

***The Impact of Rurality on Health:  
Systematic Review***

***Is there a health impact of rural compared with urban  
residence?***

***What health-related interventions work for elderly  
populations living in rural areas?***

**Jean Peters and Rachel Jackson**

**May 2005**



Section of Public Health  
School of Health and Related Research  
University of Sheffield  
& Rural Evidence Research Centre

# **The Impact of Rurality on Health**

## **Executive Summary**

### **Inequalities in health**

Over the last few years Government policy has focussed on the issue of inequalities in health and their reduction by addressing their social and economic determinants. Rural areas have pockets of deprivation alongside areas of affluence and associated inequalities in health within their local populations, yet most of the activity and national initiatives to date have been based in urban areas.

### **Definition of rurality**

There are multiple definitions of 'rurality' used in the public domain, encompassing a wide range of interpretations and descriptions. This makes any comparison of one area described as 'rural' with another, difficult. Whilst the recent classification of Bibby and Shepherd (2004) may have been adopted in some of the more recent research activity, it has yet to appear in any published research findings, and being UK-based, will not facilitate international comparisons. An international definition is needed, so that terms such as 'remote' and 'rural' are comparable between geographical areas in different countries.

### **Research questions**

To examine the impact of rurality on health, two research questions have been considered, both of which were developed in discussion with an Expert Advisory Panel. The two questions are as follows:

Research question 1: 'Is there a health impact of rural compared with urban residence?'

Research question 2: 'Which health-related interventions work in improving the physical and mental wellbeing of older people living in rural areas of the United Kingdom?'

### **Methods**

To address the two research questions, two systematic reviews of the evidence have been conducted, using Cochrane-defined criteria. Thirteen databases were searched for publications between 1990 and 2005 (January, week 3), using a broad search strategy of free text and MESH terms, for each research question. Searches were also conducted of the National Research Register, Caredata and the grey literature. Exclusion criteria included publications not in the English language, non-systematic reviews, and evidence relating to oral or dental health. Papers were included, for the first research question, if they reported direct rural urban health comparisons in economically developed countries, and for question two, if they reported UK-based interventions to manage/improve health/health care in the rural elderly (defined as aged fifty or over). All abstracts and selected papers were double read and evidence tables prepared from relevant evidence.

For the first question, there were 14,099 hits, from which 470 full texts were obtained, and 192 papers identified as relevant to address the research question. These 192 papers provided evidence on 232 health topics. For question two, there were 4561 hits, from which 96 full texts were considered and nine papers included in the review.

## **Findings**

### First research question:

**Location:** The majority of the published literature identified (116 papers), addressing rural versus urban health and health care issues, was based in the USA. The UK was represented in 44 papers, Australia and New Zealand in 29, and other European countries in 26. This has implications for interpretation and application of the evidence, as the definition of ‘rurality’ in most of the USA papers relates to metropolitan and non-metropolitan areas, terms that do not directly translate into UK-based geographical environments.

§ *Coverage of rural and urban populations is uneven across the economically developed countries, with the evidence dominated by one country (USA).*

§ *There is large variation in the definition and therefore in the populations included within and between rural and urban comparison groups.*

**Study design:** Of the published evidence found, none was acquired using the more robust study designs such as randomised controlled trials, where confounding and bias can be minimised and causation assigned. There were 35 studies that used a cohort design. It is acknowledged that there are problems with using a randomisation technique for place of residence. No systematic reviews were found. The majority (132) of the studies reported were primary research of a cross-sectional design whilst 59 analysed population-based routine data. For those analysing routine data, sample sizes were very large, but for many of the other studies, sample sizes were smaller, and the issue of power was not addressed.

§ *The quality of the evidence to demonstrate causality is poor.*

§ *Some studies may be underpowered to detect any health differences between rural and urban subjects in the sample.*

**Health topics:** The literature was dominated with studies on mortality (21), mental health (26) and health in the elderly (28). A further 28 studies examined health service access and use. Some health conditions were not addressed at all, such as renal conditions, or for which there were only a limited number of papers, for example, gastrointestinal conditions (1), infections and immunity (3), accidents and violence (3). Studies on health in children and young people were limited and these groups were not specifically addressed.

§ **Coverage of the health conditions reported is uneven and very limited or non-existent for some conditions.**

§ **Coverage across the full population age range is limited, with findings biased towards the elderly and adults in general.**

**Outcomes:** The range of outcomes used was almost as great as the number of papers found. It was therefore not possible to combine any findings in a meta-analysis. A crude proxy outcome measure was developed: papers reporting more favourable health and health service outcomes in rural areas, papers reporting in favour of urban areas, and those reporting no differences between rural and urban areas. Using this outcome measure, irrespective of study design used, in just under half of the studies, health outcomes were less favourable for those living in rural areas (48 percent in cohort studies, 43 percent in the rest). Twenty nine percent of the studies found in favour of rural areas, and for the rest, the results were equivocal.

Rural health status in the UK, on the basis of the UK evidence only, is more favourable, with 55 percent of the cross-sectional/ecological studies reporting more

favourable health outcomes and 28 percent, less favourable. However evidence from cohort studies was very limited, with four studies in total, three of which found rural health to be poorer.

**Adjustment for confounders:** In one quarter of all studies statistical modelling was used to adjust for a selection of potential confounders. The result, however, still show equivalence in health outcome overall between rural and urban populations, with 41 percent of studies having worse outcomes and 30 percent having better outcomes, for those living in rural areas, and no differences in 29 percent.

§ **The very broad range of health outcomes used limits cross-study comparisons**

§ **The broad range of health outcomes, but limited number of studies with each, reduces the opportunity to conduct any meta-analyses.**

§ **A lack of statistical detail limits interpretation of the reported values and findings.**

§ **In aggregation, there is no evidence of health benefit of rural over urban residence or vice-versa.**

#### Second research question

The interventions reported covered mobile or outreach health care services (6 studies), self-management of health condition (2) and screening (10). All studies were cross-sectional in design and all reported positive health outcomes or satisfaction with services following intervention but robust health outcome measures were lacking. Costs and cost savings were considered in three of the studies.

§ **There is very limited evidence on the effectiveness or cost-effectiveness of health care interventions conducted in rural areas and on rural populations in the UK.**

#### **Recommendations**

In summary, there is no clear direction from the evidence favouring health in rural over urban residence or vice versa or of appropriate health interventions of benefit to elderly rural residents. In general, the evidence available lacks robustness and is too heterogeneous in the definitions of rurality used, the range of health conditions and outcomes assessed, and the populations covered. Further detailed studies, preferably designed to provide some measure of causality, are needed, conducted in geographical areas with clear definitions that relate to their rurality, however defined.

# Contents

Executive Summary .....	2
Contents .....	5
Introduction.....	6
Inequalities in Health.....	6
Health and Health Inequalities in Rural Areas.....	7
What is Rurality?.....	9
The Research Programme.....	12
Research Questions .....	12
Methods .....	14
Research Question 1 .....	14
Research Question 2.....	16
Evidence .....	18
Research Question 1 .....	18
Characteristics of data extracted .....	18
Findings .....	20
Studies based in the UK.....	21
Evidence from cohort studies.....	22
Studies with potential rural dose-response model.....	22
Studies with adjustment for confounders.....	23
Summary findings for individual health topics .....	24
Research Question 2.....	41
Characteristics of data extracted .....	41
Discussion.....	44
Study Design.....	44
Population .....	44
Definition of Rurality .....	45
Health and Healthcare Topics .....	46
Health Outcomes and Analysis .....	47
Summary and Recommendations.....	49
References.....	52
References cited in Research Question 1 .....	52
References cited in Research Question 2 .....	57
Other References .....	57
Acknowledgements .....	59

# **The Impact of Rurality on Health**

## **Introduction**

### **Inequalities in Health**

Black (1980) and Acheson (1998), who both reviewed the social and economic determinants of health, emphasised the inter-relationships between determinants and inequalities in determinants between communities. Some determinants of health are of particular relevance, and will have specific impact, on residents in rural areas, for example, availability and cost of transport, ability to access health care, availability of employment and training opportunities.

Reducing inequalities in health is a national Government priority. Nationally, and within and between geographical areas and populations, there is a need to address the short-term consequences of avoidable ill health and the longer-term determinants, so that within the next ten to twenty years the 'health gap' can be narrowed and, in the longer term, no one should be seriously disadvantaged by where they live. Over the last few years, Government policy has focussed specifically on the public's health and on addressing the widening inequalities in health across populations. 'Tackling Health Inequalities A Programme for Action' (Department of Health 2003) sets out plans to tackle health inequalities over the next three years and the foundations required to meet a number of Government targets to address health inequalities, namely:

By 2010:

- To reduce inequalities in health outcomes by ten percent as measured by infant mortality and life expectancy at birth.
  - 'Starting with children under one year, to reduce by at least ten percent the gap in mortality between routine and manual groups and the population as a whole.'
  - 'Starting with local authorities, to reduce by at least ten percent the gap between the fifth of areas with the lowest life expectancy at birth and the population as a whole.'
- To reduce mortality rates from heart disease and stroke and related diseases by at least 40 percent in people under 75, with at least a 40 percent reduction in the

inequalities gap between the fifth of areas with the worse health and deprivation indicators and the population as a whole.

- To reduce mortality rates from cancer by at least 20 percent in people under 75, with a reduction in the inequalities gap of at least six percent between the fifth of areas with the worse health and deprivation indicators and the population as a whole
- To reduce adult smoking rates to 21 percent or less, with a reduction in prevalence among routine and manual groups to 26 percent or less
- To reduce the rate of teenage conceptions with the specific aim of halving the rate of conceptions among under 18s.

### **Health and Health Inequalities in Rural Areas**

A number of recent local and national programmes, such as Health Action Zones, Healthy Living Centres and latterly, the New Deal for Communities, have been initiated to tackle and reduce inequalities in health. The New Deal programme also has a brief to address the wider health determinants, such as education, crime, the physical environment and housing, and employment. However, these programmes have predominantly been located in, and focused on, urban locations and their resident populations, albeit deprived ones, where there is evidence of multiple deprivation.

However, more than 20 percent of the population (12-14 million) of England live in rural areas - the countryside, villages and rural towns and around 25-30 percent of GDP is generated through rurally located businesses (DEFRA 2003). Rural areas are similar to urban areas in that they too have their pockets of deprivation alongside those of relative affluence, and relatively high proportions of individuals living below the poverty line (Cox 1998). Inequalities in health and in the delivery of health care also exist among residents of rural areas. Such inequalities may be of a different nature due to the rurality of the location but the key psycho-social and economic determinants of health still prevail and a better understanding is still crucial for reducing social exclusion and promoting healthy sustainable rural areas and populations.

There have been significant changes in the rural economy over the last few years, with a move from land-based dominance to a range of diverse activities (Winter and Rushbrook 2003). Although there are a number of initiatives underway that are either promoting the rural economy (DEFRA 2002), or promoting access to rural areas, e.g. through Local Transport Plans (Health Inequalities Unit, Department of Health, 2004), the ongoing changes, plus the potential insecurity they may bring, will inevitably have an impact upon the demographic and health profiles of residents in rural areas. The English rural population has not only grown, in real terms, it is changing in its composition, resulting in a proportionately under-represented, predominantly healthy young population and an over-represented older age group (Buller *et al.*, 2003), with their associated age-related health problems. The ongoing demographic changes have implications for health status and healthcare services. Yet a recent BMA report (2005) highlighted that rural healthcare is being neglected, in terms of access and service and staff provision.

The health of many living in rural areas is not good and the health profile varies by, for example, occupation (Syson-Nibbs, 2003). Indeed, for some specific occupations, such as farming, there is a concern that this will not be sustainable in the long term in some areas of the country. If this is so, it will inevitably have an impact upon the health not only of farmers, but also their families and the wider local community. Farm incomes, for a variety of reasons, have fallen by as much as 75 percent in areas such as the Peak District in the last ten years (Peak District Rural Deprivation Forum, 2004) resulting in increased deprivation. Whether the health variation and inequalities seen between rural residents is attributable to variation in individual exposure to determinants of health or issues around health care provision and/or access, the evidence is unclear. There is an emerging evidence base on rurality and health and access to healthcare from Australia and the United States of America, but less information about the impact of rurality on health and health care access in the United Kingdom.

Of further relevance is that currently we have very little understanding of the cultural beliefs, social norms, barriers and stigma of rural residents that impact on health behaviour and can lead to stoicism and late presentation for care (Syson-Nibbs, 2003). Without this knowledge, it is difficult to know how, where or when to intervene and

with what actions to take, in order to reduce the health inequalities that exist in rural areas. A greater understanding is needed of

- The longer term impacts on rural residents of demographic, hereditary, and lifestyle factors interplayed with social and community networks and the socio-economic and cultural environment in the rural environment
- The evidence base on successful health care interventions for specific rural populations living in the UK.

### **What is Rurality?**

Given the ongoing demographic and economic changes in settlements in England a new classification of urban and rural areas has recently been developed (Bibby and Shepherd 2004). Its relative newness has meant that none of the literature on rural health and healthcare in England that we identified has used this definition. Conversely, in the relevant literature extracted in this review a wide range of definitions has been used, that display considerable variability in terms of choice of indicators, level of analysis and robustness. Such definitions also encompass a wide interpretation of 'rural', from remote outback areas in Australia with very small populations within a very large geographical area, to small rural towns, with smallish populations within small geographically rural areas. Below we present a summary of the definitions used, in the papers included in this review, to describe 'rural' in terms of physical geography or demographic factors. The wide variation seen in these definitions has implications for comparison and interpretation of the evidence identified in this systematic review.

A number of studies from various countries relied on self-classification of area of study by respondents (Gabhainn *et al.*, 2001, Wackerbarth *et al.*, 2001, Weeks *et al.*, 2002, Zimmerman *et al.*, 2003). This method has clear limitations, due to the unreliability of individual judgements. Jenkins *et al.*, (1997) used self-classification of study area by researchers followed by verification in their UK-based study. Other definitions used were also limited, for example use of a simple dichotomous coding with no further explanation provided (e.g. Witt Prehn and West, 1998). In other cases, authors selected and named geographical locations as rural or urban with no clear

definition of the characteristics of the location (e.g. Liff *et al.*, 1991, Allaby, 1993, Fakhoury and Roos, 1996, Bermejo *et al.*, 1997).

