Do urban environments increase the risk of anxiety, depression and psychosis? An epidemiological study.

Karen McKenzie,

Department of Clinical Psychology, University of Edinburgh.

Aja Murray and Tom Booth

Centre for Cognitive Ageing & Cognitive Epidemiology, Department of Psychology, University of Edinburgh.

Corresponding Author: Dr. Karen McKenzie, Department of Clinical Psychology, University of Edinburgh, Teviot Place, Edinburgh, EH8 9AG, Scotland, Email: kmckenzi@staffmail.ed.ac.uk, Phone: +44 (0)131 6513953
Fax: +44 (0) 131 651 3971

ABSTRACT

Background: The present total population study aimed to investigate whether there is an association between type of living environment (urban versus rural) and anxiety, depression and psychosis in the Scottish population.

Methods: Data were obtained from the Scottish Neighbourhood Statistics database on Scottish Index of Multiple Deprivation and Urban-Rural Classifications for 6505 data zones across Scotland. Multiple regression was used to test the association between prescriptions for psychotropic medication for anxiety, depression and psychosis, and type of living environment according to urban-rural classification, controlling for a range of socio-economic factors.

Results: Urban-rural classification significantly predicted poorer mental health both before (β=-.29) and after (β=-.20) controlling for a large number of socio-economic variables, with more urban areas having higher rates of prescription for psychotropic medication for anxiety, depression and psychosis.

Limitations: The current study focussed on macro-level variables and did not include individual level data. As such, the study did not include data on individual diagnoses, but instead used drug prescriptions for anxiety, depression and psychosis as a proxy for level of affective disorders within data zones.

Conclusion: More urban living environments in Scotland are associated with higher rates of prescription for psychotropic medication for anxiety, depression and psychosis.

Key words: anxiety; depression; psychosis; urban; rural; epidemiology.

INTRODUCTION

Poor mental health represents a significant issue worldwide and in the UK, with approximately 16% of the population being affected at any given time-point (Foresight, 2008; Department of Health, 2009). This is a particular issue in Scotland where approximately one in six individuals have poor mental health (Audit Scotland, 2009). Scotland also has particularly high suicide rates which exceed those for the rest of the UK (Smith-Merry et al., 2009; Mok et al., 2012). In addition to the personal cost to the individual, poor mental health has significant societal and economic implications, representing a £22.5 billion a year direct cost to the English economy (McCrone et al., 2008). In Scotland, the direct and indirect costs of poor mental health are estimated to be £10.7 billion (Scottish Association for Mental Health, 2011) As a result, understanding what factors impact upon mental health at the individual and societal level is of great importance.

An important feature of modern living has been the rapid spread of urban development. Over half the world population now live in urban areas and this is predicted to rise to over 6.3 billion by 2050 (Population Division of the Department of Economic and Social Affairs of the United Nations, 2011). It is estimated that over 80% of the population in England live in urban areas (Department for Environment, Food and Rural Affairs, n/d) with similar figures being reported for Scotland (Scottish Government, 2011).Given the current and projected growth in urban living, research into understanding the potential impacts of urban versus rural living on individual mental health is becoming increasingly pertinent.

Features of urban environments have historically been suggested to be important determinants of mental health (Faris & Dunham, 1939; Dohrenwend & Dohrenwend, 1974), however, recent research studies have tended to focus on urban-rural classifications and physical health, with impacts on mental health being rather more neglected. In a recent meta-

analysis on prevalence rates of mood, anxiety and substance disorder, Peen et al. (2010) located only 20 studies published since 1985, of which only four (Lewis & Booth, 1994; Paykel et al., 2000; Ayuso-Mateos et al., 2001; Weich et al., 2006) contained data from the United Kingdom. Of these, only three contained any data from Scotland and none represented a total population study. Pooled odds ratios for the four studies suggested that for any disorder (OR: 1.64, 95% CI: 1.32, 2.04) and mood disorders (OR: 1.30, 95% CI: 0.93, 1.82), urban environments increased the risk of poor mental health. No specific results were provided for anxiety disorders in Great Britain, however the general trend of results across all analyses was consistent: urban environments are associated with poorer mental health.

