, country of birth	OR (95% CI)		
Number of people who can be relied on			
Quartile 1 (low)		1	1
Quartile 2 (low-to-moderate)		0.58 (0.56 to 0.61)***	0.66 (0.63 to 0.68)***
Quartile 3 (moderate-to-high)		0.48 (0.47 to 0.50)***	0.56 (0.54 to 0.58)***
Quartile 4 (high)		0.36 (0.34 to 0.38)***	0.44 (0.42 to 0.46)***

*p<0.05.

**p<0.01.

***p<0.001.

Model 1: multilevel logit regression, adjusted for age and gender.

Model 2: Model 1+social interactions.

Model 3: Model 2+other individual-level variables, neighbourhood affluence and geographical remoteness.

groups was for the Chinese born in China at 14.9%, whereas the lowest was for Australian-born Swiss at 0.1%. There was evidence of heterogeneity of mean ethnic density within some groups. For example, Italians born in Australia had a mean ethnic density of 4.9%, compared with that of 7.7% for Italian-born Italians. Similar patterns were observed for the Greeks, the Chinese and the Lebanese.

For the next stage of analysis, we investigated the level of association with own-group ethnic density. This necessitated the stratification of the sample by ethnic and country of birth group to match each individual with the relevant ethnic density measure. For example, Chinese ethnic density was matched to Chinese individuals (irrespective of whether they were born in China or Australia). We conducted these analyses for all groups, but owing to space constraints we focus our report on groups that have a mean ethnic density of 2% or more: Australians, English, Scottish, Irish, German, Italian, Greek, Lebanese and Chinese. Table 3 reports mostly weak and positive or null (ie, p>0.05) correlations between own-group ethnic density and each of the social

interaction variables. The most consistent set of correlations were for the social interaction variables which indicated how many people could be relied on within a one-hour travel-time.

Table 4 reports the results of these ethnic and county of birth group-specific models. Model 1 fitted the association between psychological distress and own-group ethnic density, adjusted for age and gender. A 1% increase in own-group ethnic density appeared protective against psychological distress for the English born in UK and Australian-born Scottish, Irish and Chinese. Unexpectedly, increasing ethnic density was associated with a higher risk of psychological distress among Australians born in Australia. This model was adjusted by the social interaction variables (Model 2), but the associations between ethnic density and psychological distress persisted. Further adjustment for other individual-level variables, local affluence and geographical remoteness (Model 3) had a more substantial attenuating influence on the ethnic density ORs and 95% CIs, except that for the English born in the UK and the overseas-born Australians. We did not find any

Figure 2 Ethnic and country of birth differences in mean own-group ethnic density (%) at the Census Collection District scale, with minimum and maximum: sorted highest to lowest.

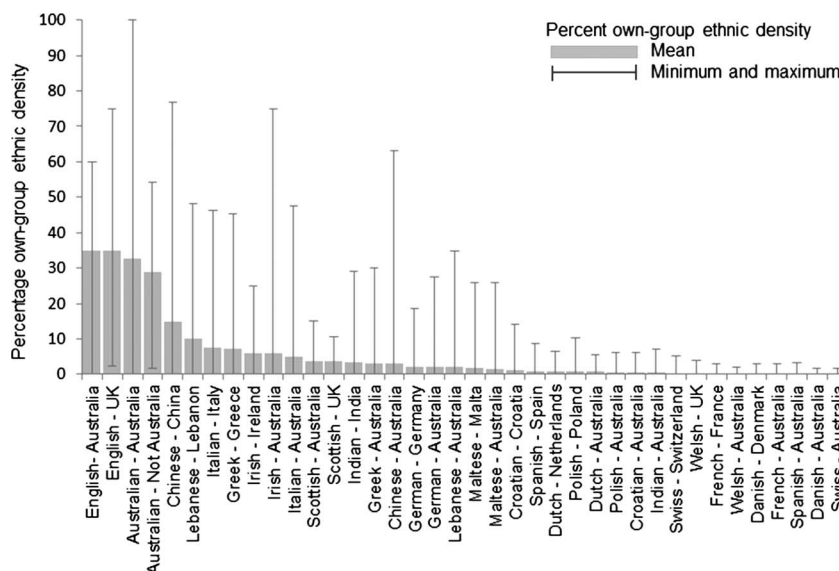


Table 3 Correlations between own group ethnic density and each of the social interactions variables, stratified by ethnic and country of birth group

