Mental health and quality of residential environment

HOLLIE THOMAS, NIKKI WEAVER, JOANNE PATTERSON, PHIL JONES, TRUDA BELL, REBECCA PLAYLE, FRANK DUNSTAN, STEPHEN PALMER, GLYN LEWIS and RICARDO ARAYA

Background  There is increasing interest in the proposition that residential environment can affect mental health.

Aims  To study the degree to which common mental disorder clusters according to postcode units and households. To investigate whether contextual measures of residential environment quality and geographical accessibility are associated with symptoms of common mental disorder.

Method  A total of 1058 individuals aged 16–75 years (response rate 66%) participated in a cross-sectional survey. The 12-item General Health Questionnaire measured symptoms of common mental disorder.

Results  Only 2% (95% CI 0–6) of the unexplained variation in symptoms existed at postcode unit level, whereas 37% (95% CI 27–49) existed at household-level, but the postcode unit variation was reduced to zero after adjustments. There was little evidence to suggest that residential quality or accessibility were associated with symptoms.

Conclusions  There was substantial unexplained variation at the household level but we could find no evidence of postcode unit variation and no association with residential environmental quality or geographical accessibility. It is likely that the psychosocial environment is more important than the physical environment in relation to common mental disorder.

Declaration of interest  None.

The common mental disorders of depression and anxiety can lead to substantial disability. The possibility that characteristics of neighbourhoods, in addition to characteristics of residents, can affect mental health is of increasing interest (Macintyre et al, 1993). There are a number of suggested neighbourhood or contextual characteristics that might affect mental health. These include social capital, defined (after Putnam, 1993) as the features of social organisation (such as networks, norms and trust) that facilitate coordination and cooperation for mutual benefit. However, neighbourhood effects might also act through the quality of the residential environment or its contribution to social cohesion, or the self-esteem felt by an individual. A few studies have measured contextual effects on mental health (Birch et al, 1988; Aneshensel & Sucoff, 1996; Dalgard & Tambs, 1997; Ross, 2000; Ellaway et al, 2001; Steptoe & Feldman, 2001; Silver et al, 2002; Weich et al, 2003; Wainwright & Surtees, 2004; Matheson et al, 2006; Fone et al, 2007) but almost all have relied on aggregated residents’ perceptions of their environment or census data (compositional data) instead of independently measured contextual characteristics such as residential quality or geographical accessibility to local services (McKenzie et al, 2002). Furthermore, the choice of the area level to be investigated is also crucial. It has been argued that ecological associations are best explored using data for small areas (Curtis & Rees Jones, 1998), and the ‘home patch’ (Barton et al, 2003) is increasingly seen as a useful unit for urban design, yet many studies have investigated much larger areas. In the UK, postcode units comprise on average 15–20 addresses, and often define a single street. Our aim was to investigate the amount of variation in symptoms of common mental disorder between postcode units and between households, and whether any such variation could be explained by contextual measures of residential environment quality and geographical accessibility of local services.

METHOD

Sampling strategy
The study was part of a research programme – Housing And Neighbourhood And Health (HANAH) – developed to investigate the relationships between the built environment, the social and economic context, and health. A cross-sectional survey was conducted in Neath Port Talbot County Borough in South Wales, UK. We restricted the sampling to postcodes with at least three households. Of the 3972 postcode units identified within the area by means of the Postcode Address File, a stratified random sample of 51 postcode units was selected using a probability of selection proportional to their size. The average size of selected postcode units was 20.5 addresses, although 20% contained 30 or more and the range was 3 to 86. Postcode units were sampled from six strata to represent low (bottom 15%), medium (middle 70%) and high (top 15%) areas of socio-economic deprivation using Townsend scores (Townsend et al, 1988), in addition to both urban and semi-urban areas.

Neath Port Talbot County Borough is the fourth most deprived of the 22 county boroughs in Wales, according to the Welsh Index of Multiple Deprivation based on the 2001 census. However, overall, areas in our sample were only a little more deprived than the average for Wales and included a reasonable spread of Townsend score values. Wales is somewhat more deprived than England on average, but direct comparison is difficult as the Welsh and English Indices of Multiple Deprivation are not comparable.