In a British based study using data from the National Morbidity Survey, and not included by Peen et al. (2010), Paykel et al. (2003) found an increased risk of psychiatric morbidity (measured using the Clinical Interview Schedule) for those living in urban versus rural environments (OR: 1.63, $p<.001$). This effect remained significant after controlling for a large number of demographic and socio-economic variables (OR: 1.33, $p<.05$). Though failing to reach statistical significance, a similar trend was seen in comparisons across semi-rural versus rural environments (OR: 1.22, controlled OR: 1.14), suggesting a possible continuum from urban to rural settings. While this study included a sample of data from Scotland, it explicitly excluded the Scottish Highlands and Islands, a geographical area which represents a significant proportion of Scotland's land mass and which is predominantly rural. A number of conceptual models have been proposed to explain the increased prevalence and risk of poor mental health in urban environments. Caracci (2008) provides a discussion of several alternatives including the urban health penalty, urban sprawl and urban health advantage models. A major focus of research into these models has been the features of urban environments which may be associated with poor mental health, such as dilapidated or disused buildings, graffiti, and litter; many of which have been associated with increased

instances of depression (Weich et al., 2002; Galeaa et al., 2005). Research in Scotland has indicated that those living in more deprived areas have a higher likelihood of living in close proximity to unpleasant environmental conditions that may constitute a risk to their physical and mental health, including sources of industrial pollution and derelict land (Fairburn et al., 2005).

As well as the impact that the actual physical environment can have on mental health, subjective perception of the quality of an area has also been suggested as being important for both physical and mental health, impacting on behaviours associated with improved health e.g. walking, (Ross, 2000) as well as factors which influence social cohesion (see Ellaway et al., 2009 for an overview). Both have been proposed as candidate mediators of the relationship between aspects of the environment and health (e.g. Groenewegen et al., 2011). Specific to Scotland, Ellaway et al., (2009) found that those who subjectively rated their living environment as being lower quality (particularly with respect to street level issues such as graffiti and environmental issues such as safe play areas) were more likely to report regularly experiencing anxiety and depression, after controlling for gender, age and class.

Another distinguishing feature between urban and rural environments may be differential access to green space i.e. space which has not been subject to development, which is open and which contains natural vegetation (Centres for Disease Control and Prevention, 2008) and which may include parks, gardens and woods. A body of research suggests that having access to green space is associated with improved mental health and can have a greater impact on mental than physical health (Ohta et al., 2007; Sugiyama et al., 2008; Maas et al., 2009; Groenewegen et al., 2011). A number of mechanisms have been proposed to explain this association, including green space as a means for reducing stress and for increasing social cohesion and support (Sugiyama et al., 2008; Stigsdotter et al., 2010; van den Berg et al., 2010; Thompson et al., 2012), although whether it promotes physical exercise

is less clear (see Groenewegen et al., 2011 for an overview).The relationship between type of living environment and health is, therefore, potentially multi-faceted.

When considering the evidence for a causal effect of urban versus rural environments on health, it is also important to consider the possible confounding effects of differences in socioeconomic status (SES) between these environments (Weich et al., 2002). There are well established associations between SES and both mental and physical health (Adler & Snibbe, 2003). Lower income is associated with poorer health within nations, even those that differ from one another in their health care systems and wealth. Within nations the association holds across the entire range of SES i.e. increments in SES are associated with differences in health irrespective of whether two highly wealthy strata of the population or two fairly impoverished strata of the population are being compared (Adler & Snibbe, 2003). The potential entanglement of variance in SES, type of environment and health has been evidenced in work by Mitchell & Popham (2008). They found that the type of environment- specifically, exposure to green space- may act as a mediator of income related inequalities in health. They found, in an English population study, that income deprivation related differences in all cause mortality and mortality from circulatory disease were lower amongst those in the areas designated as being most green. It was these health outcomes that were hypothesised by the authors to be most modifiable by green space exposure. A potential mediating role of the environment on the income-health association complicates the situation, because it implies that not only might income affect a person's health directly, it may do so indirectly through the type of living environment that they find themselves in. Therefore, SES may not only confound the association between income and mental health by affecting both directly, but may also introduce a selection bias whereby lower income individuals may find themselves in poorer quality environments.