A large number of papers quoted population density as a measure of rurality (e.g. Morgan *et al.*, 2000 Chevalley *et al.*, 2002). Walters *et al.* (2004) broke down areas into quartiles: 1=lowest density quartile (0-355 people/km), 2=intermediate lower density (356-1069 people/km), 3=intermediate higher density (1070-2466 people/km) and highest density (>2467 people/km). Sources of data used in definitions also varied. Some UK-based studies relied on census data. Saunderson *et al.*, (1998) used Census data to categorise areas by population density and Phillimore and Reading (1992) rated population density by the Office of Population Censuses and Surveys classification. A number of papers defined rurality according to the Office for National Statistics (Law and Morris, 1998, White *et al.*, 1999). Reading *et al.*, (1993) classed enumeration districts by population size. A combination of population density and population potential was also used (Middleton *et al.*, 2003).

Other European definitions varied widely and were often based on country-specific national data sets (e.g. Launoy *et al.*, 1992, Friis and Storm, 1993).

Papers relating to access in a number of countries frequently used measures of geographical accessibility in terms of journey time or distance to services (e.g. Fortney *et al.*, 1999, Lovett *et al.*, 2002, Meden *et al.*, 2002). Combinations of remoteness and population size were also utilised (Jones and Bentham, 1997, Mehlum *et al.*, 1999, Campbell *et al.*, 2000, Haynes and Gale, 2000,). Dickinson *et al.*, (2002) used a combination of measures incorporating urbanicity and occupation.

The majority of the literature drawn from the USA used a metropolitan/non-metropolitan definition based on Metropolitan Statistical Areas (e.g. Fingerhut *et al.*, 1998, Barnett *et al.*, 2000, Eberhardt *et al.*, 2001). Some US authors incorporated geographical context of area (e.g. open country/non-farm or farm setting, small city and urban) (Dwyer and Miller, 1990), availability of services (e.g. water supply, public transport) (Fahs *et al.*, 2002) and availability of health services (e.g. numbers of physicians, hospitals and hospital beds and ratios per 1000 residents (Gillanders *et al.*, 1996) into their definition. Others used USA Census-based definitions of rurality

(Blazer *et al.*, 1995, Brown *et al.*, 2000). Wing *et al.*, (1992) classified rurality according to US State Economic Areas, whilst other authors based their definition of rurality on the United States Department of Agriculture classification system (Labuhn *et al.*, 1993, Singh and Siahpush, 2002).

Parikh *et al.*, (1996) and Yiannakoulis *et al.*, (2004) based their definitions of rurality on data held by Statistics Canada.

Definitions specific to Australia were also encountered, such as the Rural, Remote and Metropolitan Index: 1) capital cities 2) other metropolitan centres population >100,000 3) large rural centres 25,000-99,999 4) small rural centres 10,000-24,999 5) other rural areas less than 10,000 6) remote centres greater/equal to 5000 7) other remote areas population <5000 (e.g. Britt *et al.*, 2001, Caldwell *et al.*, 2004). A number of Australian papers used the Accessibility and Remoteness Index of Australia (ARIA) to stratify population drawn from metropolitan, rural and remote areas into categories: highly accessible, accessible, moderately accessible, remote, very remote (e.g. Wilkinson *et al.*, 2001, Eckert *et al.*, 2004).

Dudley *et al.*, 1998b classed regions according to the Australian Department of Primary Industries and Energy and Department of Human Services and Health, whilst Vu *et al.*, (2000) used a local definition of rurality specific to New South Wales in their study.

The considerable number of different definitions used in literature, both within and across countries, poses difficulties to the formation of urban/rural comparisons of health. The utilisation of standardised definitions in future studies should clarify the impact of rurality on health.

## The Research Programme

Rural health is one of the component parts of the research programme for the Rural Evidence Research Centre (led by Birkbeck College, University of London). As a first stage in the research programme, with respect to health, a scoping exercise has been carried out to identify and examine the existing evidence base on health and rurality. A steering group of experts was assembled to inform the review. Group membership includes members drawn from the School of Health and Related Research (ScHARR) and the Department of Geography at the University of Sheffield, a Primary Care Trust with a large rurally based population (High Peak and Dales), the Institute of Rural Health, and DEFRA. The group held its first meeting in October 2004, with a brief to identify key areas of concern with respect to rural health and on which to focus initially and to define the topic for the scoping exercise. The outcome from this meeting and further refinement were three defined prioritised research questions relating to rural health. This scoping exercise has focused on the first two questions:

- What is the impact of rurality on health on an international comparative level?
- What health care interventions exist to address health problems of older people living in rural areas in the United Kingdom?

The scoping exercise therefore consists of two systematic reviews, using Cochrane-defined criteria, to address the two research questions outlined above. The third question related to resource allocation and was not included in this review.

### Research Questions

#### Research question 1:

**‘What is the impact of rurality on health, is there a health impact of rural compared with urban residence?’**

Population=Adults and children in rural and urban populations in developed countries

Intervention/Exposure=Rural residence

Comparison= Health status and service utilisation in urban areas

Outcome=Physical and mental health, use, access, provision of health services

Research question 2:

‘Which health-related interventions work in improving the physical and mental wellbeing of older people living in rural areas of the United Kingdom?’

Population=People aged 50+ years residing in rural areas of the United Kingdom

Intervention=Interventions in primary/community care conducted in rural areas and addressing physical and mental health

Comparison=Any appropriate option

Outcome=Physical and mental wellbeing in older people in rural areas

## Methods

### Research Question 1

After consultation meetings with information resources specialists at ScHARR, University of Sheffield, a broad search strategy was devised to identify articles matching against a number of free text-words contained within article titles relating to rural health or against MeSH terms relating to ‘rural’, ‘remote’, ‘health’, ‘morbidity’ and mortality’ and related variants. The following databases were searched for the period 1990-2005 (January week 3): HMIC, AMED, Medline, CINAHL, Cochrane Library, DARE, EMBASE, PsycINFO, Social Service Abstracts, Sociological Abstracts, ASSIA, Web of Science and Proceedings at Web of Knowledge. From these databases 14,099 hits were retrieved. Searches of the Caredata database, the National Research Register and grey literature were also performed. The start date for the search strategy of 1990 was based upon the premise that health care and some approaches to health have changed considerably over the last ten to twenty years and evidence published in papers from the 1980’s would not necessarily be of relevance to today’s health services.

Articles were considered if (i) written in the English language, (ii) indicated a direct comparison of health in urban and rural environments. Non-systematic review and commentaries were not selected for inclusion. Articles relating solely to oral or dental health were not considered. Relevant cited references in all retrieved papers were identified and processed in turn. The final reference list was checked for any missing papers by members of the Steering Committee.

For relevance of application of any findings from this systematic review of the evidence to the UK, we restricted the evidence included to that from countries with a similar profile to that of the United Kingdom. Using gross national income (GNI) as a measure of development of a country, we included evidence only from those countries classified as developed on the basis of their having a high-income economy as measured by gross national income (GNI) per capita

(<http://www.worldbank.org/data/countryclass.classgroups.htm> May 2005).

We recognise that the evidence around health care and health services, rather than health conditions, from other countries, may not be directly applicable to the UK because of differences in health care systems. However, there should be no systematic differences in impact of rurality on health and ill health across different countries.

A number of papers were identified that reported on health and health service issues, such as gaps in service provision among rural residents, e.g. need for alcohol services for women in rural populations (Booth and McLaughlin 2000) but without an urban comparison, it was impossible to determine if such services were lacking in rural areas, or present but needed in greater capacity to serve those in rural areas etc. Similarly papers were identified that looked at specific occupations, such as farming (Syson-Nibbs, 2003) or the impact on health if living near main roads (Maheswaran & Elliott, 2003). However, if papers did not include comparative data from an urban population, or clearly defined both rural and urban groups, and where we could not detect if there was evidence of inequality or inequity in health or healthcare, they were excluded. Papers, such as Campbell *et al.* 2000, in which the authors looked at changes in health outcomes with respect to distance from a health care centre, have been included in this systematic review. Although it has not been clear in all instances that the greater distances and travel times are due to living in a rural location, rather than in an urban area with poor road systems. Similarly, in addressing the second research question, studies that covered all ages, but with no subgroup analyses on the elderly were excluded, even though they provided, for example, evidence of satisfaction with rural-based hospital services (Jones *et al.*, 2005).

Our research question was to determine if there was an impact of rurality upon health. We have interpreted this as focusing on the impact of rurality on those who reside in rural areas. We have not included those who visit the area on a short-term basis, for such as a holiday or driving on rural roads to travel from one urban residence, where they reside, to another. There is evidence that road traffic accidents, for example, vary with population density (Muelleman and Mueller 1996) but this is not always attributable to rurality of residence.

Full text versions of 470 potentially eligible references were sourced and scrutinised by two reviewers (RJ and JP) and 192 full papers were identified as relevant to address the research question.

A data extraction table was drawn up and used systematically by two reviewers (RJ and JP) to collate relevant information from the 192 eligible references in terms of location, definition of rurality used, number and characteristics of subjects, study design, outcomes, findings and additional comments relating to quality of study and implications of the research. The subject matter covered by the 192 references was broken down into a number of categories: mortality; general health; specific health conditions; population groups; behavioural factors; and trends over time. Some of these 192 references underwent multiple extractions as they provided evidence for more than one area of interest, such as a health condition and/or health service provision for that condition, and/or changes over time in that condition, resulting in 232 extractions in total. Results of 232 extractions are presented in the following tables and appendices. Nineteen further outstanding references, received after completion of this draft report, have been identified as suitable for inclusion and will be extracted at later date and included in future publications.

## **Research Question 2**

After consultation meetings with information resources specialists at ScHARR, University of Sheffield, broad search strategies were devised to identify articles matching against free text-words contained within article titles or against MeSH terms relating to 'rural', 'remote', 'old age', 'elderly', 'intervention' and variants. The following databases were searched for the period 1990-2005 (January week 3): HMIC, AMED, Medline, CINAHL, Cochrane Library, DARE, EMBASE, PsycINFO, Social Service Abstracts, Sociological Abstracts, ASSIA, Web of Science and Proceedings at Web of Knowledge. From these databases 4561 hits were retrieved. Searches of the Caredata database, the National Research Register and grey literature were also performed. The start date was selected as described for research question 1.

Additional searches were performed in the predominantly UK-focused HMIC and AMED databases using a number of British rural geographical location names

(including 'Highlands', 'islands', 'lake\$', 'peak\$', 'Pennine\$', 'dale\$' and 'downs') in order to identify any further interventions. Searches were also performed in Medline, Google Scholar and SCIRUS for any relevant rural randomised controlled trials based in rural regions of the United Kingdom.

References cited in retrieved articles were also scrutinised, and processed where relevant and the final reference list was checked for gaps by members of the Steering Committee.

Articles were considered if (i) written in the English language, (ii) if the research setting was located in the United Kingdom (iii) related to an intervention aimed at improving the physical and and/or mental health of older people in rural environments. The focus was on identifying interventions that could be implemented in rural areas to manage/improve the health and health care of the elderly rural population and evidence on the cost effectiveness of an intervention or on its mechanism for delivery was not specifically sought. Articles relating solely to oral or dental health were not considered.

An age cut-off to define the lower band for the 'elderly' was set at 50 years. This arbitrary value was selected as older age has a broad and variable definition, and people as young as 50 may be classed as entering old age (National Service Framework for Older People (Department of Health, 2001)).

Full text versions of 96 potentially eligible references were sourced and scrutinised by two reviewers (RJ and JP). The majority of these were subsequently excluded as they were not interventions, they did not relate to an elderly population, they were of day care rather than health care services, or they were not based within the UK.

A data extraction table was drawn up and used systematically by two reviewers (RJ and JP) to collate relevant information from nine eligible references in terms of location, definition of rurality used, number and characteristics of subjects, study design, outcomes, findings and additional comments relating to quality of study and implications of the research.

# Evidence

## Research Question 1

### Characteristics of data extracted

One hundred and ninety two papers were identified, in some instances providing information for more than one health topic, resulting in 232 extractions of relevant evidence to inform the research question on the impact of rurality on health. The health topics identified are those that were studied in the literature included in this review, because of its relevance to the research question. Of these 232, two were duplicate reports of the same study. We found no information, including costs, on why some interventions were conducted in the way they were, in either rural or urban areas.

The characteristics of data extracted in terms of country of origin and study design for the health topics identified are as follows:

Country of origin	Extractions (n=)
United Kingdom	44
Republic of Ireland	3
Other Europe	26
USA	116
Canada	11
Australia and New Zealand	29
Japan	3
<b>Total</b>	<b>232</b>

<b>Study design</b>	<b>Extractions (n=)</b>
Ecological	59
Cross-sectional	132
Case-control	1
Qualitative	5
Cohort	35
Randomised controlled trial	0
Systematic review	0
<b>Total</b>	<b>232</b>

The health topics for which evidence is available are as follows:

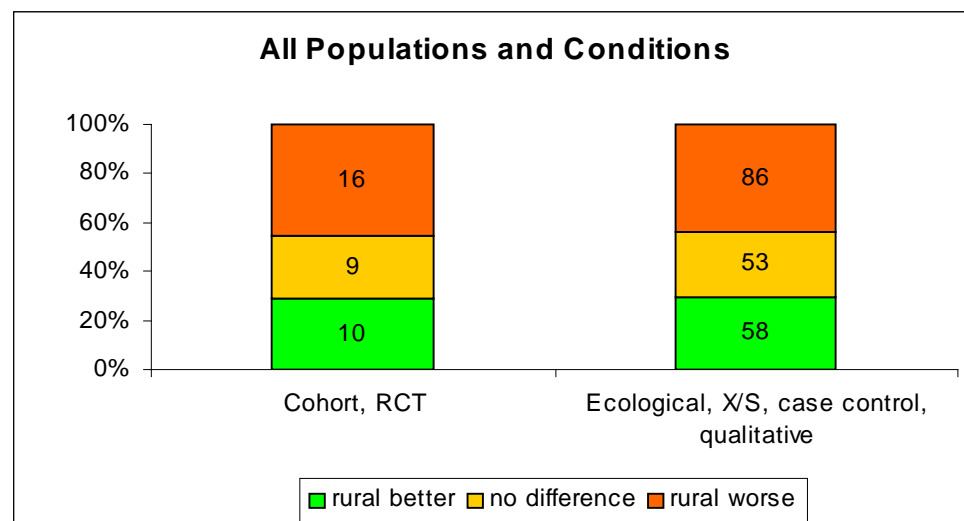
<b>Health topic</b>		<b>Extractions (n=)</b>
General Morbidity	Physical Health	15
	Mental Health	26
Health Conditions	Cancer	16
	Cardiovascular Conditions	11
	Cerebrovascular and Neurological Conditions	5
	Musculoskeletal Conditions	5
	Respiratory Conditions	6
	Diabetes	4
	Gastrointestinal Conditions	1
	Visual Problems	4
	Populations	Paediatrics
Elderly		28
Behaviours	Infection and Immunity	3
	Sexual Health	3
	Lifestyle	15
	Accidents and Violence	3
	Suicide	15
Mortality		21
Longitudinal Trends		13
Health Services Access and Utilisation		28
<b>Total</b>		<b>232</b>

## Findings

Fifty percent of the 232 identified published items of evidence comes from USA-based studies and 84 percent of the evidence is based on studies that are of a cross-sectional design, many of which have involved the analysis of routine data sets. A range of health problems has been studied, but one third of the total literature is dominated by studies of mortality, mental health, and the elderly, with another 12 percent reporting on health care services. There are also gaps in the evidence base, with no studies on, for example, renal conditions, hearing problems, and few on children and adolescents.