A total of 1523 addresses were identified in the 51 postcode units. As the number of addresses varied greatly between postcode units, a sampling fraction of 0.7 was applied to each postcode unit with up to 36 addresses, giving a maximum of 25 sampled addresses in these postcode units. For postcode units with more than 36 addresses, 25 were chosen at random. Of these 1523 addresses, 140 were not eligible (e.g. commercial or empty properties) and a further 148 contained only occupants who were outside the age limit of 16–75 years. In Neath Port Talbot, there were about 2.02 individuals per household on average.


500
Measures

Self-administered questionnaire

All residents aged 16–75 years in each sampled household were asked to complete the questionnaire survey. Questionnaires were left at 887 households (72% of the eligible sampling frame). Questionnaire distribution began on 15 May 2001 and was completed on 5 August 2001. Common mental disorder was measured by the 12-item General Health Questionnaire (GHQ; Goldberg & Williams, 1988), with a score of 3 or more used for case definition. The survey included additional self-administered questions regarding social capital, social cohesion, perceptions of the local area, and individual-level socio-demographic and socio-economic variables.

The variables listed in Table 1 were used in further analysis. Financial situation was assessed using the question, ‘How well do you feel you are managing financially these days?’ The ‘unaffordable lifestyle’ items were ‘keep household warm’, ‘keep house damp-free’, ‘keep house in decent state of decoration’, ‘replace worn-out furniture’, ‘have friends and family to your home for a drink or meal at least once a month’, ‘have a week’s annual holiday away from home’, ‘have new rather than second-hand clothes’, ‘eat meat, chicken, fish or vegetarian equivalent at least every second day’ and ‘eat fresh fruit and vegetables every day’. The response ‘would like to but can’t afford it’ was coded as 1 for each of these items and the total score was therefore between 0 and 9. These items are from the Breadline Britain surveys (Gordon & Pantazis, 1997). Overcrowding was a self-reported item. Type and age of property were obtained from the Welsh School of Architecture database for Neath Port Talbot.

Residential Environment Assessment Tool

The Residential Environment Assessment Tool (REAT; Dunstan et al., 2005) was designed to measure directly the observable characteristics of urban residential environment. Full details of the scale and its development are provided by Dunstan et al. (2005). Residential environmental assessments of each postcode unit were undertaken over 3 days at the end of June 2001 by four raters.

The 28 environmental characteristics rated included property vandalism, stray dogs, presence of hedges and fences, garden and property maintenance, presence of recreational space, the predominant outlook (green space or buildings) and density of housing. Given the different nature of these constructs, it was decided that an overall score would require different items to be given different weights. For example, the presence of burnt-out cars would probably be given more importance than the existence of recreational space. In order to obtain these weights we conducted a separate survey of a random sample of 130 residents from the Neath Port Talbot County Borough’s citizens’ panel, in which they were asked the degree to which the presence or absence of each characteristic was felt to be desirable or undesirable. A questionnaire was posted and 97 (65%) completed and returned. The survey was also posted on the local authority staff website, and a further 37 responses were received from members of staff. The results from the survey were used to generate an integer weight between 1 and 3, based on the median value of the responses to the citizens’ panel survey. The scores were multiplied by the weight and summed to give a total score. The decision to use integer weights was to simplify the use of the scale (Dunstan et al., 2005). A high overall score indicated an area of general low quality, with a greater number of negative or undesirable features. In order to perform a sensitivity analysis we also calculated a residential quality score before application of weights.

The total REAT score had a range from 0 to 68. For the 51 sampled postcode units in the borough of Neath Port Talbot, the REAT score ranged from 8 to 46 (mean 23.9, s.d.=8.3). We analysed the data from REAT as a continuous variable, but for the analyses presented in this paper total REAT score was split into thirds of the distribution (score <21.0, 21.0–27.5, 28+). The reliability of REAT scores was assessed by comparing them with ratings by a second observer. Twenty-four of the 28 items had a kappa statistic of more than 0.8. The lowest value (κ=0.58) occurred for the condition of the paths, whereas for the maintenance of shared space κ=0.67. Kappa values for the density of housing and maintenance of houses were 0.7–0.8. The intra-class correlation coefficient for the total score was over 0.9.