These different strands of research suggest that important relationships may exist between health, SES and type of living environment. Factors that appear to be important in relation to the latter include where it lies on the urban-rural continuum, the extent to which it includes green space and both the actual and perceived quality of the environment. These potential relationships may be particularly pertinent to the Scotland, where it has been found that those living in more socio-economic deprived areas have a greater likelihood of exposure to environment related health risks such as derelict land (Fairburn et al., 2005).

Aims of study

The primary aim of the current study is to investigate, using data on the total Scottish population, whether the urban-rural status of areas of Scotland is predictive of mental health, controlling for multiple aspects of SES. There have been very few epidemiological studies in the UK examining the relation between urban-rural features and mental health and no total population studies in Scotland. The geographical landscape (Scottish Government, 2011), the pattern of deprivation (Fairburn et al., 2005), and significant mental health issues in Scotland (Scottish Association for Mental Health, 2011) as well as the fact that the results obtained from one country cannot necessarily be generalised to other countries (Richardson et al., 2010) provides a rationale for conducting such research in Scotland.

METHODS

Ethics

Ethical approval for the project was obtained from the authors' educational institution.

Database

All data were extracted from the Scottish Neighbourhood Statistics database (http://www.sns.gov.uk/). The database provides information for all of Scotland from local authority level to small data zone level (which range between 500 and 1,000 residents**),**

covering a total population of 5194000. Included in the database are data from the Scottish Index of Multiple Deprivation (SIMD: Scottish Government, 2009). Data for the current study are taken from SIMD 2009, which includes data collected between 2004 and 2008. The database provides a relative measure of deprivation for 6505 data zones (here referred to as settlements). The SIMD contains multiple measures of deprivation described below.

The key independent variable in the current study is the urban-rural classification (described below) of each of the 6505 data zones from the Scottish Neighbourhood Statistics database.

Measures

Urban-rural classification

Settlements were assigned an urban-rural classification based on two main criteria: their population size and their remoteness/accessibility. Classification formed six ordered categories, the definitions ranging from large urban areas (settlements of over 125,000 people) to remote rural areas (with a population of under 3000 people and with a driving time of over half an hour to a settlement with a population of 10000 or more). For further information on these categories and how the information for assigning settlements to categories, see http://www.scotland.gov.uk/Topics/Statistics/About/Methodology/UrbanRuralClassification. Urban-rural classification for the years 2009-2010 were used in analyses. These correlated at greater than $r = .99$ with urban-rural classification for the years 2007-2008.

Settlement mental health

Settlement mental health was operationalized as the estimated proportion of the population prescribed drugs for anxiety, depression or psychosis in 2007, as described in SIMD 2009. The proportion of prescribed drugs provides an objective measure of the volume of mental health conditions within a settlement, and is not contingent on self-reports of

mental status. This is one indicator of the Health Deprivation index domain used to estimate the SIMD of a settlement.

Socioeconomic status covariates

SES measures were also included in the analysis with the aim of controlling for any confounding influence of SES on the association between urban-rural classification and settlement mental health. Here we use the six subscales scores of the total SIMD score as SES covariates. Individual subscales were preferred to the total score in order to examine the individual covariate effects of different components of SES. Each subscale is in itself constructed from a number of different variables. These are summarised in Table 1. The remaining variables used to construct the Health Deprivation index domain were also included as covariates.

INSERT TABLE 1 HERE

Statistical Analysis

Data were treated as continuous for analyses. Usually, a minimum of five ordered categories are required to justify treating data as continuous (e.g. see Rhemtulla et al., 2012) and each of the measures in the present study had at least six.

Data were analysed using linear multiple regression. We estimated three models. In Model 1, settlement mental health was regressed on the urban-rural classification of the region. In Model 2, we examined the effect of controlling for SES by regressing settlement mental health on urban-rural classification plus a number of covariates designed to control for differences in SES. These covariates were statistically controlled by using simultaneous entry of all predictors.