Ethnic group, country of birth	How many times last week did you:			How many people outside your home, within 1 h of travel, do you feel you can depend on
	Spend time with friends/family who do not live with you	Talk to someone (friends, relatives or others)	Go to meetings of social clubs, religious groups or other groups you belong to	
Australia, Australia	0.012**	-0.017***	-0.012**	0.008*
Australian, not Australia	-0.010	-0.053*	0.005	-0.001
English, Australia	0.019***	0.001	0.013**	-0.001
English, UK	0.0156	-0.010	0.029**	0.006
Scottish, Australia	0.007	0.008	0.001	0.014*
Scottish, UK	0.036*	0.029	-0.007	0.031
Irish, Australia	0.005	0.009	-0.001	0.005
Irish, Ireland	-0.014	-0.012	0.019	-0.027
German, Australia	-0.002	-0.016	0.016	0.024*
German, Germany	-0.022	0.020	-0.004	0.057**
Italian, Australia	0.018	-0.028	-0.035*	0.049**
Italian, Italy	0.028	0.025	0.045	0.086**
Greek, Australia	0.066*	-0.032	-0.028	0.117**
Greek, Greece	0.012	-0.026	0.052	0.017
Lebanese, Australia	-0.033	0.047	0.055	0.273***
Lebanese, Lebanon	-0.029	0.009	-0.061	-0.031
Chinese, Australia	0.048	-0.015	0.008	-0.059
Chinese, China	0.036	0.033	0.082**	-0.007

*p<0.05.

**p<0.01.

***p<0.001.

evidence of interactions between ethnic density and any other independent variables in our models. Results from the imputed dataset were similar to those from complete-case analysis.

DISCUSSION

This paper examined the relationship between ethnic density and psychological distress in one of the most ethnically diverse areas of Australia. We found substantive heterogeneity in the risk of psychological distress between and within ethnic groups. Ethnic differences in social interactions, individual and neighbourhood characteristics did not explain the ethnic differences in the risk of psychological distress. More social interactions were associated with a lower risk of psychological distress, especially the number of people the study participants felt they could rely on. Increasing own-group ethnic density was associated with more social interactions and less psychological distress for some ethnic groups, but not all. However, it was the characteristics of individuals and the neighbourhoods in which they lived,

not the social interactions, which mostly explained the ethnic density effects on psychological distress. Only the English born in the UK and the overseas-born Australians appeared to benefit from ethnic density after controlling for all other characteristics.

Although there are many studies on ethnic density and mental health,^{4 6 10-18} only two others have tested whether this relationship is explained by social interactions. A UK study¹⁰ found a lower risk of common mental disorders for the Irish and Bangladeshi groups which they studied in more ethnically dense neighbourhoods. This was not fully explained by the measures of practical and emotional social support. Contrary to the ethnic density hypothesis, this study also reported significantly higher risk of common mental disorders among white British in ethnically dense neighbourhoods. A study in the USA¹¹ also showed the benefits of living in a higher own-ethnic group density neighbourhood for the emotional well-being of black and Hispanic groups. Measures of personal and neighbourhood social support partially explained the relationship for blacks but not among Hispanics. Therefore, despite using

Table 4 Association between own-group ethnic density and psychological distress by ethnic group, adjusting for social interactions and other individual and neighbourhood characteristics: ORs (95% CIs)

	Model 1 OR (95% CI)	Model 2	Model 3
Australian, Australia	1.011 (1.008 to 1.014)***	1.010 (1.007 to 1.014)***	1.000 (0.997 to 1.004)
Australian, not Australia	0.974 (0.959 to 0.988)***	0.976 (0.961 to 0.991)**	0.973 (0.955 to 0.991)**
English, Australia	1.000 (0.996 to 1.003)	1.000 (0.996 to 1.004)	0.998 (0.994 to 1.002)
English, UK	0.992 (0.986 to 0.999)*	0.993 (0.987 to 1.000)*	0.992 (0.985 to 0.999)*
Scottish, Australia	0.972 (0.945 to 1.000)*	0.979 (0.951 to 1.007)	0.986 (0.957 to 1.015)
Scottish, UK	0.982 (0.913 to 1.057)	0.991 (0.921 to 1.067)	1.002 (0.929 to 1.081)
Irish, Australia	0.977 (0.962 to 0.992)**	0.980 (0.965 to 0.995)**	0.998 (0.983 to 1.014)
Irish, Ireland	0.940 (0.861 to 1.026)	0.946 (0.863 to 1.038)	0.965 (0.868 to 1.073)
German, Australia	0.987 (0.949 to 1.028)	0.994 (0.954 to 1.036)	1.000 (0.959 to 1.042)
German, Germany	0.999 (0.901 to 1.107)	1.004 (0.905 to 1.115)	1.002 (0.895 to 1.121)
Italian, Australia	0.991 (0.973 to 1.009)	0.994 (0.977 to 1.012)	1.013 (0.992 to 1.034)
Italian, Italy	0.998 (0.985 to 1.011)	1.002 (0.989 to 1.016)	1.003 (0.988 to 1.017)
Greek, Australia	0.983 (0.943 to 1.024)	0.994 (0.955 to 1.035)	1.006 (0.963 to 1.052)
Greek, Greece	1.009 (0.987 to 1.032)	1.011 (0.989 to 1.034)	1.005 (0.979 to 1.032)
Lebanese, Australia	1.008 (0.954 to 1.065)	1.038 (0.981 to 1.099)	0.983 (0.913 to 1.057)
Lebanese, Lebanon	1.025 (0.999 to 1.051)	1.023 (0.995 to 1.051)	1.012 (0.983 to 1.042)
Chinese, Australia	0.897 (0.812 to 0.990)*	0.861 (0.760 to 0.975)*	0.884 (0.699 to 1.116)
Chinese, China	1.003 (0.992 to 1.014)	1.004 (0.993 to 1.014)	0.999 (0.988 to 1.011)

*p<0.05.