Geographical accessibility scores

The locations of a range of facilities were provided by Neath Port Talbot County Borough Council and were mapped on a geographical information system. Facility

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Characteristics of the sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
<td>n (%)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>474 (45.0)</td>
</tr>
<tr>
<td>Female</td>
<td>579 (55.0)</td>
</tr>
<tr>
<td>Working status</td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>509 (48.7)</td>
</tr>
<tr>
<td>Seeking work</td>
<td>34 (3.3)</td>
</tr>
<tr>
<td>Carer or looking after children/house</td>
<td>102 (9.8)</td>
</tr>
<tr>
<td>Student or on training scheme</td>
<td>42 (4.0)</td>
</tr>
<tr>
<td>Retired</td>
<td>232 (22.2)</td>
</tr>
<tr>
<td>Permanently unable to work</td>
<td>126 (12.0)</td>
</tr>
<tr>
<td>Financial situation</td>
<td></td>
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<tr>
<td>Living comfortably</td>
<td>182 (17.5)</td>
</tr>
<tr>
<td>Doing all right</td>
<td>387 (37.3)</td>
</tr>
<tr>
<td>Just about getting by</td>
<td>336 (32.4)</td>
</tr>
<tr>
<td>Finding it difficult</td>
<td>82 (7.9)</td>
</tr>
<tr>
<td>Finding it very difficult</td>
<td>51 (4.9)</td>
</tr>
<tr>
<td>Unaffordable lifestyle items (0–9)</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>554 (57.0)</td>
</tr>
<tr>
<td>1–2</td>
<td>199 (20.5)</td>
</tr>
<tr>
<td>3–5</td>
<td>155 (16.0)</td>
</tr>
<tr>
<td>6–9</td>
<td>63 (6.5)</td>
</tr>
<tr>
<td>Proportion of household income from benefits</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>477 (48.6)</td>
</tr>
<tr>
<td>Very little</td>
<td>154 (15.7)</td>
</tr>
<tr>
<td>Quarter</td>
<td>83 (8.5)</td>
</tr>
<tr>
<td>Half to three-quarters</td>
<td>109 (11.0)</td>
</tr>
<tr>
<td>All</td>
<td>159 (16.2)</td>
</tr>
<tr>
<td>Duration of residence in area</td>
<td></td>
</tr>
<tr>
<td>&lt;1 year</td>
<td>41 (3.9)</td>
</tr>
<tr>
<td>1 year</td>
<td>43 (4.1)</td>
</tr>
<tr>
<td>2–5 years</td>
<td>143 (13.5)</td>
</tr>
<tr>
<td>6–9 years</td>
<td>100 (9.5)</td>
</tr>
<tr>
<td>10+ years</td>
<td>726 (68.6)</td>
</tr>
<tr>
<td>Property type</td>
<td></td>
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<tr>
<td>Detached</td>
<td>191 (18.1)</td>
</tr>
<tr>
<td>Semi-detached</td>
<td>445 (42.1)</td>
</tr>
<tr>
<td>End-terrace</td>
<td>94 (9.0)</td>
</tr>
<tr>
<td>Mid-terrace</td>
<td>270 (25.6)</td>
</tr>
<tr>
<td>Flat</td>
<td>55 (5.2)</td>
</tr>
<tr>
<td>Age of property</td>
<td></td>
</tr>
<tr>
<td>Pre-1919</td>
<td>328 (31.1)</td>
</tr>
<tr>
<td>1919–1944</td>
<td>132 (12.5)</td>
</tr>
<tr>
<td>1945–1964</td>
<td>249 (23.6)</td>
</tr>
<tr>
<td>1965–1980</td>
<td>200 (19.0)</td>
</tr>
<tr>
<td>Post-1980</td>
<td>146 (13.8)</td>
</tr>
<tr>
<td>Household crowding</td>
<td></td>
</tr>
<tr>
<td>Too crowded</td>
<td>132 (12.6)</td>
</tr>
<tr>
<td>Just right</td>
<td>837 (79.6)</td>
</tr>
<tr>
<td>Too big</td>
<td>83 (7.8)</td>
</tr>
<tr>
<td>Area of residence</td>
<td></td>
</tr>
<tr>
<td>Semi-urban</td>
<td>663 (62.7)</td>
</tr>
<tr>
<td>Urban</td>
<td>395 (37.3)</td>
</tr>
<tr>
<td>Area socio-economic deprivation (Townsend Score)</td>
<td></td>
</tr>
<tr>
<td>Least deprived</td>
<td>204 (19.3)</td>
</tr>
<tr>
<td>Mild deprived</td>
<td>713 (67.4)</td>
</tr>
<tr>
<td>Most deprived</td>
<td>141 (13.3)</td>
</tr>
</tbody>
</table>
categories were leisure (e.g. cinema, public
house, children’s play park); sports (e.g.
swimming pool, sports centre, playing
field); transport (e.g. bus stop, train station,
cycle paths); shopping (e.g. post office, local
shop, pharmacy); and public services (e.g.
general practice, community centre, school). The citizens’ panel survey also
asked residents’ views on suitable levels of
access. These results, together with existing
indices (Barton et al., 2003), allowed each
facility to be allocated to one of four cate-
gories reflecting priority of importance:

(a) category 1: nearest bus stop, local shop,
pharmacy;
(b) category 2: general practice, post office,
cycle path, primary school, children’s
play park;
(c) category 3: playing field, public house,
supermarket, community centre, chil-
dren’s nursery, bus station, secondary
school, train station, swimming pool,
sports centre, restaurant;
(d) category 4: cinema, non-food stores,
bowling green, tennis courts.

Each of the four categories was then as-
signed a distance band indicating good, fair
and poor levels of geographical accessi-
bility. Category 1 facilities were assigned
distances of less than 300 m (good), 300–
500 m (fair) and over 500 m (poor); for
category 2 the distances were less than
600 m, 600–800 m and over 800 m; for
category 3 they were less than 800 m,
800–1900 m and over 1900 m for category
4 they were less than 1300 m, 1300–
1900 m and over 1900 m.

An automated process using a geogra-
phical information system calculated the
distance from the nearest facility to each
postcode unit, allocating a score of 2 for
good, 1 for fair and 0 for poor accessibility.
The scores were summed to create a geo-
graphical accessibility score for each post-
code unit with a range of 0–46, with
higher scores indicating better levels of ac-
cessibility. The geographical accessibility
scores ranged from 16 to 42 for the 51
sampled postcode units. We took a similar
approach towards analysis as described
above for the REAT score.

Statistical analyses
Sample characteristics and prevalence of
common mental disorder were derived
using commands in Stata version 6.0 for
Windows to allow for clustering by post-
code unit. Prior to multilevel modelling
the data were analysed at a single level
(again allowing for clustering) in order to
help inform inclusion of confounding vari-
ables in the multilevel models. Together
with the variables in Table 1, the following
variables were investigated for an indepen-
dent association with GHQ case status:
marital status, having children at home,
car ownership, housing tenure, household
monthly income, total floor area of property,
council tax band of property and urbanicity.

Multilevel modelling (Goldstein, 1995)
used MLwiN version 1.10 software (Insti-
tute of Education, University of London,
UK). All analyses using multilevel model-
ing excluded the seven postcode units with
five or fewer replies. Sensitivity analyses
were also completed, excluding 318 house-
holds with only one response per household
(while also excluding postcode units with
five or fewer replies) to check the robust-
ness of the estimate of residual variation
in GHQ symptoms at the household level.

A simple variance components null
model to estimate the residual variation at
postcode unit, household and individual le-
vels was fitted first using GHQ scores both
as a continuous total score and a binary
outcome (GHQ case v. non-case). Analyses
involving the continuous outcome were
based on a normally distributed multilevel
model whereas those involving the binary
outcome were based on a binomial multi-
level model using a logit link function.
Markov chain Monte Carlo (MCMC)
procedures using Gibbs sampling generally
provide more accurate parameter estimates
(Rodriguez & Goldman, 2001) and these
were used throughout. Individual-, house-
hold- and postcode-level predictors of
GHQ were then added to the model as
fixed effects in a cumulative manner and
changes in variance were noted.

RESULTS

Characteristics of sample
A total of 1058 questionnaires were re-
turned, giving a response rate of 66%.
These 1058 individuals were clustered in
647 households (household response rate
73%) within 51 postcode units. Seven post-
code units included replies from five or few-
er participants; after excluding these
postcode units the multilevel analyses were
based on 1042 individuals nested within
634 households within 44 postcode units.
The number of respondents per household
ranged from 1 to 5, the number of house-
holds per postcode unit ranged from 4 to
25 and the total number of respondents
per postcode unit ranged from 6 to 47.