The findings from this systematic review of the evidence can be summarised in the following graph. This illustrates the number and percentage of papers that report more favourable health and health service outcomes in rural areas, those that find in favour of urban areas, and those that report no differences between rural and urban populations for a given health outcome. The graph also illustrates the source of the evidence in terms of the study design used, broken down into the two categories of study that can show or not show a causal pathway: cohort or randomised trial versus cross-sectional, case-control, ecological, or qualitative.

**Figure 1:** Health benefit by area of residence and study design: all studies



The graph illustrates the dominance of ecological and cross-sectional studies (there was only one case-control study and very few qualitative) in the literature. It also illustrates the equivalence of the evidence, across both types of study design, although

there is a non-significant trend, that for a given health outcome, that outcome is less favourable for those living in rural compared with those in urban areas.

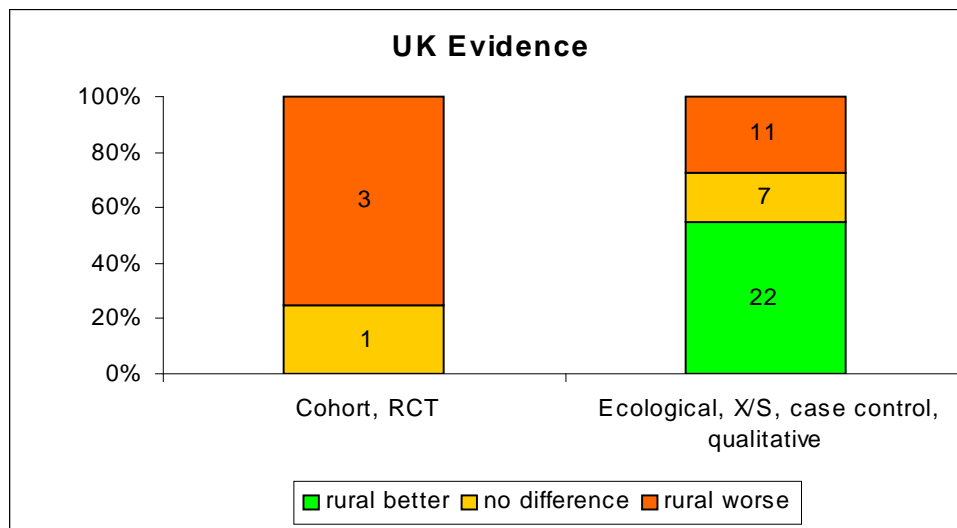
### **Studies based in the UK**

Studies based in the UK have focussed mainly on analyses of routinely collected data, such as the 1991 census data with respect to limiting long term illness and mortality, the National Survey of Psychiatric Morbidity for prevalence of psychiatric morbidity, and Cancer and death registry data. A few studies have focussed on specific health issues and health services such as self-rated health and lifestyle factors (1), diabetic retinopathy (1) and use of family planning (1) and asthma (2) services or total services provided (2). One study only used a postal questionnaire survey to collect primary data on the prevalence and severity of hip pain and disability, in south west England.

The studies ranged geographically from those across the whole of Great Britain (5 studies), England and/or Wales (13), or Scotland (6) to those in specific geographical areas or towns (14) and they focussed on health status (29) or health services (11). The four cohort studies, three of which identify urban areas as more favourable to health, used Cancer registry data and patient case notes to study either cancer patient survival rates (3) or outcome in those with psychiatric morbidity (1).

The graph below illustrates the evidence base for the UK with respect to studies looking at health outcomes in rural versus urban populations. Studies are predominantly cross-sectional in design and the evidence of benefit on health by area of residence is mixed, with the very few cohort studies suggesting that rural health is poorer, but with the converse finding from the cross-sectional evidence.

**Figure 2:** Health benefit by area of residence and study design: UK-based studies



### **Evidence from cohort studies**

Thirty cohort studies were identified providing 38 health-related pieces of evidence. The majority of these cohort studies were based in the USA (14 studies), with four from Australia, three each from the UK and Denmark, two from Sweden and one each from Switzerland, Portugal, France and Germany. The research questions addressed split into 18 covering health topics, six of these pertaining to cancer, and 14 on health care services, with some papers providing evidence both on the health condition and on provision and use of health care services for it. Three studies looked at children (aged 10-24 overall) and mental health (schizophrenia) or suicide, whilst the rest of the studies involved adults, although ages covered were not stated for 18 studies.

Overall, the evidence from the cohort studies (see Figure 1) suggests that populations living in rural areas have worse health outcomes and use and access to health care services.

### **Studies with potential rural dose-response model**

Instead of using a dichotomous definition to denote area of residence as ‘rural’ versus ‘urban’, however each were defined, a number of the studies have used a graded definition, with several categories from remote through rural, villages, towns to large cities. In some instances a U-shaped curve was reported with respect to health outcomes, in which health outcomes were more favourable in e.g. rural areas compared with remote and urban, or more favourable in semi-rural compared with

rural and urban. More work needs to be done looking at this dose response, but only after unpicking the rurality definitions further.

### Studies with adjustment for confounders

Fifty-six studies provided evidence of health outcomes in rural compared with urban populations after adjustment for potential confounders in addition to age and sex. Only 11 of these studies were of a cohort design. Papers from the USA (26 studies) were the predominant source of literature, with 13 from the UK, four each from Canada and Australia, two from Denmark and from Sweden, and one each from Switzerland, France, Holland, Italy and New Zealand. The number of papers covering health topics versus health care services have an approximate 2:1 distribution.

**Figure 3:** Health benefit by area of residence and study design: modelled data

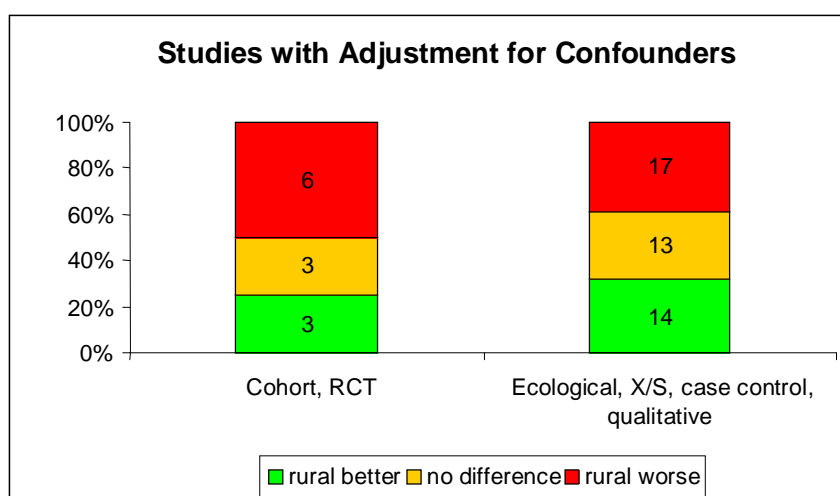


Figure 3 illustrates the health outcomes in studies where adjustment has been made for a range of potential confounders. There was no consistency in the modelling and choice of confounders across studies. The graph emphasises the lack of cohort studies and the general equivalence of the findings across both study types, with a slightly higher proportion of studies resulting in a less favourable health outcome for those living in rural areas, after adjustment.

## **Summary findings for individual health topics**

### **Morbidity**

#### **Physical health**

Fifteen papers were identified that address a range of issues around health in general, such as non-disease specific morbidity, limiting long term illness, and health-related quality of life. Eight studies were located in the UK, six in the USA and the other three in Holland (2) and Sweden. All the studies used a cross-sectional design and most analysed census or other routinely collected data. With two exceptions (Leeflang *et al.* 1992, Logan *et al.* 2003), all the study populations reported were large (>1000).

In a cross-sectional survey of metropolitan and non-metropolitan residents aged 19 to 64 in the United States a mixed picture emerged, with some health issues being worse in urban areas, some worse in rural, whilst for others there were no differences by location, after adjustment for confounders (Eggebeen & Lichter (1993). Barnett *et al.* (2002) and Leeflang *et al.*, 1992 did not find differences in health by rurality. Lower standardised illness ratios (SIRs) were reported for rural areas (Haynes and Gale 2000, Levin 2003) but Shouls *et al.*, (1996) identified a U-shaped curve with semi-rural having lower SIRs than either rural or urban residents. A similar U-shaped curve was identified for limiting long-term illness (Barnett *et al.*, 2001), with lowest levels in rural populations and higher levels in both urban and remote areas of England.

From a telephone survey in Kentucky, USA, Mainous & Kohrs (1995) identified few rural/urban differences in self-reported health although urban (metropolitan) residents had significantly higher levels of social functioning, mental health and health perception. For those aged 65 and over, health status and functioning were poorer in the rural elderly compared with those in urban areas. However another study in Kentucky, USA, found that rural women self-rated their health as worse and experienced more health complaints (Logan *et al.*, 2003). Chronic illness also appears to impact differently on rural versus urban elderly residents with those in urban areas being less likely to report problems (Goins & Mitchell 1999). For rural USA veterans, self-reported health-related quality of life was lower, and they had more physical but less mental comorbidity than urban and suburban veterans, after adjustment for socio-economic factors (Weeks *et al.*, 2004).

Samuelsson *et al.* (1993), after adjustment for potential confounders, observed fewer cases of urinary tract infection in rural females and less jaundice among rural males. The authors did not spot any differences in life expectancy in terms of survival rates between urban and rural populations after adjustment for potential confounders.

Whilst Huff *et al.*, (1999) found a similar association between deprivation and health in both rural and urban areas of Trent region, England, Haynes and Gale (1999) found better health in rural areas than would be anticipated from the levels of deprivation present although the relationship was weak.

### **Mental health**

Twenty-six studies were identified that reported on the prevalence of mental health conditions and use of mental health services and of these only seven used a cohort design, the rest being cross-sectional, with most comprising large sample sizes as they involved analyses of data from national surveys. Two studies had duplicate publications. Six studies were based in the UK, 12 in the USA, three in Australia, two in Canada, and one each in Italy, Denmark and New Zealand. Age ranges, where stated, covered from 15 to 92 years.

Within the general population, compared with urban, rural residents were reported to have a lower prevalence of neurotic disorder (Jenkins *et al.* 1997), psychiatric morbidity (Paykel *et al.* 2000), levels of depression (Hoyt *et al.* 1997, Walters *et al.* 2004), common mental disorders (Weich *et al.* 2003), diagnosis or risk of schizophrenia (Dottl & Greenley 1997, Mortensen *et al.* 1999), lower prevalence of negative affect (Jonas and Wilson, 1997) and lower rates of GP encounters for psychological problems (Britt *et al.* 2001, Caldwell *et al.* 2004). Conversely there were more psychiatric admitting commitments in rural areas (Bachman *et al.* 1996) and in those with dementia in nursing facilities, rural residents had longer stays but lower mortality rates (Bolda & Mooney-Murray 2001).

In five studies, no conclusive evidence of an association with place of residence was found for psychiatric morbidity (Roman-Clarkson *et al.* 1990, Blazer *et al.* 1994), Alzheimer's disease (Bédard *et al.* 2004), prevalence of psychological distress,

clinical depression and self-reported mental health (Eckert *et al.* 2004), or mood disorders (Parikh *et al.* 1996).

With respect to health service use in those with mental health problems, rural residents in Nottinghamshire, UK, with primary psychiatric disturbance were at a disadvantage with less psychiatric contacts, less likely to be admitted to either a psychiatric hospital or as day patients, less likely to receive psychotropic drugs, they make less use of other psychiatric teams and have fewer outpatient appointments, compared with their urban counterparts (Seivewright *et al.* 1991). Similarly, those with mental health problems in urban Cambridgeshire, UK, had more day care service provision (Smith & Ramana 1998) and in non-metropolitan USA made fewer mental health visits (Pettersen 2003.) Higher rates of service use for schizophrenia were reported in urban Italy (Thornicoff *et al.* 1993) and the USA (Fischer *et al.* 1996). Patients with bipolar disorder were more at risk of receiving services exclusively from a general medical provider and using hospital or emergency room services rather than best care if they lived in a rural area in the USA (Rost *et al.* 1998b), although the sample size was small and the confidence intervals very wide.

Some studies found no urban/rural variation in rate, quality or type of outpatient treatment for depression (Rost *et al.* 1998a).

Perceptions of mental health and potential stigmatisation of those with a mental health problem differed between rural and urban residents. For example, students raised in rural areas viewed depressive behaviour as less healthy (Chimonides & Frank 1998) whilst higher levels of stigma were attached to seeking help from a professional (Rost *et al.* 1993).

## **Health conditions**

### **Cancer**

Sixteen primary research studies were identified that looked at both rural and urban populations with respect to seven named cancers, but with most papers focusing on either colorectal or breast cancer. Four studies were based in Scotland, six in the USA, and two each from Denmark, France, and Australia. Nine of the studies reported on retrospective or prospective cohorts.