As the data for each settlement represented an aggregate estimate across all members of its population, settlements of smaller size would be expected to yield estimates with larger sampling errors. In order to control for this effect we estimated a third model (Model 3) in which settlement mental health was regressed on both urban-rural classification and SES covariates but the contribution of each settlement to the regression model estimates was weighted by the square root of its population size in the year 2009 (the same year for which the SIMD data were calculated). This was in order to reflect the fact that the standard error of a sample estimate is proportional to the square root of the sample size. This procedure can be used in the present analysis to observe the effect of weighting cases by population size on the magnitude and direction of regression coefficients but does not produce accurate standard errors for them. Only regression coefficients are, therefore, reported for the case weighted model.

In any statistical analysis, it is important to ensure that observed patterns of association are not due mainly to a small number of highly influential cases (Pek & MacCallum, 2011). Influential cases are not synonymous with outlying cases, as influential cases are not necessarily outliers and outliers may not be influential cases, and it is the latter to which model parameter magnitudes are especially sensitive (Pek & MacCallum, 2011). Models were, therefore, checked for influential cases as identified by Cook's distances of greater than one (Field, 2005).

It was not necessary to take steps to address missing data as complete data were available for all variables used in the analysis.

RESULTS

Table 2 shows the weighted mean percentage of the population prescribed drugs for anxiety, depression or psychosis in each category of urban-rural classification. It shows that as the environment becomes more urban, prescription percentages decrease. To investigate

whether this association could be explained by socio-economic confounders, we estimated a series of multiple regression models.

INSERT TABLE 2 HERE

Regression coefficients for the urban-rural classification as a predictor of the estimated proportion of the population being prescribed drugs for anxiety, depression or psychosis are provided in Table 3. Shown are coefficients both without SES covariates (Model 1) and controlling for the SES covariates (Model 2). In Model 1, a settlement's urban-rural classification significantly predicted the prescription of drugs for depression, anxiety and psychosis (β=-.29, p<.001). The direction of the association indicated that the more rural settlements have fewer prescriptions of drugs for depression, anxiety and psychosis. The association was attenuated in Model 2 after including SES covariates ($\Delta\beta$= -.09) but remained statistically significant (β=-.20, p<0.01). A number of the SES covariates had significant effects in Model 2, the largest being Comparative Illness (β=.49), Employment Deprivation (β=-.40) and Income Deprivation (β=.17). In Model 3 in which cases were weighted by settlement size, there was no change in the regression coefficient estimating the association between urban-rural classification and the prescription of drugs for depression, anxiety and psychosis. There were also no influential cases identified, suggesting that the model was not sensitive to the presence of a small number of cases with a large impact.

INSERT TABLE 3 HERE

DISCUSSION

The aim of the present study was to explore the association between type of living environment and mental health, as indicated by prescriptions for psychotropic medication for anxiety, depression and psychosis at a population level in Scotland. The study found that, after controlling for multiple measures of SES, the urban-rural classification of Scottish settlements was a significant predictor of estimated mental health. In large sample sizes such as in the present study, even trivially small effects can be statistically significant, therefore, it is necessary to consider the magnitude of the observed effect and whether it represents an effect that is likely to be of practical significance. Although what constitutes an effect size of a magnitude indicating a potentially important effect in different fields is somewhat subjective and will depend on the specific research area (Kelley & Preacher, 2012), we would argue that this size of effect is, in the context of epidemiological research large enough to be considered potentially important. For example, many epidemiological associations which are considered to be important have shown beta coefficients smaller than this, such as the association between smoking and cognitive decline in older adulthood (Anstey et al., 2007).