The socio-demographic and socio-
economic characteristics of the 1058 study
participants are presented in Table 1. The
average age of the sample was 46.0 years,
and 55% were women. Just under half of
the participants were employed and 22% were
retired. Over half reported their finan-
cial situation as either ‘comfortable’ or ‘all
right’, similarly, 57% reported no lifestyle
item that they desired but were unable to
afford. However, 13% were finding their
financial situation either difficult or very
difficult, and 16% reported that all of their
household income was derived from bene-
fits. The majority had lived in their area
for 10 years or more. The most common
type of housing was semi-detached or
mid-terrace, with a wide range of ages of
property. Approximately 13% of parti-
cipants reported overcrowding in their
house. As a consequence of the sampling
strategy, the majority of respondents lived
in semi-urban areas, and 13% lived in the
most deprived areas.

Variance components null model
for symptoms of common mental
disorder
We estimated that approximately 2% (95% CI
0–6) of the unexplained residual varia-
tion in symptoms of common mental disor-
der was at the postcode unit level, 37% (95% CI
26–49) at the household level and 61% at the individual level (Table 2).

More than a quarter of the sample
(26.5%, 95% CI 23.5–29.4) were scored as
cases on the 12-item GHQ. The null
model for the binary GHQ outcome led to
similar estimates of percentage residual
variation of postcode unit, household and
individual level (Table 2). Although these
results were consistent with those using
GHQ score as a continuous outcome, the
MCMC modelling of this binary outcome
proved difficult as convergence was slow,
with high levels of autocorrelation in the
series that gave the posterior distributions
of the variances at the three levels. This
suggested that estimates were unreliable.
We therefore decided to restrict further
analyses to models using GHQ total
symptom score as the outcome variable.

Including individual, household
and postcode unit characteristics
in the model
Individual, household and postcode unit-
level fixed effects were added to the null
model using GHQ symptom score as the continuous outcome (Table 3). Inclusion of the individual-level exposures reduced the total residual variation and also the percentage of residual variation at postcode level, whereas the percentage residual variation at household and individual level increased slightly. Further inclusion of either household or postcode unit exposures had a less dramatic effect on the total amount of residual variation and did not greatly alter the estimate of percentage residual variance attributable to each level.

### Residential environment quality and geographical accessibility

The quality of the residential environment was not statistically significantly associated with symptoms of common mental disorder (Table 4) although symptoms were less common in areas with lower REAT scores (more attractive areas). After adjusting for the individual-level variables these differences were reduced. The geographical accessibility score was not statistically significantly associated with GHQ symptom score either before or after adjusting for individual-level variables (Table 4). The geographical accessibility score of leisure and entertainment facilities was most strongly associated with GHQ score, but the association was not statistically significant either before or after adjustment for individual-level variables.

### Sensitivity analysis

The sensitivity analysis (excluding 318 households with only one response) was based on 687 individuals within 329 households within 45 postcode units, and the results were comparable with those reported in Tables 2 and 3. For example, the estimates for the null model were postcode unit variance 0.43% (95% CI 0.0–2.78), household variance 32.4% (95% CI 22.0–44.2) and individual variance 67.1% (95% CI 58.1–77.7) when excluding households with single responses.

We also performed analyses using a residential environment score in which the weights had not been used. The correlation between this unweighted REAT score and weighted REAT was 0.98. We had very similar and non-significant results using this alternative residential score.

### DISCUSSION

The most striking result suggests that approximately 37% (95% CI 25–50) of the variation in symptoms of common mental disorder is explained at the household level, whereas there appeared to be virtually no variation across postcode units once individual characteristics had been taken into account. Few previous household surveys of mental health have been able to quantify the variation between households because they have sampled one individual per household. Weich et al (2003) estimated that 14% of the variation in prevalence of common mental disorder occurred at the household level in the British Household Panel Survey. Our results suggest a stronger association in GHQ score between individuals living in the same household in this much smaller area. We do not have any satisfactory explanation for this difference, but one might expect that these characteristics would vary between different geographical locations in the UK.

The proportion of unexplained variance in common mental disorder at the household level remained almost identical after adding potential explanatory household factors. Chandola et al (2003) reported a similar finding when attempting to account for the 20% of total variation in self-rated general health attributable to households. Household variation in mental health suggests that who you live with is more important than the internal or external environment in its effect on mental health. Other possible explanations include a household effect on perceptions and expectations of the external residential environment. The physical environment of the home might also affect self-esteem and psychological well-being either directly, or indirectly through a lack of social contact if the home environment inhibits visits from friends and family.