The evidence of any rural urban relationship with cancer is unclear. The main message identified, from several of the papers, is that the greater the distance lived away from health care provision, by an individual who develops a cancer, the less likely it is that their cancer will be diagnosed before death (Campbell *et al.*, 2000) and the greater their risk of metastases (Campbell *et al.* 2001). However once a cancer was suspected, distance was not related to time from referral to treatment (Campbell *et al.* 2002, Dejardin *et al.* 2004). Rural residents had a higher risk for some cancers, e.g. breast (Witt Prehn & West, 1998) and rural patients had poorer survival rates for some if not all cancers (Launoy *et al.*, 1992, Campbell *et al.*, 2001, Wilkinson & Cameron 2004), and cancer at a more advanced stage on presentation (Liff *et al.*, 1991, Campbell *et al.*, 2001) or diagnosis (Launoy *et al.*, 1992). Rural patients also have more extensive treatment (Meden *et al.*, 2002, for breast cancer) even though remoteness and rurality do not appear to cause delays in treatment once referral is made (Campbell *et al.*, 2002).

Converse evidence from Denmark suggests that there are no excess rates for lung cancer in rural areas, after adjustment for smoking and occupation (Engholm *et al.* 1996) but possibly higher rates in rural areas for all site cancers and particularly for respiratory, urinary, and buccal cavity/pharyngeal cancers (Friis & Storm 1993) and for cervical cancer (O'Brien *et al.* 2000). Similarly, using cancer registry data, Wilkinson & Cameron (2004) reported that the annual age-standardised incidence of all forms of cancer in Australian rural residents was approximately four percent lower than that found in urban residents. They found a variation in prevalence of different cancers by place of residence (urban versus rural) with three cancer types (buccal cavity, lip and pharyngeal) all higher in rural areas but another eight types with a higher prevalence in urban populations, and no differences for a further twenty.

Views and experiences of cancer were found to be similar in rural and urban patients (Lyons, 2004) with speed of referral and issues of communication being considered important by both groups although rural patients had lower expectations of care and more barriers to receiving specialist care (Bain & Campbell 2000). Such factors might contribute to the differences in health outcomes reported in the studies above. Rurality and distance were not found to be linked with any delay in treatment in France

(Dejardin *et al.*, 2004) or with access to state-of-the-art equipment (Howe *et al.*, 1992) although Launoy *et al.*, found that rural residents were less likely to receive treatment in specialist centres. Ethnicity may also be a factor in health care. Duelberg (1992) found no differences by place of residence for rates of cervical cancer screening for white women although for black residents, urban women were more likely to be screened compared with rural counterparts.

### **Cardiovascular conditions**

Eleven studies were identified that considered cardiovascular issues in rural and urban residents. None of the studies were located in the UK, six were from the USA, and one each from Sweden, Norway, Germany, Canada and Australia and only two used a cohort design. Fahs *et al.*, (2002) found no differences between rural and urban women for cardiovascular risk factors, with the exception of systolic blood pressure, which was found to be higher in rural women, although no adjustments were made for the significantly higher mean age of the rural women. Obisesan *et al.*, (2000), on the other hand, found no differences overall in prevalence of hypertension in metropolitan and non-metropolitan black women, black men, or white women aged 40-79, or in white men aged 40-59. Earlier onset of coronary heart disease was seen in white women aged 35-74 living in metropolitan versus non-metropolitan areas in the USA with higher levels of income, education and occupational status in the same areas (Wing *et al.*, 1992).

Mortality rates for heart disease were found to be higher in Australian non-metropolitan (Vu *et al.*, 2000) and USA non-metropolitan/rural Southern areas (Eberhardt *et al.*, 2001) and Appalachia (USA). This was especially true for specific ethnic populations, such as African Americans of all ages and younger whites (Barnett *et al.*, 2000), although in the Northeast, the reverse was found, with lower rates in non-metropolitan areas (Eberhardt *et al.*, 2001). Krüger *et al.* (1995) also found higher rates of ischaemic heart disease in urban areas of Norway compared with rural, as did Messner & Lundberg (2004) in Sweden for myocardial infarction. Conversely, after adjustment for confounders, Jin *et al.* (2003) found no differences in mortality rates for congestive heart failure in a Canadian population and Taubert *et al.*, (2001) found no differences in one year all cause mortality from heart failure, even though their German urban patients had significantly more co-morbidities on presentation.

Hospital admission rates for congestive heart failure were lower for metropolitan (urban) residents but there were no differences in length of hospital stay even though rural patients had lower co-morbidity scores (Jin *et al.*, 2003). Poorer quality inpatient hospital care was observed for patients with a myocardial infarction in North American rural hospitals (Sheikh & Bullock 2001), whilst an urban heart centre had significantly higher prescribing rates for ACE inhibitors,  $\beta$  blockers, and digitalis, for patients with heart failure compared with a rural community hospital (Taubert *et al.* 2001).

### **Cerebrovascular and neurological conditions**

Of the five papers identified on this health area, two papers focused on rural – urban factors and stroke. No differences were found in life prevalence of stroke between rural and urban residents aged 65 and older in Spain (Bermejo *et al.*, 1997). However, annual incidence of stroke, in the cohort study by Correia *et al.* (2004) in Portugal, was higher in rural men and women compared with their urban counterparts.

A further three papers, all cross-sectional in design, reported on multiple sclerosis in the USA (Stuifbergen 1999), cerebrovascular disease in Canada (Yiannakoulias *et al.*, 2004) and traumatic brain injuries in the USA (Gabella *et al.*, 1997). For all of these three problems, living in a rural area was less favourable to health outcome.

### **Musculoskeletal conditions**

Five studies addressed rural urban differences in musculoskeletal conditions. Two of these were based in the USA (Madhok *et al.* 1993, Melton *et al.* 1999), one in Canada (Payne *et al.* 2003), one in Finland (Lüthje *et al.* 1995) and one in the UK (Eachus *et al.* 1999). Two involved older populations, over 54 years of age (Lüthje *et al.* 1995) or 65 years or over (Payne *et al.*, 2003) whilst in the other three studies, subjects were aged 35 and over. All five studies were cross-sectional in design.

Two papers, taken from the same survey of patient medical records in the United States, report on fractures and issues of rurality (Madhok *et al.*, 1993, Melton *et al.*, 1999). Both sets of authors found that fracture rates were significantly higher in urban areas compared with rural, specifically for fractures of the proximal femur (Madhok *et*

*al.*, 1993), and foot and toe (Melton *et al.*, 1999). However Lütthje *et al.* found no difference in the number of new hip fractures during 1989 and Eachus *et al.* found no difference in disease severity and hip pain after adjustment for age and sex, between rural and urban residents. Payne *et al.*, (2003) also found no difference in the prevalence of falls in rural versus urban elderly residents in Ontario, Canada.

### **Respiratory conditions**

Six studies, all using a cross-sectional design, were identified in which researchers examined the relationship between respiratory health and rural/urban residence. The studies addressed respiratory health in general (Britt *et al.* 2001), asthma (Jones & Bentham 1997, Jones *et al.* 1999, Tong & Drake 1999) and chronic obstructive pulmonary disease (COPD) (Labuhn *et al.* 1993, Eberhardt *et al.* 2001). Sample sizes were relatively large in most cases as data came from national datasets.

Hospital admissions for asthma and asthma mortality rates were higher in residents in rural areas (Tong and Drake, 1999) and mortality increased with travel time and distance to hospital after adjusting for confounding variables (Jones *et al.* 1999, Jones and Bentham 1997). For COPD, death rates were higher in non-metropolitan counties in the USA (Eberhardt *et al.* 2001). However, for general respiratory conditions, Britt *et al.* (2001) found a higher relative rate of patient reasons in urban areas for consulting their GP for this condition.

Labuhn *et al.* looked at smoking cessation attempts in COPD patients by place of residence and reported that rural patients, whilst not differing from urban with respect to demographic, health and smoking status, used fewer cessation methods and had fewer levels of social support to aid their cessation attempts.

### **Gastrointestinal conditions**

One study only, based in Australia, was identified that considered gastrointestinal problems with respect to rurality (Britt *et al.*, 2001). Doctor consultations in this cross-sectional survey were higher for those living in urban areas, with no differences between rural and urban residents for lifestyle factors such as smoking, and other health issues, such as self reported health status and obesity.

### **Visual problems**

Four studies, all based in Australia, were identified that looked at rural versus urban differences in various eye problems: cataract (McCarty *et al.*, 1999a), pterygium (McCarty *et al.*, 2000), diabetic retinopathy (McKay *et al.*, 2000), and ocular trauma (McCarty *et al.*, 1999b). McCarty *et al.* (1999a) found no differences in the age-standardised prevalence of cataract in the Australian populations they studied but rural residence was an independent risk factor for pterygium (McCarty *et al.*, 2000) and eye injury was more common in rural than suburban males (McCarty *et al.*, 1999b). Prevalence of diabetic retinopathy was similar in rural and urban Australian residents (McKay *et al.*, 2000).

### **Populations**

#### **Paediatrics**

Of the ten studies that relate to children, eight focussed predominantly on the time around birth, with the other two covering specific health care needs (Saywell *et al.* 1993) and firearm-related deaths (Svenson *et al.* 1996). Three studies were located in the UK (Charlton 1996, Dickinson *et al.* 2002, Reading *et al.* 1993), whilst the rest were based in the USA. All were cross-sectional in design with the majority reporting on analyses of national routinely collected data.

With respect to the newborn, four studies found better outcomes in rural areas, with lower rates for birthweight (Charlton, 1996), stillbirths (Dickinson *et al.*), neonatal deaths (Baldwin *et al.* 2002), and low birth weight (Reading *et al.*, 1993). In four studies based in the USA, Alexy *et al.* (1997), Larson *et al.* (1997) and Clarke & Coward (1991), found that residence was not associated with low birth weight or neonatal mortality whilst Eberhardt *et al.* (2001) found higher infant mortality rates in the more rural (non-metropolitan) areas.

With respect to health during childhood, asthma was more prevalent in urban children, whilst cleft lip, epilepsy and heart defects were more common in rural (Saywell *et al.* 1993), as were risk of firearm deaths (Svenson *et al.* 1996).

#### **Elderly**

Twenty-eight studies looked at differences in health and use of, or access to, health services by older residents in rural compared with urban areas. One study only was

located in the UK, all the rest were located in the USA, apart from three, one each in Finland, Portugal and Switzerland. The definition of elderly embraced those aged 55 or above (2 studies), aged 62 and over (1 study), aged 65 and over (4 studies), aged 69 and over (5 studies), over 70 (1 study), over 72 (1 study), over 100 (1 study) whilst the rest quoted a mean age ranging between 69 and 73 years.

No differences were found between rural and elderly residents for self-reported health (Clark & Dellasega 1998, Payne *et al.*, 2003), lifestyle practices (Speake *et al.*, 1991), health status Gillanders *et al.*, 1996), physical health after adjustment for demographic factors (Morgan *et al.*, 2000), falls (Payne *et al.*, 2003), incontinence (Buettner & Langrish 1999) or prescribed drug use (Lago *et al.*, 1993). However Gale (1993) found rural women had better psychosocial health. Chevalley *et al.*, (2002) found a lower incidence (adjusted for age, gender, urban/rural status, institutionalisation) of hip fracture in rural residents whilst Lüthje *et al.*, (1995) found no differences in hip fractures in their slightly younger population aged 54 years and over compared with 65 years and over. For elderly residents with dementia in nursing facilities, rural residents were found to have lower levels of cognitive impairment and less behaviour and mood problems yet to be more socially and physically active in routine activities but with no adjustment for any differences in physical impairment (Bolda & Mooney Murray 2001).

With respect to health care service access and use, the evidence is mixed. Influenza vaccination uptake was higher (Zimmerman *et al.*, 2003) and diabetes patients were more likely to receive services (Rosenblatt *et al.*, 2001) if living in a rural area. Further, urban residents had longer hospital stays (Schultz 1997) and higher levels of stress and greater use of community services (Gale 1993). In their study, Dansky *et al.*, (1998) found higher rates of inpatient use among urban residents but higher rates of home health care among rural residents whilst Saag *et al.* (1998) found no effect of urban/rural status on seeing a physician for arthritis care. Clark & Dellasega (1998) reported that whilst the objective health of their rural residents studied was poorer they did not use any more services. After hospital discharge, rural patients were found to have more skilled care needs but urban area families were meeting more of the functional needs than rural families (Schultz 1997). Rural dwellers with one or more memory or activities in daily living impairments were less likely to use primary care

physicians, for their memory disorders (Chumbler *et al.*, 2001). Finally, no association was found between rurality and use of health care services by McConnel & Zetzman (1993), after adjustment for need.

In terms of activities of daily living, Duncan *et al.* (1997) found greater impairment in urban dwellers. Conversely, in a small group of centenarians, Clayton *et al.* (1994) found higher levels of health (activities of daily living) in 66 urban residents whilst 18 rural contemporaries had higher levels of morale and degree of independence. There were no differences between the two groups for physical or mental health.

Standardised death rates for those aged 65 and over are higher (Eberhardt *et al.*, 2001) and motor vehicle crash fatalities higher in the elderly (Clark 2001) in rural areas. Although it is unclear whether the elderly crash fatalities are of residents in rural areas or if this was just the location at which the fatality occurred. However for residents with dementia in nursing facilities, mortality rates are lower in rural residents (Bolda & Mooney Murray 2001). Abuse - physical, emotional and deprivation, has been reported by more rural patients whilst for urban, passive neglect is more of an issue (Dimah & Dimah 2003).

Some of the differences seen in health and use of health services between rural and urban residents may be accounted for in terms of attitude, with rural residents having more positive views on ageing (Paúl *et al.*, 2003). Other factors such as ethnicity may also be contributing factors (Dwyer and Miller 1990). For rural residents, but not urban, living alone and life satisfaction predict social isolation and loneliness (Havens *et al.*, 1996). Elderly rural residents in England were found to eat more fresh fruit and green vegetables than their urban counterparts although levels of exercise were similar (Morgan *et al.*, 2000).