**p<0.01.

***p<0.001.

Model 1: adjusted for age and gender

Model 2: Model 1+social interactions

Model 3: Model 2+individual characteristics, neighbourhood affluence and geographical remoteness

contrasting measures of mental health and social interactions for different ethnic groups in the UK, USA and Australia, our findings are consistent wherein social interactions only played a weak role in explaining the ethnic density effect on mental health.

A particular strength of our study includes the large sample sizes for many different ethnic groups; more than it has been possible to analyse in previous studies.⁴ This allowed stratification by country of birth, which afforded new insights into the heterogeneity of mental health, social interactions and ethnic density within groups. It is noteworthy that the levels of ethnic density varied considerably by the country of birth within some ethnic groups (eg, the Chinese), though not all (eg, the English). Given the general supposition that higher levels of ethnic density are better for mental health, it could be argued that, for many groups, the levels of ethnic density do not achieve a sufficient concentration necessary for health promotion in this sample. This hypothesis is not convincing; however, when one considers that no association between ethnic density and psychological distress was found for the Chinese born in China, who reported a mean ethnic density of approximately 15% and a maximum of nearly 80%, there was an association among the Chinese born in Australia, for whom the mean ethnic density was about 5% and a maximum of around 63%. Likewise, there appeared to be a benefit of ethnic density for the UK-born English, but not the English born in Australia, despite having

very similar levels of own-group ethnic density. As such, it would appear that a more nuanced approach may be required in future, using other sources of administrative data and qualitative methods to examine what it is about ethnically dense neighbourhoods that promotes better mental health in some ethnic groups, but not all.

Our measures of psychological distress and social interactions have been widely validated. The small geographical scale (CCD) used to construct ethnic density provided a more accurate description of local circumstances than previous work which has relied upon larger spatial scales, helping to identify small 'pockets' of ethnic density and affluence that would otherwise have been hidden.⁴⁷ The focus on small-scale geography is an advantage, though our study shares a common limitation among others of this genre in the reliance upon administrative boundaries, which are unlikely to perfectly correlate with residents' perceptions of neighbourhood.⁴⁸ Such perceptions may vary depending upon location, circumstances and individual characteristics, including ethnicity. Therefore, it would appear that future research may need to explore the ethnic density hypothesis with customised measures of neighbourhood scale.

It is reasonable to expect that social support from the neighbourhood would be reflected in the four measures of social interactions used in the study, albeit imperfectly. Social clubs attended, for example, may be located in the neighbourhood and many of the people who can be relied on within 1 h of travel may in fact live

much closer. The limitation, however, is that the questions used in the 45 and Up Study did not ask participants to distinguish how many of these interactions occurred within versus outside the neighbourhood in which they lived. It would be useful for further work, therefore, to examine indicators which specify neighbourhood parameters within the question. Another limitation was that the 45 and Up Study was sampled from the Medicare Australia database which mainly includes Australian citizens and migrants on permanent residency visas. Only some migrants on temporary visas are included in this scheme and this is likely to mean that some ethnic minorities were not represented in our study. Representativeness is also a concern for a dataset, wherein the response rate was only 18%, although comparisons between the 45 and Up Study and a 'representative' dataset have helped to alleviate these concerns to some extent.²⁷ However, the comparisons in the aforementioned study did find heterogeneity between psychological distress and English spoken at home, and did not have an explicit focus on ethnic differences. Although regression methods are robust to missing data assumptions, there is still the possibility of bias. The 45 and Up Study asked participants about Aboriginal and Torres Strait Islander origin, though responses to this variable were not available for this investigation and are the focus of a follow-up study. Many studies have suggested that spatial variation in the experiences of racism could help to explain the ethnic density effect.^{14 16} Although we had no measure of racism in our study, virtually all benefits of ethnic density were already explained by other individual characteristics. Finally, our study represents only people of age 45 years and older, so it cannot discount the possibility of different patterns for younger age groups.

CONCLUSION

Ethnic groups in New South Wales, Australia, experience substantively different risks of psychological distress. These differences also align by country of birth, though there is no consistent pattern. Increasing social interactions, particularly those which help people to develop relationships with others they can depend on in times of need, are beneficial for mental health regardless of ethnicity and country of birth. In comparison, the ethnic density of where people live was protective only for the UK-born English and the overseas-born Australians.

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Contributors XF and TAB designed the analyses for the study which utilised an existing dataset. XF carried out the analyses and wrote the paper draft. All authors have commented on, edited and approved the final draft.

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