Our results suggest little variation in symptoms of common mental disorder at the postcode unit level. The confidence interval suggests that the maximum variation compatible with our data could be approximately 2.4% after taking account of individual and household factors. We are not aware of any previous research in the UK that has used postcode units in a multilevel model to assess the area-level variation in common mental disorder. However, previous findings from larger areas suggest that between 1% and 3% of the total variance in common mental disorder can be attributed to differences among UK regions (Duncan et al, 1995), Welsh unitary authorities (Skapinakis et al, 2005), UK electoral wards (Weich et al, 2003; Wainwright & Surtees, 2004; Fone et al, 2007), census tracts in urban areas of Canada (Matheson et al, 2006) and boroughs of Amsterdam (Reijneveld & Schene, 1998).

It is difficult, though, to exclude the possibility that larger contextual effects
1. Values are the mean difference between the reference category and the other categories of REA Tool score. GHQ, General Health Questionnaire; REA Tool, Residential Environment Assessment Tool.

2. Adjusted for gender, age, working status, financial situation and number of unaffordable lifestyle items.

3. Adjusted for gender, age, working status, financial status, unaffordable items.

4. Model 2 plus household exposures (proportion income from benefits, crowding in house, level of social support).

5. Confidence limit does not cross zero as % variance cannot hold negative values.

Table 3  Effect of inclusion of individual, household and postcode unit fixed effects on the unexplained variance in General Health Questionnaire (GHQ) symptom score

<table>
<thead>
<tr>
<th></th>
<th>GHQ symptom score</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Variance</td>
<td>(s.e.)</td>
<td>Percentage variance</td>
</tr>
<tr>
<td>Model 1 (null)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postcode unit</td>
<td>0.54</td>
<td>(0.58)</td>
<td>1.7</td>
</tr>
<tr>
<td>Household</td>
<td>12.09</td>
<td>(1.87)</td>
<td>37.3</td>
</tr>
<tr>
<td>Individual</td>
<td>19.78</td>
<td>(1.48)</td>
<td>61.0</td>
</tr>
<tr>
<td>Total</td>
<td>32.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postcode unit</td>
<td>0.06</td>
<td>(0.11)</td>
<td>0.3</td>
</tr>
<tr>
<td>Household</td>
<td>8.77</td>
<td>(1.43)</td>
<td>37.1</td>
</tr>
<tr>
<td>Individual</td>
<td>14.81</td>
<td>(1.20)</td>
<td>62.6</td>
</tr>
<tr>
<td>Total</td>
<td>23.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 3</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Postcode unit</td>
<td>0.07</td>
<td>(0.12)</td>
<td>0.3</td>
</tr>
<tr>
<td>Household</td>
<td>8.37</td>
<td>(1.42)</td>
<td>36.5</td>
</tr>
<tr>
<td>Individual</td>
<td>14.46</td>
<td>(1.21)</td>
<td>63.2</td>
</tr>
<tr>
<td>Total</td>
<td>22.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postcode unit</td>
<td>0.08</td>
<td>(0.15)</td>
<td>0.25</td>
</tr>
<tr>
<td>Household</td>
<td>8.56</td>
<td>(1.46)</td>
<td>37.1</td>
</tr>
<tr>
<td>Individual</td>
<td>14.41</td>
<td>(1.22)</td>
<td>62.5</td>
</tr>
<tr>
<td>Total</td>
<td>23.05</td>
<td></td>
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</tbody>
</table>

Table 4  Difference in GHQ symptom score categorised by quality of residential environment and geographical accessibility scores

<table>
<thead>
<tr>
<th></th>
<th>Mean difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted</td>
</tr>
<tr>
<td><strong>Model 1 (null)</strong></td>
<td></td>
</tr>
<tr>
<td>Total score &lt;21.0</td>
<td>Reference</td>
</tr>
<tr>
<td>Total score 21.0–27.5</td>
<td>0.20</td>
</tr>
<tr>
<td>Total score 28+</td>
<td>0.54</td>
</tr>
<tr>
<td><strong>Geographical accessibility</strong></td>
<td></td>
</tr>
<tr>
<td>Total score &lt; 25.0</td>
<td>Reference</td>
</tr>
<tr>
<td>Total score 25.0–31.0</td>
<td>0.26</td>
</tr>
<tr>
<td>Total score 32+</td>
<td>−0.89</td>
</tr>
</tbody>
</table>