## **Behaviours**

### **Infection and Immunity**

Three studies were identified, based in the Republic of Ireland (Taylor *et al.* 1997), the USA (Heckman *et al.* 1998) and Australia (Windsor *et al.* 2005), that looked at rural urban differences in a diverse range of conditions and patients: HIV patients (Heckman *et al.*, 1998), prevalence of toxoplasma antibodies in children (Taylor *et*

*al.*, 1997) and prevalence of *Helicobacter pylori* infection in all ages (Windsor *et al.*, 2005). Prevalence of toxoplasma antibodies and *Helicobacter pylori* were both higher in rural areas. For HIV patients, rural residents were more likely to report having to travel long distances to access care, transport problems, a shortage of professionals trained in health care, and stigma.

### **Sexual Health**

Three studies only were found, one each in England, Australia and the USA, that addressed family planning services and pregnancy (Allaby, 1993, Britt *et al.* 2001) and obstetrics (Hart *et al.* 1996).

English rural teenagers were less likely, compared with their urban counterparts, to use NHS family planning facilities (Allaby, 1993), whilst rates for GP consultations for pregnancy and family planning in a large sample of Australian residents, ages unstated, were higher in small rural areas (Britt *et al.*, 2001). Rural physicians in the USA used fewer resources in their care of low-risk non-referred pregnant patients (Hart *et al.*, 1996).

### **Lifestyle**

Fifteen studies were identified, all of which, except three were based in the USA, two focussed on high school students, the rest on adults, and all were cross-sectional in design.

Studies have reported on cigarette smoking, alcohol and other drug consumption, and physical activity levels in rural versus urban locations. Other studies have looked at levels of obesity by location of residence. Only one study addressed preventive behaviour and that was in terms of stages of readiness to adopt physical activity, with rural residents being closest, although that does not necessarily mean they will execute any action any earlier (Potvin *et al.*, 1997).

Some studies found no overall differences in lifestyle practices between rural and urban residents; for the elderly (Speake *et al.*, 1991) or students (Cronk & Sarvela 1997); or for specific practices such as smoking (Johnson *et al.*, 1995), smoking in

COPD patients (Labuhn *et al.*, 1993), alcohol consumption (Eberhardt *et al.*, 2001), or obesity-linked attempts to lose weight (Reeder *et al.* 1997).

In other studies, rural urban differences were apparent, with prevalence or risk of smoking higher in rural adolescents (Eberhardt *et al.*, 2001) rural student (Atav and Spender 2002), rural adults (Eberhardt *et al.*, 2001) but urban black women (Duelberg 1992).

The risk of American rural students drinking alcohol was found to be higher (Atav & Spender 2002) but Johnson *et al.*, (1995) found that rural Canadian residents of all ages drank less alcohol, than their urban counterparts. With respect to treatment for at-risk drinkers, rural residents had an increased likelihood of receiving treatment than urban residents, from a general medical provider (Rost *et al.*, 2000).

Rural residents were found to be more sedentary, have more personal barriers to doing physical activity and a greater caregiving role than urban residents (Wilcox *et al.*, 2000). They did less physical activity (Eberhardt *et al.*, 2001) and were therefore less likely to meet the recommended levels of physical activity (Parks *et al.*, 2003). Lack of activity, and to a lesser extent, an excess intake of calories, is leading to an increased prevalence of obesity nationally and internationally. Eberhardt *et al.*, and Ramsey and Glenn, (2002) found higher levels of overweight and obesity in rural residents with differences by ethnicity (Sobal *et al.*, 1996). Rural white women and men and rural black men were all more likely to be extremely overweight.

Some of the differences seen in lifestyle behaviours are likely to be a consequence of local social cultural mores. High school students in rural areas were more accepting of alcohol abuse behaviour and less accepting of excessive spending behaviours and they viewed depressive behaviours as less healthy (Chimonides & Frank 1998).

### **Accidents and violence**

Three studies only were identified that had looked at variation in motor vehicle crashes and homicides in rural and urban areas, and all were located in the USA and based on analysis of routine data. Mortality rates from motor vehicle crashes are higher in rural compared with urban USA (Brown *et al.*, 2000) particularly for the

elderly (Clark 2001). Conversely firearm homicide rates in rural areas are about one fifth the number seen in urban (6.5 versus 33.5 per 100,000) and non-firearm homicides about half (2.1 versus 4.7 per 100,000) (Fingerhut *et al.*, 1998).

### **Suicide**

Fifteen papers were identified, four each from the UK and USA, five from Australia and one from each of Norway and Italy. All but two reported on cross-sectional studies, with most carrying out secondary analysis of census data and covering all ages or aged 15 and over. Six studies addressed specific age ranges; 10-19 (Dudley *et al.* 1998a), 15-24 (Dudley *et al.* 1998b, Mehlum *et al.* 1999), 15-34 (Wilkinson & Gunnell 2000), 15-44 (Middleton *et al.* 2003), and 16-64 (Charlton 1995).

For suicide, there is probably the clearest evidence that rates in rural areas, for both sexes, irrespective of country, are worse than those in urban areas (Charlton 1995, Dudley *et al.* 1998a,b, Saunderson *et al.* 1998, Singh & Siahpush 2002, Middleton *et al.* 2003). Kelly *et al.* (1995), Eberhardt *et al.* (2001) and Caldwell *et al.* (2004) had similar results in their studies of males only. Use of firearms for the act of committing suicide was higher in rural areas (Branas *et al.* 2004) and farmers were one of the occupations at most risk of suicide and likely to use firearms (Kelly *et al.* 1995).

Four studies only varied in their findings of higher risk of suicide in rural residents. In Italy, Micciolo *et al.* (1991) found that suicide rates were higher in urban males and females, whilst for Morrell *et al.* (1999), rates varied with migrant status, with no differences with respect to rurality for Australian born males and migrant females, but higher rates in rural areas for migrant males. Also in Australia, whilst rates were higher in rural areas for 15-24 year old males, for 25-34 year old males and 15-34 year old females, no differences by residence were reported (Wilkinson & Gunnell 2000). Suicide rates by area of residence did not vary between Norwegian young adults (15-24 years) (Mehlum *et al.* 1999).

Albers & Evans (1994) looked at suicide ideation, which is somewhat different from the event itself, and found no differences between rural and urban adolescents overall, although there was some variation with residence by year of schooling and ethnicity.

## **Mortality**

Twenty one papers have been published on mortality rates in rural compared with urban areas, predominantly using census and other routine national data sets, and with two only using a cohort study design. Ten of the papers cover the UK whilst of the others, single studies were based in the Republic of Ireland, Spain, and Sweden, six in the USA and two in Australia.

Overall, standardised mortality rates were found to be lower in rural compared with urban areas in England and Wales (Charlton 1996, Shouls *et al.* 1996, Huff *et al.* 1999, Haynes & Gale 1999, 2000, Senior 2000) and the USA (after adjustment for confounders – Smith *et al.* 1995, Glenn & Jijon 1999, House *et al.* 2000). However other authors have reported higher rates in rural areas in the USA (all cause mortality – Eberhardt *et al.* 2001, premature mortality - Mansfield *et al.* 1999), all cause mortality in Australia (Trickett *et al.* 1997) and motor vehicle deaths (Brown *et al.* 2000). Wilkinson *et al.* (2001) found a small positive significant correlation between mortality with remoteness in Australia, but indigenous status was more strongly correlated with mortality. Possible explanatory factors for higher rural mortality in the USA include fewer physicians per population, lower welfare spending and the head of the household being female (Mansfield *et al.* 1999).

With respect to mortality attributable to specific conditions and causes, Stiernstrom *et al.* (2001) found no differences in mortality rates in Sweden for various conditions and causes between farmers, age-sex matched to rural non-farmers and urban residents and Lawler (2002) found no difference in winter mortality by population density in the UK. Barnett *et al.* also found no differences in annual mortality rates for south west England between urban, fringe and rural areas. In three other studies, from a range of health conditions studied, mortality rates were lower in rural areas for some conditions and in urban areas for others (Law & Morris 1998, Morales Suarez-Varela 1995, Boland *et al.* 2005).

Phillimore & Reading (1992), on examining the relationship between deprivation, rurality and mortality, found greater variation in standardised mortality rates between the most and least deprived urban wards compared with rural. An additional study also reported widest inequalities in premature mortality in cities in Wales and SMRs

in Northern England respectively and least in rural areas, and with the differences reducing after controlling for deprivation (Senior *et al.*, 2000).

### **Longitudinal trends**

Thirteen studies were identified, based in England and Wales (1), Sweden (1), Norway (2), Canada (1), USA (6), Japan (1), and Australia (1), addressing adolescent and student populations (Cronk & Sarvela 1997, Fingerhut *et al.* 1998, Dudley *et al.* 1998, Mehlum *et al.* 1999) and adults. The health areas examined include mortality, homicide and suicide (7 studies), lifestyle practices (1), heart disease (3), other health outcomes (1) and access to, and use of, health care resources (1).

In general, mortality rates and prevalence of specific ill-health conditions have declined over time, but outcomes in rural areas are poorer relative to urban areas. Suicide rates for young people have increased in rural regions (Singh & Siahpush 2002), whilst decreasing (Middleton *et al.* 2003) or remaining unchanged (Mehlum *et al.* 1999) in urban areas. Deaths from ischaemic heart disease and sudden death of unknown cause were higher in Norway in urban compared with rural regions by 31 percent and 28 percent respectively between 1966 and 1971. Over the next twenty years both conditions declined in both areas and both sexes, but with the rate of decline greater in urban areas, so by 1986-1989 both were approximately eight percent higher in rural compared with urban areas (Krüger *et al.*, 1995). Coronary heart disease mortality rates declined in the USA in both rural and urban areas, with earlier onset of decline in urban areas (1962-1978, Wing *et al.* 1992) and rate of decline higher in urban areas, thus narrowing the gap between rural and urban rates (1980-1997, Barnett *et al.*, 2000). Whilst reductions over time have been reported in numbers of deaths from motor vehicle accidents in the USA, rural rates have remained higher than urban (Brown *et al.*, 2000). One paper only reported better health outcomes for rural areas over time (Fukuda *et al.*, 2004). Fukuda and colleagues found that, in Japan, SMRs had increased between quintiles in urban areas over time (1973-1998), whilst they had decreased in rural regions in the same time period.

Not all death rates have consistently declined over time. Average annual firearm homicide rates increased between 1987 and 1991 in the USA in all geographical

areas, but with double the increase rate (19.8% versus 10.7%) in fringe (suburban) compared with small counties (semi rural) areas. Between 1993 and 1995, rates declined with lower rates of decline in the suburban areas. Non-firearm homicide rates showed the largest decrease between 1987 and 1990 in the urban areas (Fingerhut *et al.*, 1998). A similar trend was seen with suicide rates, which have increased in young males over time but differentially in urban and rural areas, resulting in the higher rates seen in urban areas in 1964 being replaced by higher rates in rural males by 1993 (Dudley *et al.*, 1998b).

Other authors have been reported on changes in health with changes in the social conditions of rural and urban areas. After adjustment for confounders, Diderichsen & Janlert (1992) found that mental, cardiopulmonary and pain symptoms were all higher in those born in a rural area of Sweden about 60 years ago, even though the rural area had changed in employment prospects from farmer to blue collar occupations over time. The urban area studied had also changed its occupational profile from working class to salaried. Social behaviours have also changed over time, with rates for rural students for smoking, alcohol consumption and other drug taking behaviour increasing over time to become similar to that of urban students by 1992 (Cronk & Sarvela 1997).

Changes have occurred over time in access to services. Fakhoury & Roos (1996) reported a greater increase between 1986 and 1991 in access to ambulatory care services in urban areas compared with rural, a similar increase in access to psychiatrists, a reduction in rural access to paediatricians whilst in urban areas access increased, and a greater increase in number of physician visits in rural residents.

### **Health care services: access and use**

Twenty eight papers reported on a comparison of rural and urban health professionals and facilities and access to, or use of health services, of which 19 were located in the USA. The rest were from Australia (4), UK (3), Europe wide (1) and Sweden (1). Four of the studies only were based on cohorts.

#### ***Facilities***

Rural areas in the UK had more hospitals and beds per head of population (White *et al.* 1999), whilst in the USA, in rural areas, hospitals are smaller (Weeks *et al.* 2002)

and primary care centres have been open for less time (Leiyu *et al.* 1994). In a survey across 30 European countries, Boerma *et al.* (1998) found that more comprehensive services were provided by rural practices.

### ***Staff***

As with facilities, rural areas have a greater relative supply of staff, e.g. in rural Alaska and Wyoming, they have relatively more public health professionals and fewer job vacancies (Rosenblatt *et al.* 2002), with rural practitioners also working longer hours per week (Gabhainn *et al.* 2001).

### ***Use of services***

Both Blazer *et al.* (1995) and McConnel & Zetzman (1993) found no rural/urban differences in inpatient and outpatient service use and Lago *et al.* (1993) found no association of rurality with prescription use. Although Blazer *et al.* did find that there was more frequent continuity of care in rural areas with residents usually seeing the same health care provider and Farrell *et al.* (1996) found higher levels of continuity of care in those discharged to community health services. Rural residents in Australia with respiratory conditions had a lower relative rate of patient reasons for contacting their GP for their respiratory condition (Britt *et al.*, 2001).

For patients with conditions with chronic pain, visits to primary care physicians were more frequent in rural areas (Probst *et al.* 2002). In Wisconsin, Cheh & Phillips (1993) found that diabetes and hip surgery patients in rural areas received less physical therapy and skilled nursing visits and use of medical home and community care was positively associated with urban residence (Rabiner 1995, Schlenker *et al.* 2002). Kenney (1993) found that rural Medicare beneficiaries were less likely to use home health care services than their urban counterparts. The variation and conflict in the results may relate to the selection of services being studied. In a survey of 18 different health services, Dempsey *et al.* (2003) found that there were differences in use between rural and urban Australian residents for nine only of the services with greater use made by rural residents of eight of these.

Admissions to hospital for a number of health conditions were lower overall for rural compared with urban workers, with admissions being particularly low for farmers, compared with an age-sex matched group of rural residents but non-farmers (Stiernstrom *et al.* 2001).

### ***Access to services***

Rural residents inevitably have to travel further to access health care, but in some rural areas of the UK, unless they have private transport or can purchase transport, there are difficulties in accessing services as bus routes and community transport are not available (Lovett *et al.* 2002). Increased travel time can translate into making fewer visits for care by some patients (Nemet & Bailey, 2000), such as those with depression (Fortney *et al.* 1999) or those with a permanent clinical condition, such as sickle cell anaemia (Telfair *et al.* 2003). Given the problems with access it is unclear why rural Medicare beneficiaries were less likely to use home health care services (Kenney 1993) unless there is an issue of cost for rural elderly (Stewart & Rosenthal 1997), despite Medicare coverage in the USA (Blazer *et al.* 1995).