The exact mechanisms by which living environment influences mental health are unknown, but the recognition that multiple factors may contribute individually and in interaction with each other has led to the development of an integrated explanatory model. Galea et al. (2005) propose a conceptual framework which suggests that health is a function of urban living conditions which are composed of factors such as population demographics, the physical and social environment and infra-structure of formal and informal health and social services. These in turn are shaped by global, national and local factors, such as government and local policy, demographic and economic changes. Caracci (2008) has proposed ways in which this model can help to capture the complexity of the relationship between health and living environment. It is suggested that it can facilitate interventions at a

range of points in the model including changing the social environment (Dalgard &Tambs, 1997) and targeted public health interventions (Freudenberg, 2000).

An important feature which distinguishes urban and rural living, and which has been researched with respect to its mental health benefits, is green space. Overall, the available research suggests that living in a green environment can have a positive impact on mental health (Ohta et al., 2007; Sugiyama et al., 2008; Maas et al., 2009). The extent to which differences in access to green space might underpin the relationship found between mental health and living environment in the present study can, however, only be inferred as, while Pretty et al. (2005) note that 'urban settings by definition have less nature than rural ones' (p9), the extent to which green space was available, and accessed within each data zone, and its actual and perceived quality were not directly measured in the present study. Obtaining reports of the quality of green space and of the urban versus rural environments more generally may be especially important. Mitchell & Popham (2007) found that having more green space was actually related to *poorer* health in lower income suburban areas, but suggested that the green space in question may have been of lower quality and not aesthetically pleasing to residents. Unfortunately we were unable to differentiate between pleasant and unpleasant urban and rural environments in the present study.

The fact that the present study controlled for many settlement level factors which are hypothesised to impact on health, such as socio-economic and deprivation indices, however, suggests that the extent of accessible green space in an environment may be an important mediator. As such, encouraging those with mental health problems to access high quality green space may represent a potential cost-effective intervention, which has minimal, if any, side effects and which would not require a wait for specialist intervention. Further research on the relationship of access to green space on the mental health of the Scottish population

and in clinical populations is needed to assess the impact of type and extent of exposure to green space on the range of mental health problems.

Limitations

The present study represented a national population study with a very large sample which controlled for a number of indices of SES. It is, however, acknowledged that any population is subject to a range of environmental factors at any given time (Richardson et al., 2009) which may impact singly or in combination on mental health. In this context the study had a number of limitations. As a population study it was unable to identify and control for a number of individual level factors such as gender, disability, ethnicity and age. In addition, we were unable to assess actual and individuals' perception of the quality of their environment, which have previously been found to be important influences on mental health (Fairburn et al., 2005; Ellaway et al., 2009). Another limitation of not having individual level data is that we could not control for selection bias, in particular, that those with better mental health elected to live in more rural locations. Further, the primary focus of the current study is the macro level environment of urban versus rural living and, as has been noted by Weich et al. (2002) the broad contextual features of environments (urban-rural) should not be equated to individual demographic or socio-economic factors. Finally, because we had only cross-sectional data, we could not assess the impact of living environment over time.

While the study avoided the potential limitation of relying on subjective self- report measures of mental health, the use of prescriptions for anxiety, depression and psychosis as an indirect measure of population mental health, rather than a direct measure according to diagnosis, also has problems. As Mok et al. (2012) note, drug prescribing may simply represent demand and supply of medication, prescribing patterns, or availability of alternative interventions such as psychological interventions. Previous studies have, however, used

prescriptions for psychotropic medication as a proxy for mental health (Mok et al., 2012) and it is used as such within both the Scottish (Scottish Index of Multiple Deprivation, 2009) and English (English Indices of Deprivation, 2010) indices for multiple deprivation. In addition, research has suggested that prescribing patterns for antidepressants are consistent with more direct measures of mental illness e.g. psychiatric admissions (Centres for Disease Control and Prevention, 2008).

Further, although the present study has the advantage of being able to control for the possible confounding influence of differences in SES status between urban and rural settings, these differences have been demonstrated to be complex (Amato & Zuo, 1992). For example, car ownership may be considered essential in rural communities, irrespective of income, rather than being an indicator of a particular socio-economic status (Watt et al., 1994). In addition, despite the general balance of research evidence, including our own results, suggesting that urban, not rural, living to be the biggest detriment to mental health and well-being, it is important to acknowledge that aspects of rural living may also contribute to poor mental health. For example, studies in Dumfries (Scotland) by McCreadie and colleagues, discussed by Philo et al. (2003), highlight the potentially detrimental impact of social isolation in rural communities.