1. Confidence limit does not cross zero as % variance cannot hold negative values.

The choice of geographical category will affect the results (Blakely & Woodward, 2000) and a balance is needed between defining an area small enough to indicate a homogeneous community while taking into consideration the fact that any inaccuracies in exposure measurement will be more noticeable in small areas (Jarman, 1997). Reijnveld et al. (2000), for example, found more variation between neighbourhoods (areas with similar types of building delineated by natural boundaries) than between postcode sectors (designed to include similar numbers of addresses but not delineated by natural boundaries) in Amsterdam, although the results were not always statistically significant. Most research on contextual effects, including our own, has been based on administrative rather than geographic classifications and might therefore fail to detect effects because of this.

**Quality of residential environment and geographical access**

We did not find that the contextual measure of residential environment quality was associated with symptoms of common mental disorder. Weich et al. (2002) did report that some independently rated household and neighbourhood characteristics were associated with the prevalence of common mental disorder, although multilevel models were not used to analyse their data. After adjustment, deck access properties, age of property and private gardens were associated with common mental disorder. In Chile, Araya et al. (2007) used a method analogous to ours and did find an association between the physical environment in large areas of Santiago and mental health. However, the circumstances in Chile differ in many respects from those in the UK, and socio-economic differences are more marked.

Geographical accessibility of local facilities was not associated with symptoms of common mental disorder. We are not aware of any previous studies of such a measure of access. Thomson et al. (2003) assessed, using qualitative methods, the health impact of a new swimming pool in Glasgow, UK. The residents, especially mothers of young children, reported mental health benefits from the social contact encouraged by the pool. These data illustrate that the relationship between the provision of local facilities and mental health is complex and inadequately summarised by simple measures of distance. Likewise, a variety of other social and monetary factors can affect access.

**Strengths and limitations**

Our study used independent measures of residential quality and geographical accessibility, and carried out an analysis that took the hierarchical structure of the data into account. The multilevel models allowed us to estimate unexplained variation at higher levels and allowed us to model higher-level
variables such as REAT scores in a robust manner. However, the study investigated a relatively small area, and perhaps there was not enough variation between our postcode units to detect using our methods. The confidence intervals for our estimates are also relatively wide and it is possible that we had insufficient statistical power to detect any differences. Furthermore, our independent measures at the highest level concentrated on the physical aspects of the environment, mostly because we thought that these could be measured reliably. The quality of the environment, the presence or absence of graffiti and the maintenance of properties also reflect something about the psychosocial environment, but we did not measure these aspects directly. We therefore did not study some of the less easily measured constructs, such as social cohesion or social capital, at the postcode unit level.

**Contextual effects on mental health**

The most striking finding is the considerable clustering of common mental disorder within households, in contrast to the relatively tiny or non-existent clustering at postcode level. It seems likely that the most important contextual influence on common mental disorder is that provided by the people with whom an individual lives in a household. Our research concentrated on classifying the physical environment in neighbourhoods, but our results suggest that it is the psychosocial environment that we need to understand. Perhaps future research should concentrate more upon the psychosocial characteristics of households and neighbourhoods, rather than attempting the easier task of assessing the physical environment.

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HOLLIE THOMAS, DPhil, Department of Psychological Medicine, School of Medicine, Cardiff University; NIKKI WEAVER, MSc, JOANNE PATTERSON, BSc, PHIL JONES, PhD, Centre For Research in the Built Environment, Welsh School of Architecture, Cardiff University; TRUDA BELL, MSc, REBECCA PLAYLE, PhD, FRANK DUNSTAN, DPhil, STEPHEN PALMER, FFPM, Department of Epidemiology, Statistics and Public Health, School of Medicine, Cardiff University; Cardiff; Glyn LEWIS, FRCPsych, PhD, RICARDO ARAYA, MRCpsych, PhD, Division of Psychiatry, University of Bristol, Bristol, UK

Correspondence: Professor Glyn Lewis, Division of Psychiatry, University of Bristol, Cootham House, Cootham Hill, Bristol BS6 6JL, UK. Tel: +44 (0)117 954 6796; fax: +44 (0)117 954 6672; email: Glyn.Lewis@bristol.ac.uk

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