### ***The patients***

Rural residents were found to be less satisfied with health care services (Edelman & Menz 1996) although for those being treated in Medicare-certified home health agencies, they had proportionately better outcomes in terms of activities of daily living (Adams & Short 1999). Better access translated into higher levels of subjective wellbeing in Australian residents (Murray *et al.* 2004).

In two qualitative studies, rural and urban women were found to have similarities in their perceived barriers to service use but differences in context, such as greater difficulty in obtaining appointments and lack of qualified and consistent providers in rural areas (Logan *et al.* 2004) and a lack of information services (Sample & Darragh 1998).

## **Research Question 2**

### **Characteristics of data extracted**

Nine papers were identified as providing relevant evidence to inform the research question on the effectiveness of interventions to improve the physical and mental well-being of older people living in rural areas of the UK. The interventions for which evidence is available include:

- Mobile or new local outreach health care services (6)
- Self management (2)
- Screening (1)

All nine studies reported positive health outcomes or satisfaction with services by participants/ patients, usually in the form of patient satisfaction questionnaires, but information on hard health outcomes was generally lacking. Three of the studies addressed costs and potential cost savings through the interventions.

Nine papers were identified that provided evidence of interventions targeted at the elderly living in rural areas. None of the interventions were randomised controlled trials. The majority involved provision of additional or new health care facilities/staff in rural areas, such as mobile branch surgery (Bentham & Haynes 1992), a mobile diabetic retinopathy screening van (Leese *et al.* 1993), an outreach cataract surgery clinic in a community hospital (Haynes *et al.* 2001), and a chemotherapy treatment unit in a district general hospital (McCavana 2000). Two other studies involved the provision of an exercise programme (Tedesco 1997) and leisure activities, in the latter case delivered via a mobile day care facility (Greener 1994). The final two studies examined the effectiveness of an arthritis rural patient education programme (Barlow & Williams 1999) and a screening tool to identify unmet needs (Kestin & Savage 1990).

Projects were located across Great Britain: in Scotland (2), Norfolk (2), the Lake District (1), Tayside (1), the South West (Cornwall and Somerset) (3).

Assessment of effectiveness of the chemotherapy unit (McCavana 2000), the mobile day care leisure facility (Greener 1994), the mobile outreach programme (Burnett & Mort, 2001) and the cataract day surgery service outreach clinic (Haynes *et al.* 2001) were based on surveys of users, who were reported to be satisfied with the scheme and/or would recommend it to others. In addition, for the latter study, the authors calculated a net cost benefit to patients using the cataract service of £39,000 per annum. The mobile screening unit for diabetic retinopathy (Leese *et al.* 1993) also demonstrated cost savings by identifying rural residents, who usually present with advanced disease, at an earlier stage in their disease, whilst the modelled cost savings for geriatric screening were calculated at £1925 (Kestin & Savage, 1990). More robust evidence was available for the mobile branch surgery, which replaced a conventional branch surgery in one village and created a new service in a second.

There was a documented increase in consultation rates in the rurally-located mobile unit and a corresponding fall at the main surgery (Bentham & Haynes 1992). Participants were reported to be satisfied with the exercise programme (Tedesco 1997) and with the arthritis education programme (Barlow & Williams, 1999), reporting more health benefits, with respect to decreased back and joint pain and weight loss and decreased levels of pain, anxiety, depression and fatigue, respectively in the two studies.

## Discussion

The following comments are general to both systematic reviews.

### Study Design

There is a considerable literature published on the subject of rural health. Many papers were identified from abstracts identified in the initial searches of the databases and grey literature. Of these, considerable numbers of papers were retained in the systematic review after full appraisal. We believe that our search strategy was robust, our inclusion and exclusion criteria clear, and that all relevant papers are likely to have been identified.

However the quality of the evidence from the papers identified and included in the systematic review is limited as none were randomised trials and relatively few were of a cohort design. Obviously it is not appropriate or ethical to conduct randomised controlled trials to examine the impact of rural versus urban residence on health outcomes, although for the second research question looking at effectiveness, the randomised trial is the most appropriate study design. There were very few cohort studies that addressed the first research question and none that covered the second. Most studies were cross-sectional in design based upon interview or questionnaire surveys, or secondary analysis of national surveys, such as census data. No systematic reviews were identified.

### *In summary*

- *the quality of the evidence to demonstrate causality is poor.*

### Population

Whilst the populations studied were limited to those resident in economically developed countries so that any findings would be more relevant to the UK, approximately half of the papers included in this systematic review were based in the USA. This has implications for interpretation with possible bias due to USA dominance of this evidence and applicability given the greater degree of rurality and even remoteness found in some areas of the USA compared with the UK. Secondly,

core differences in health care funding and service provision between the USA and UK, also limit the applicability to the UK of any health care services findings in rural USA.

A relatively large proportion of studies focussed on the health status and use and access to health care services by the elderly, some studies covered the newborn and very few reported on children and adolescents. Consequently there are gaps in the evidence base and a bias in the evidence towards the older population.

Because a large proportion of the evidence is based upon secondary analyses of routine data sets, the sample sizes in most of these studies are very large. This means that for those studies, there would be adequate power to detect any differences in health outcome, if they exist, and if any statistical analyses have been carried out. However, for many of the other cross-sectional studies, sample sizes were smaller and the issue of power was not discussed.

#### *In summary*

- *coverage of rural and urban populations is uneven across the economically developed countries, with the evidence dominated by one country (USA).*
- *coverage across the full population age range is limited, with findings biased towards the elderly and adults in general.*
- *Overall sample sizes are large but some studies may be underpowered.*

#### **Definition of Rurality**

A major issue in interpretation of the evidence from the literature identified is the definition of rurality used by the authors of each published study. We have provided an overview of the definitions used and Appendix 3 contains a summary table of them. One author's definition of rural, based on population size could be equivalent to that for an urban population in another study. In North American studies particularly, metropolitan and non-metropolitan categories were used, where metropolitan included population size and presence of one or more cities. Non-metropolitan, whilst not including a city could have reasonably large populations, although the population may be spread over a large area, but population density was not given.

*In summary*

- *there is large variation in population included within and between rural and urban comparison groups.*

## **Health and Healthcare Topics**

The majority of papers identified addressed four main topics: mortality, mental health, the elderly, and health services, although the latter covered several areas, such as service provision, access, and use. There was very little evidence on general health. The chronic conditions of the circulatory system and diabetes, that have greater impact with increasing age and, sometimes through gender, have been addressed, as has the impact of age per se with studies focussing on the elderly. Some papers have reported on general chronic ill-health as measured by limiting long term illness (a census question in the UK). However, few studies examined the impact of rurality on the other health systems: musculoskeletal, urinary, reproductive, gastrointestinal, or the senses except vision. Infection is only addressed in three papers, yet residents in the countryside are more exposed to agents leading to infection, e.g. unpasteurised milk, untreated water, contact with infected animals. Such issues are of less relevance to urban dwellers and this may be one possible reason for the limited numbers of papers addressing infection in rural and urban areas.

Individual lifestyle factors, such as smoking and alcohol use were covered in teenage and adult populations. However information on other drug taking, healthy eating, exercise taking, and appropriate ill-health prevention activities with respect to the health of rural compared with urban residents, is very limited. Social and community networks form some of the wider determinants of health, and one of the main features of the New Deal for Communities agenda to address inequalities in health in deprived urban areas. We looked for evidence of non-clinical interventions but found no studies that examined health status with respect to social cohesion, and all its component parts, within rural versus urban neighbourhoods.

Finally, some of the broader determinants of health, the socio-economic, cultural and environmental factors, along with e.g. housing, transport, nutrition, sanitation, and

education, appear either not to have been researched or, if researched, the findings do not appear to have been published. Such factors may impact differentially upon the health of rural residents compared with their urban counterparts.

*In summary*

- *coverage of the health conditions reported is uneven.*
- *Coverage is missing completely for some health conditions.*
- *coverage of the wider determinants of health is very limited.*

## **Health Outcomes and Analysis**

The choice of health outcomes was very varied, even when addressing the same health condition. For example, for cancers, the 16 papers included outcomes such as travel time and distance to care as well as diagnosis, treatment, prognosis, survival, disease stage, incidence, relative risk and health behaviours. The large range of outcomes studied, but the limited number of studies with any one defined outcome, provided insufficient data to conduct any meta-analyses across studies.

A further limitation to many of the papers included in this review is that many of the papers reported very limited analyses of the data, mostly with point estimates, no confidence intervals and few statistical tests conducted and/or their results reported. Even fewer studies, whether cohort or cross-sectional, conducted any additional analyses to examine health outcomes after adjustment for potential confounders, even after reporting underlying differences in some baseline characteristics between rural and urban populations.

One other issue that makes comparison of the evidence between studies more difficult is the variation recorded in prevalence of a health problem depending upon whether data has been self-reported or collected from clinical test outcomes. However, within any one study, the data collection instrument was the same for both urban and rural subjects, thus the comparison of rural versus urban health status is valid.

*In summary*

- *the very broad range of health outcomes used limits cross study comparisons.*

- *the lack of statistical detail limits interpretation of the reported values and findings.*
- *the broad range of health outcomes, but limited number of studies with each, reduces the opportunity to conduct any meta-analyses.*

## Summary and Recommendations

From the papers included in this systematic review, no clear direction in the evidence has emerged favouring health in rural over urban areas or vice versa. The picture is very mixed, by country, population ethnicity, gender, age and condition. This lack of clarity in favour of rural over urban or vice versa, may be a real finding – that there are no universal differences, just variation, which may favour a rural environment for some conditions or population groups and an urban environment for others. Conversely the finding could be due to a lack of robust evidence, which is also certainly the case, as this systematic review clearly shows. We need more robust, valid evidence in order to understand the complexities of the relationship between rurality and health.

To clarify the impact of rurality on health and to inform future policy, with respect to the health of rural populations, in its broadest sense, i.e. embracing the wider determinants of health such as education, housing and transport, as well as health per se and provision of health care, there is a need for studies that:

- are more robust comparative health studies across rural and urban cohorts
- are UK based
- address the wider determinants of health
- have clearly defined health outcomes
- have appropriate statistical analyses that adjust for potential confounding factors between and within populations.

To examine further the impact upon health of living in a rural area, we recommend:

1. Further analysis of the evidence from these two systematic reviews on health outcomes and health care service use:
  - using selected definitions of rurality, to make comparisons across more homogenous populations, with respect to place of residence
  - using selected definitions of rurality to examine any dose response effects.

2. Development of an internationally agreed definition of rurality, which would be used in all studies from now on (in parallel with local definitions if locally required).
3. Carrying out of a cohort study,
  - either using the ongoing Millenium newborn cohort, but ensuring that subsequent follow-ups include a representative powered sample of children living in rural areas (with rural defined using the new definition)
  - and/or examining the feasibility of using data from the previous UK-based cohort studies, such as the National Child development Study (NCDS), a cohort born in one week of March, 1958, if this dataset includes identifiable rural-based subgroups.

To improve the health of the elderly, a subgroup of the population currently increasing in proportion in rural areas, given that robust evidence of effectiveness of interventions to improve physical and mental health in rural areas of the UK is lacking, we recommend that:

1. Primary research be conducted, using a qualitative methodology, to gain a greater understanding of the health needs, and the applicability, acceptability and feasibility of any future intervention in this population.
2. Interventions based on evidence from other countries be considered for implementation in the UK, if setting and population group are relevant, but that any intervention is funded for a full robust evaluation and the findings published, to inform other providers and policy makers.
3. Any innovative interventions introduced in rural areas to address local health or health care service issues, be introduced using an appropriate robust study design, preferably a randomised controlled trial. Again, the evidence on the effectiveness of any innovative intervention needs to be evaluated and published. If randomised trials are not feasible, funders and/or providers should consider other design

options, such as before and after studies with a matching control group, to assess the impact of, and exclude, any external factors influencing change.