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Table 1:

Scottish Index of Multiple Deprivation subscale variables

SIMD Domains	Indicators
Current Income	Number of adults (aged 16-59) receiving Income Support; number of adults (aged 60 plus) receiving Guaranteed Pension Credit; number of children (aged 0-15) dependent on a recipient of Income Support; number of adults receiving (all) Job Seekers Allowance; number of children (aged 0-15) dependent on a recipient of Job Seekers Allowance.
Employment	Working age unemployment claimant count averaged over 12 months; working age Incapacity Benefit recipients, men aged under 65 and women aged under 60; working age Severe Disablement Allowance recipients; working age Compulsory New Deal participants — New Deal for the under 25s and New Deal for the 25+ not included in the unemployment claimant count.
Education, Skills and Training	School pupil absences; pupil performance on SQA at stage 4; working age people with no qualifications; 17-21 year olds enrolling into higher education; people aged 16-19 not in full time education, employment or training.
Geographic Access	Drive time: average drive time to a primary school; average drive time to a secondary school; average drive time to a GP; average drive time to a post office; average drive time to shopping facilities; average drive time to a fuel station. Public transport: public transport travel time to shopping facilities; public transport travel time to a GP; public transport travel time to a post office.
Housing	Persons in households that are overcrowded; persons in households without central heating.
Crime	Recorded crimes of violence; recorded domestic housebreaking; recorded vandalism; recorded drugs offences; recorded minor assault.

Note: Full details on the combining of the indicator variables can be found in the Technical Report (Scottish Government, 2009)

Table 2: Weighted Mean Percentage of the Population Prescribed Drugs for Anxiety, Depression or Psychosis across Categories of Urban-Rural Classification

Urban-Rural Classification	**1**	**2**	**3**	**4**	**5**	**6**
Population living in Urban-Rural Classification	1998881	1555063	461318	186582	608170	334186
Weighted Mean % of the Population Prescribed Drugs for Anxiety, Depression or Psychosis	9.37	9.17	8.35	8.37	8.04	7.63

Note. 1-6 indicates most to least urban environment.

Table 3:

Regression Coefficients for Models with Urban-Rural Classification Predicting Proportion of the Settle Population Prescribed Drugs for Anxiety, Depression, or Psychosis

Model		**B**	**SE (B)**	***Beta***	***t***	***p***
1.	Urban-Rural Classification	-.36	.02	-.29	-24.11	<.001
2.	Urban-Rural Classification	-.25	.02	-.20	-16.45	<.001
	SIMD Subscale Scores					
	Current Income Deprivation Rank	.00	.00	.17	4.78	<.001
	Employment Deprivation Rank	.00	.00	-.40	-11.49	<.001
	Education Deprivation Rank	.00	.00	.03	1.19	=.23
	Geographic Access Deprivation Rank	.00	.00	-.11	-8.95	<.001
	Housing Deprivation Rank	.00	.00	.03	2.15	<.05
	Crime Deprivation Rank	.00	.00	.04	2.70	<.01
	Health Deprivation Rank Variables					
	Standardized Mortality Ratio	.00	.00	.03	2.69	<.01
	Hospital Episodes Related to Alcohol	-.00	.00	-.10	-6.45	<.001
	Hospital Episodes Related to Drugs	-.00	.00	-.05	-4.34	<.001
	Comparative Illness Factor	.02	.00	.49	17.04	<.001
	Emergency Admissions to Hospital	.00	.00	.03	1.60	=.11
	Proportion of live births w/low birth weight	.07	.41	.00	.17	=.87

Note. Model 1 includes only urban-rural classification as a predictor. Model 2 includes urban-rural classification plus SES covariates. Model 3 is not shown as its purpose was to examine the effect of weighting datapoints by settlement size, however, this procedure made no difference to the magnitude of the estimate of the association between urban-rural classification and estimated settlement mental health ($\Delta\beta = 0$).

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