# References

## References cited in Research Question 1

- Adams, C. and Short, R. Rural Versus Urban Home Health: Does Locale Influence OASIS Outcomes? *Outcomes Management for Nursing Practice*. 1999; 3(1): 26-32.
- Albers, E. and Evans, W. Suicide ideation among a stratified sample of rural and urban adolescents. *Child and Adolescent Social Work Journal*. 1994; 11(5): 379-389.
- Alexy, B.; Nichols, B.; Heverly, M. A., and Garzon, L. Prenatal factors and birth outcomes in the public health service: a rural urban comparison. *Research in Nursing and Health*. 1997; 20:61-70.
- Allaby, M. A. K. Reviewing family planning services: a method for population based outcome-related needs assessment. *British Journal of Family Planning*. 1993; 18:102-105.
- Atav, S. and Spencer, G. A. Health Risk Behaviours among Adolescents Attending Rural, Suburban, and Urban Schools: A Comparative Study. *Family Community Health*. 2002; 25(2): 53-64.
- Bachman, S. S.; Drainoni, M. L.; Strickler, G.; Dittmar, N. D., and Shon, S. P. Utilization of a state hospital by urban and rural local mental health authorities. *Administration and Policy in Mental Health*. 1996; 23(5): 439-454.
- Bain, N. S. C. and Campbell, N. C. Treating patients with colorectal cancer in rural and urban areas: a qualitative study of the patients' perspective. *Family Practice*. 2000; 17(6): 475-479.
- Baldwin, L. M.; Grossman, D. C.; Casey, S.; Hollow, W.; Sugarman, J. R.; Freeman, W. L., and Hart, L. G. Perinatal and infant health among rural and urban American Indians/Alaska natives. *American Journal of Public Health*. 2002; 92(9): 1491-1497.
- Barnett, E.; Halverson, J. A.; Elmes, G. A., and Braham, V. E. Metropolitan and non-metropolitan trends in coronary heart disease mortality within Appalachia, 1980-1997. *Annals of Epidemiology*. 2000; 10:370-379.
- Barnett, S.; Roderick, P., and Diamond, M. I. A multilevel analysis of the effects of rurality and social deprivation on premature limiting long term illness. *Journal of Epidemiology Community Health*. 2001; 55:44-51.
- Barnett, S.; Roderick, P.; Martin, D.; Diamond, I., and Wrigley, H. Interrelations between three proxies of health care need at the small area level: an urban/rural comparison. *Journal of Epidemiology Community Health*. 2002; 56:754-761.
- Bermejo, F.; Vega, S.; Morales, J. M.; Diaz, J.; López, L.; Parra, D.; Colmenarejo, C., and Gabriel R. Prevalence of stroke in two samples (rural and urban) of old people in Spain. A pilot door-to-door study carried out by health professionals. *Neurologia*. 1997; 12(4): 157-161.
- Blazer, D. G.; Kessler, R. C.; McGonagle, K. A., and Swartz, M. S. The prevalence and distribution of major depression in a national community sample: the National Comorbidity Survey. *American Journal of Psychiatry*. 1994; 151(7): 979-986.
- Blazer, D. G.; Landerman, L. R.; Fillenbaum, G., and Homer, R. Health Services Access and Use among Older Adults in North Carolina: Urban vs. Rural Residents. *American Journal of Public Health*. 1995; 85(10): 1384-1390.
- Boerma, W. G. W.; Groenewegen, P. P., and Van Der Zee, J. General Practice in Urban and Rural Europe: The Range of Curative Services. *Social Science and Medicine*. 1998; 47(4): 445-453.
- Boland, M.; Staines, A.; Fitzpatrick, P., and Scallan, E. Urban-rural variation in mortality and hospital admission rates for unintentional injury in Ireland. *Injury Prevention*. 2005; 11:38-42.
- Bolda, E. J. and Mooney Murray, K. Admission severity and mortality rates among rural and urban nursing facility residents with dementia. *Research and Policy Brief (Maine Rural Health Research Center)*. 2001; (Online at <http://muskie.usm.maine.edu/Publications/rural/pb25.pdf>).
- Branas, C. C.; Nance, M. L.; Elliott, M. R.; Richmond, T. S., and Schwab, C. W. Urban-rural shifts in intentional firearm death: different causes, same results. *American Journal of Public Health*. 2004; 94(10): 1750-1755.
- Britt, H.; Miller, G. C., and Valenti, L. It's different in the bush. A comparison of general practice activity in metropolitan and rural areas of Australia 1998-2000. Canberra: Australian Institute of Health and Welfare; 2001; AIHW Cat. No. GEP 6.
- Brown, L. H.; Khanna, A., and Hunt, R. C. Rural vs. urban motor vehicle crash death rates. *Prehospital Emergency Care*. 2000; 4:7-13.
- Buettner, L. L. and Langrish, S. Rural vs. urban caregivers of older adults with probable Alzheimer's disease: perceptions regarding daily living and recreation needs. *Activities, Adaptation and Ageing*. 1999; 24(2): 51-65.
- Bédard, M.; Koivuranta, A., and Stuckey, A. Health impact on caregivers of providing informal care to a cognitively impaired older adult: rural versus urban settings. *Canadian Journal of Rural Medicine*. 2004; 9(1): 15-23.
- Caldwell, T. M.; Jorm, A. F., and Dear, K. B. G. Suicide and mental health in rural, remote and metropolitan areas in Australia. *Medical Journal of Australia*. 2004; 181(7 Suppl): S10-4.
- Campbell, N. C.; Elliott, A. M.; Sharp, L.; Ritchie, L. D.; Cassidy, J., and Little, J. Impact of deprivation and rural residence on treatment of colorectal and lung cancer. *British Journal of Cancer*. 2002; 87:585-590.
- Campbell, N. C.; Elliott, A. M.; Sharp, L.; Ritchie, L. D.; Cassidy, J., and Little, J. Rural and urban differences in stage at diagnosis of colorectal and lung cancers. *British Journal of Cancer*. 2001; 84(7): 910-914.
- Campbell, N. C.; Elliott, A. M.; Sharp, L.; Ritchie, L. D.; Cassidy, J., and Little, J. Rural factors and survival from cancer: analysis of Scottish cancer registrations. *British Journal of Cancer*. 2000; 82(11): 1863-1866.
- Charlton, J. Trends and patterns in suicide in England and Wales. *International Journal of Epidemiology*. 1995; 24(3 Suppl 1): S45-S52.
- Charlton, J. Which areas are the healthiest? *Population Trends*. 1996; 83:17-24.
- Cheh, V. and Phillips, B. Adequate Access to Posthospital Home Health Services: Differences Between Urban and Rural Areas. *The Journal of Rural Health*. 1993; 9(4): 262-269.
- Chevalley, T.; Herrmann, F. R.; Delmi, M.; Stern, R.; Hoffmeyer, P.; Rapin, C. -H., and Rizzoli, R. Evaluation of the age-adjusted incidence of hip fractures between urban and rural areas: The difference is not related to the prevalence of institutions for the elderly. *Osteoporosis International*. 2002; 13:113-118.
- Chimonedes, K. M. and Frank, D. I. Rural and urban adolescents' perceptions of mental health. *Adolescence*. 1998; 33(132): 823-832.
- Chumbler, N. R.; Cody, M.; Booth, B. M., and Beck, C. K. Rural-urban differences in services use for memory-related problems in older adults. *Journal of Behavioral Health Services and Research*. 2001; 28(2): 212-221.
- Clark, D. and Dellasega, C. Unmet health care needs: comparison of rural and urban senior center attendees. *Journal of*

- Gerontological Nursing. 1998; 24(12): 24-33.
- Clark, D. E. Motor vehicle crash fatalities in the elderly: rural versus urban. *Journal of Trauma Injury Infection and Critical Care*. 2001; 51:896-900.
- Clarke, L. L. and Coward, R. T. A Multivariate Assessment of the Effects of Residence on Infant Mortality. *The Journal of Rural Health*. 1991; 7(3): 246-265.
- Clayton, G. M.; Dudley, W. N.; Patterson, W. D.; Lawhorn, L. A.; Poon, L. W.; Johnson, M. A., and Martin, P. The influence of rural/urban residence on health in the oldest-old. *International Journal of Aging and Human Development*. 1994; 38(1): 65-89.
- Correia, M.; Silva, M. R.; Matos, I.; Magalhães, R.; Castro Lopes, J.; Ferro, J. M., and Silva, M. C. Prospective community-based study of stroke in Northern Portugal. Incidence and case fatality in rural and urban populations. *Stroke*. 2004; 35:2048-2053.
- Cronk, C. E. and Sarvela, P. D. Alcohol, Tobacco, and Other Drug Use among Rural/Small Town and Urban Youth: A Secondary Analysis of the Monitoring the Future Data Set. *American Journal of Public Health*. 1997; 87 (5): 760-764.
- Dansky, K. H.; Brannon, D.; Shea, D. G.; Vasey, J., and Dirani, R. Profiles of hospital, physician and home health service use by older persons in rural areas. *The Gerontologist*. 1998; 38(3): 320-330.
- Dejardin, O.; Herbert, C.; Velten, M.; Buemi, A.; Menegoz, F.; Maarouf, N., and Launoy, G. Social and geographical factors influencing the delay in treatment for colorectal cancer. *British Journal of Cancer*. 2004; 91:1751-1752.
- Dempsey, P.; Wilson, D.; Taylor, A., and Wilkinson, D. Self-Reported Patterns of Health Services Utilisation: An Urban-Rural Comparison in South Australia. *Australian Journal of Rural Health*. 2003; 11:81-88.
- Dickinson, H. O.; Hutton, J. L.; Greaves, L. H.; Dummer, T. J. B., and Parker, L. Deprivation and stillbirth risk in rural and urban areas. *Paediatric and Perinatal Epidemiology*. 2002; 16:249-254.
- Diderichsen, F. and Janlert, U. Effects of economic change on male morbidity in neighbouring industrial and rural municipalities in northern Sweden. *Journal of Epidemiology and Community Health*. 1992; 46:605-607.
- Dimah, K. and Dimah, A. Elder abuse and neglect among rural and urban women. *Journal of Elder Abuse and Neglect*. 2003; 15(1): 75-93.
- Dotl, S. L. and Greenley, J. R. Rural-urban differences in psychiatric status and functioning among clients with severe mental illness. *Community Mental Health Journal*. 1997; 33(4): 311-321.
- Dudley, M.; Kelk, N.; Florio, T. M.; Howard, J. P., and Waters, B. G. H. Suicide among young Australians, 1964-1993: an interstate comparison of metropolitan and rural trends. *Medical Journal of Australia*. 1998b; 169:77-80.
- Dudley, M.; Kelk, N.; Florio, T. M.; Waters, B. G. H.; Howard, J. P., and Taylor, D. Coroners' records of rural and non-rural cases of youth suicide in New South Wales. *Australian and New Zealand Journal of Psychiatry*. 1998a; 32:242-251.
- Duelberg, S. I. Preventive Health Behaviour among Black and White Women in Urban and Rural Areas. *Social Science and Medicine*. 1992; 34(2): 191-198.
- Duncan, R. P.; Coward, R. T., and Gilbert, G. H. Rural-urban comparisons of age and health at the time of nursing home admission. *Journal of Rural Health*. 1997; 13(2): 118-125.
- Dwyer, J. W. and Miller, M. K. Determinants of primary caregiver stress and burden: area of residence and the caregiving networks of frail elders. *Journal of Rural Health*. 1990; 6(2): 161-184.
- Eachus, J.; Chan, P.; Pearson, N.; Propper, C., and Smith, G. D. An additional dimension to health inequalities: disease severity and socioeconomic position. *Journal of Epidemiology Community Health*. 1999; 53:603-611.
- Eberhardt, M. S.; Ingram, D. D., and Makuc, D. M. *et al.* *Urban and Rural Health Chartbook*. Health, United States, 2001. Hyattsville, Maryland: National Center for Health Statistics; 2001.
- Eckert, K. A.; Taylor, A. W.; Wilkinson, D. D., and Tucker, G. R. How does mental health status relate to accessibility and remoteness? *Medical Journal of Australia*. 2004; 181:540-543.
- Edelman, M. A. and Menz, B. L. Selected Comparisons and Implications of a National Rural and Urban Survey on Health Care Access, Demographics, and Policy Issues. *The Journal of Rural Health*. 1996; 12(3): 197-205.
- Eggebeen, D. J. and Lichter, D. T. Health and well-being among rural Americans: variations across the life course. *Journal of Rural Health*. 1993; 9(2): 86-98.
- Engholm, G.; Palmgren, F., and Lyngge, E. Lung cancer, smoking, and environment: a cohort study of the Danish population. *British Medical Journal*. 1996; 312:1259-1263.
- Fahs, P. S.; Grabo, T. N.; James, G. D.; Neff-Smith, M., and Spencer, G. A comparison of the cardiovascular risks of rural, suburban and urban women. *Online Journal of Rural Nursing and Health Care*. 2002; 2(1):(Online).
- Fakhoury, W. K. H. and Roos, L. Access to and Use of Physician Resources by the Rural and Urban Populations in Manitoba. *Canadian Journal of Public Health*. 1996; 87(4): 248-252.
- Farrell, S. P.; Koch, J. R., and Blank, M. Rural and Urban Differences in Continuity of Care After State Hospital Discharge. *Psychiatric Services*. 1996; 47(6): 652-654.
- Fingerhut, L. A.; Ingram, D. D., and Feldman, J. J. Homicide rates among US teenagers and young adults: differences by mechanism, level of urbanization, race and sex, 1987 through 1995. *Journal of the American Medical Association*. 1998; 280(5): 423-427.
- Fischer, E. P.; Owen, R. R., and Cuffel, B. J. Substance abuse, community service use and symptom severity of urban and rural residents with schizophrenia. *Psychiatric Services*. 1996; 47(9): 980-984.
- Fortney, J.; Rost, K.; Zhang M., and Warren, J. The Impact of Geographic Accessibility on the Intensity and Quality of Depression Treatment. *Medical Care*. 1999; 37(9): 884-893.
- Friis, S. and Storm, H. H. Urban-rural variation in cancer incidence in Denmark 1943-1987. *European Journal of Cancer*. 1993; 29A(4): 538-544.
- Fukuda, Y.; Nakamura, K., and Takano, T. Increased excess deaths in urban areas: quantification of geographical variation in mortality in Japan, 1973-1998. *Health Policy*. 2004; 68:233-244.
- Gabella, B.; Hoffman, R. E.; Marine, W. W., and Stallones, L. Urban and rural traumatic brain injuries in Colorado. *Annals of Epidemiology*. 1997; 7:207-212.
- Gabhainn, S. N.; Murphy, A. W., and Kelleher, C. A national general practice census: characteristics of rural general practices. *Family Practice*. 2001; 18(6): 622-626.
- Gale, B. J. Psychosocial health needs of older women: urban versus rural comparisons. *Archives of Psychiatric Nursing*. 1993; 7(2): 99-105.
- Gillanders, W. R.; Buss, T. F., and Hofstetter, C. R. Urban/rural elderly health status differences: the dichotomy reexamined. *Journal of Aging and Social Policy*. 1996; 8(4): 7-24.
- Glenn, L. L. and Jijon, C. R. Risk-adjusted in-hospital death rates for peer hospitals in rural and urban regions. *Journal of Rural Health*. 1999; 15(1): 94-107.

Goins, R. T. and Mitchell, J. Health-related quality of life: does rurality matter? *Journal of Rural Health*. 1999; 15(2): 147-156.

Greenley, J. R. and Dottl, S. L. Sociodemographic characteristics of severely mentally ill clients in rural and urban counties. *Community Mental Health Journal*. 1997; 33(6): 545-551.

Hart, L. G.; Dobie, S. A.; Baldwin, L. M.; Pirani, M. J.; Fordyce, M., and Rosenblatt, R. A. Rural and urban differences in physician resource use for low-risk obstetrics. 1996; 31(4): 429-452.

Havens, B.; Hall, M.; Sylvestre, G., and Jivan, T. Social Isolation and Loneliness: Differences between Older Rural and Urban. *Canadian Journal on Aging*. 2004; 23(2): 129-140.

Haynes, R. and Gale, S. Deprivation and poor health in rural areas: inequalities hidden by averages. *Health and Place*. 2000; 6:275-285.

Haynes, R. and Gale, S. Mortality, long-term illness and deprivation in rural and metropolitan wards of England and Wales. *Health and Place*. 1999; 5:301-312.

Heckman, T. G.; Somlai, A. M.; Peters, J.; Walker, J.; Otto-Salaj, L.; Galdabini, C. A., and Kelly, J. A. Barriers to care among persons living with HIV/AIDS in urban and rural areas. *AIDS Care*. 1998; 10(3): 364-375.

House, J. S.; Lepkowski, J. M.; Williams, D. R.; Mero, R.; Lantz, P. M.; Robert, S. A., and Chen, J. Excess mortality among urban residents: how much, for whom and why? *American Journal of Public Health*. 2000; 90(12): 1898-1904.

Howe, H. L.; Katterhagen, J. G.; Yates, J., and Lehnerr, M. Urban-rural differences in the management of breast cancer. *Cancer Causes and Control*. 1992; 3:533-539.

Hoyt, D. R.; Conger, R. D.; Gaffney Valde, J., and Weihs, K. Psychological distress and help seeking in rural America. *American Journal of Community Psychology*. 1997; 25(4): 449-470.

Huff, N.; Macleod, C.; Ebdon, D.; Phillips, D.; Davies, L., and Nicholson, A. Inequalities in mortality and illness in Trent NHS Region. *Journal of Public Health Medicine*. 1999; 21(1): 81-87.

Jenkins, R.; Lewis, G.; Bebbington, P.; Brugha, T.; Farrell, M.; Gill, B., and Meltzer, H. The National Psychiatric Morbidity Surveys of Great Britain-initial findings from the Household Survey. *Psychological Medicine*. 1997; 27:775-789.

Jin, Y.; Quan, H.; Cujec, B., and Johnson, D. Rural and urban outcomes after hospitalization for congestive heart failure in Alberta, Canada. *Journal of Cardiac Failure*. 2003; 9(4): 278-285.

Johnson, J. L.; Ratner, P. A., and Bottorff, J. L. Urban-rural differences in the health-promoting behaviours of Albertans. *Canadian Journal of Public Health*. 1995; 86(2): 103-108.

Jonas, B. S. and Wilson, R. W. Negative mood and urban versus rural residence: using proximity to metropolitan statistical areas as an alternative measure of residence. *Advance Data. National Center for Health Statistics*. 1997; 281.

Jones, A. P. and Bentham, G. Health service accessibility and deaths from asthma in 401 local authority districts in England and Wales, 1988-92. *Thorax*. 1997; 52:218-222.

Jones, A. P.; Bentham, G., and Horwell, C. Health service accessibility and deaths from asthma. *International Journal of Epidemiology*. 1999; 28(1): 101-105.

Kelly, S.; Charlton, J., and Jenkins, R. Suicide deaths in England and Wales, 1982-1992: the contribution of occupation and geography. *Population Trends*. 1995; 80:16-25.

Kenny, G. M. Is Access to Home Health Care a Problem in Rural Areas? *American Journal of Public Health*. 1993; 83(3): 412-414.

Kröger, Ø.; Aase, A., and Westin, S. Ischaemic heart disease mortality among men in Norway: reversal of urban-rural difference between 1966 and 1989. *Journal of Epidemiology and Community Health*. 1995; 49:271-276.

Labuhn, K.; Lewis, C.; Koon, K., and Mullooly, J. P. Smoking cessation experiences of chronic lung disease patients living in rural and urban areas of Virginia. *Journal of Rural Health*. 1993; 9(4): 305-313.

Lago, D.; Stuart, B., and Ahern, F. Rurality and prescription drug utilization among the elderly: an archival study. *Journal of Rural Health*. 1993; 9(1): 6-16.

Larson, E. H.; Hart, L. G., and Rosenblatt, R. A. Is non-metropolitan residence a risk factor for poor birth outcome in the U.S.? *Social Science and Medicine*. 1997; 45(2): 171-188.

Launoy, G.; Le Coutour, X.; Gignoux, M.; Pottier, D., and Dugleux, G. Influence of rural environment on diagnosis, treatment, and prognosis of colorectal cancer. *Journal of Epidemiology and Community Health*. 1992; 46(4): 365-367.

Law, M. R. and Morris, J. K. Why is mortality higher in poorer areas and in more northern areas of England and Wales? *Journal of Epidemiology Community Health*. 1998; 52:344-352.

Lawlor, D. A.; Maxwell, R., and Wheeler, B. W. Rurality, deprivation, and excess winter mortality: an ecological study. *Journal of Epidemiology Community Health*. 2002; 56:373-374.

Leeflang, R. L.; Klein-Hesseling, D. J., and Spruit, I. P. Health effects of unemployment: I. Long-term unemployed men in a rural and an urban setting. *Social Science and Medicine*. 1992; 34(4): 341-350; ISSN: 0277-9536.

Leese, G. P.; Ahmed, S.; Newton, R. W.; Jung, R. T.; Ellingford, A.; Baines, P.; Roxburgh, S., and Coleiro, J. Use of mobile screening unit for diabetic retinopathy in rural and urban areas. *British Medical Journal*. 1993; 306(6871): 187-189.

Leiyu, S.; Samuels, M. E.; Ricketts, T. C., and Konrad, T. R. A rural-urban comparative study of nonphysician providers in community and migrant health centers. *Public Health Reports*. 1994; 109(6): 809-815.

Levin, K. A. Urban-rural differences in self-reported limiting long-term illness in Scotland. *Journal of Public Health Medicine*. 2003; 25(4): 295-302.

Liff, J. M.; Chow, W., and Greenberg, R. S. Rural-urban differences in stage at diagnosis. *Cancer*. 1991; 67:1454-1459.

Logan, T. K.; Stevenson, E.; Evans, L., and Leukefeld, C. Rural and Urban Women's Perceptions of Barriers to Health, Mental Health, and Criminal Justice Services: Implications for Victim Services. *Violence and Victims*. 2004; 19(1): 37-62.

Logan, T. K.; Walker, R.; Cole, J.; Ratliff, S., and Leukefeld, C. Qualitative differences among rural and urban intimate violence victimization experiences and consequences: a pilot study. *Journal of Family Violence*. 2003; 18(2): 83-92.

Lovett, A.; Haynes, R.; Sunnenberg, G., and Gale, S. Car travel time and accessibility by bus to general practitioner services: a study using patient registers and GIS. *Social Science and Medicine*. 2002; 55:97-111.

Lyons, M. A. Psychosocial impact of cancer in low-income rural/urban women: Phase I. *Online Journal of Rural Nursing and Health Care*. 2004; 4(1): [Online].

Lüthje, P.; Peltonen, A.; Nurmi, I.; Kataja, M., and Santavirta, S. No differences in the incidences of old people's hip fractures between urban and rural populations: a comparative study in two Finnish health care regions in 1989. *Gerontology*. 1995; 41(1): 39-44.

Madhok, R.; Melton III, L. J.; Atkinson, E. J.; O'Fallon, W. M., and Lewallen, D. G. Urban vs. rural increase in hip fracture incidence. *Acta Orthopaedica Scandinavica*. 1993; 64(5): 543-548.

Mainous, A. G. and Kohrs, F. P. A Comparison of Health Status Between Rural and Urban Adults. *Journal of Community Health*. 1995; 20(5): 423-431.

- Mansfield, C. J.; Wilson, J. L.; Kobrinski, E. J., and Mitchell, J. Premature mortality in the United States: the roles of geographic area, socioeconomic status, household type, and availability of medical care. *American Public Health Association*. 1999; 89(6): 893-898.
- McCarty, C. A.; Fu, C. L., and Taylor, H. R. Epidemiology of pterygium in Victoria, Australia. *British Journal of Ophthalmology*. 2000; 84:289-292.
- McCarty, C. A.; Mukesh, B. N.; Fu, C. L., and Taylor, H. R. The epidemiology of cataract in Australia. *American Journal of Ophthalmology*. 1999a; 128:446-465.
- McCarty, C. A.; Fu, C. L. H., and Taylor, H. R. Epidemiology of ocular trauma in Australia. *Ophthalmology*. 1999b; 106:1847-1852.
- McConnel, C. E. and Zetzman, M. R. Urban/rural differences in health service utilization by elderly persons in the United States. *Journal of Rural Health*. 1993; 9(4): 270-280.
- McKay, R.; McCarty, C. A., and Taylor, H. R. Diabetic retinopathy in Victoria, Australia: the Visual Impairment Project. *British Journal of Ophthalmology*. 2000; 84:865-870.
- Meden, T.; St. John-Larkin, C.; Hermes, D., and Sommerschild, S. Relationship between travel distance and utilization of breast cancer treatment in rural northern Michigan. *Journal of the American Medical Association*. 2002; 287(1): 111.
- Mehlum, L.; Hytten, K., and Gjertsen, F. Epidemiological trends of youth suicide in Norway. *Archives of Suicide Research*. 1999; 5:193-205.
- Melton III, L. J.; Crowson, C. S., and O'Fallon, W. M. Fracture incidence in Olmsted County, Minnesota: Comparison of urban with rural rates and changes in urban rates over time. *Osteoporosis International*. 1999; 9:29-37.
- Messner, T. and Lundberg, V. In northern Sweden myocardial infarction morbidity and case fatality are lowest in rural areas. *Scandinavian Cardiovascular Journal*. 2004; 38(5): 265-269.
- Micciole, R.; Williams, P.; Zimmermann-Tansella, C., and Tansella, M. Geographical and Urban-Rural variation in the seasonality of suicide: some further evidence. *Journal of Affective Disorders*. 1991; 21(1): 39-43.
- Middleton, N.; Gunnell, D.; Frankel, S.; Whitley, E., and Dorling, D. Urban-rural differences in suicide trends in young adults: England and Wales, 1981-1998. *Social Science and Medicine*. 2003; 57:1183-1194.
- Morales Suárez-Varela, M. M.; Dominguez-Lillo, C., and Llopis-González, A. A comparative study of mortality in agricultural and industrial areas in Spain. *European Journal of Epidemiology*. 1995; 11:633-641.
- Morgan, K.; Armstrong, G. K.; Huppert, F. A.; Brayne, C., and Solomou, W. Healthy ageing in urban and rural Britain: a comparison of exercise and diet. *Age and Ageing*. 2000; 29:341-348.
- Morrell, S.; Taylor, R.; Slaytor, E., and Ford, P. Urban and rural suicide differentials in migrants and the Australian-born, New South Wales, Australia 1985-1994. *Social Science and Medicine*. 1999; 49:81-91.
- Mortensen, P. B.; Pedersen, C. B.; Westergaard, T.; Wohlfahrt, J.; Ewald, H.; Mors, O.; Anderson, P. K., and Mads, M. Effects of family history and place and season of birth on the risk of schizophrenia. *New England Journal of Medicine*. 1999; 340(8): 603-608.
- Murray, G.; Judd, F.; Jackson, H.; Fraser, C.; Komiti, A.; Hodgins, G.; Pattison, P.; Humphreys, J., and Robins, G. Rurality and mental health: the role of accessibility. *Australian and New Zealand Journal of Psychiatry*. 2004; 38:629-634.
- Nemet, G. F. and Bailey, A. J. Distance and health care utilization among the rural elderly. *Social Science and Medicine*. 2000; 50:1197-1208.
- O'Brien, E. D.; Bailie, R. S., and Jelfs, P. L. Cervical cancer mortality in Australia: contrasting risk by Aboriginality, age and rurality. *International Journal of Epidemiology*. 2000; 29(5): 813-816.
- Obisesan, T. O.; Vargas, C. M., and Gillum, R. F. Geographic variation in stroke risk in the United States. Region, urbanization and hypertension in the Third National Health and Nutrition Examination Survey. *Stroke*. 2000; 31:19-25.
- Parikh, S. V.; Wasylenko, D.; Goering, P., and Wong, J. Mood disorders: rural/urban differences in prevalence, health care utilization and disability in Ontario. *Journal of Affective Disorders*. 1996; 38(1): 57-65.
- Parks, S. E.; Housemann, R. A., and Brownson, R. C. Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States. *Journal of Epidemiology and Community Health*. 2003; 57:29-35.
- Paykel, E.; Abbott, R.; Jenkins, R.; Brugha, T., and Meltzer, H. Urban-rural mental health differences in Great Britain: Findings from the National Morbidity Survey. *International Review of Psychiatry*. 2003; 15(1-2): 97-107.
- Paykel, E. S.; Abbott, R.; Jenkins, R.; Brugha, T. S., and Meltzer, H. Urban-rural mental health differences in Great Britain: findings from the National Morbidity Survey. *Psychological Medicine*. 2000; 30:269-280.
- Payne, M. C. W.; Perkin, T. R., and Payne, W. L. Incidence of falls by rural elders compared with their urban counterparts. *Canadian Journal of Rural Medicine*. 2003; 8(1): 19-24.
- Paúl, C.; Fonseca, A. M.; Martín, I., and Amado, J. Psychosocial profile of rural and urban elders in Portugal. *European Psychologist*. 2003; 8(3): 160-167.
- Petterson, S. M. Metropolitan-nonmetropolitan differences in amount and type of mental health treatment. *Archives of Psychiatric Nursing*. 2003; 17(1): 12-19.
- Phillimore, P. and Reading, R. A rural advantage? Urban-rural health differences in Northern England. *Journal of Public Health Medicine*. 1992; 14(3): 290-299.
- Potvin, L.; Gauvin, L., and Nguyen, N. M. Prevalence of stages if change for physical activity in rural, suburban and inner-city communities. *Journal of Community Health*. 1997; 22(1): 1-13.
- Probst, J. C.; Moore, C. G.; Baxley, E. G., and Lammie, J. J. Rural-Urban Differences in Visits to Primary Care Physicians. *Health Services Research*. 2002; 34(8): 609-615.
- Rabiner, D. J. Patterns and Predictors of Noninstitutional Health Care Utilization by Older Adults in Rural and Urban America. *The Journal of Rural Health*. 1995; 11(4): 259-273.
- Ramsey, P. W. and Glenn, L. L. Obesity and health status in rural, urban and suburban Southern women. *Southern Medical Journal*. 2002; 95(7): 666-671.
- Reading, R.; Raybould, S., and Jarvis, S. Deprivation, low birth weight and children's height: a comparison between rural and urban areas. *British Medical Journal*. 1993; 307(6917): 1458-1462.
- Reeder, B. A.; Chen, Y.; Macdonald, S. M.; Angel, A., and Sweet, L. Regional and rural-urban differences in obesity in Canada. *Canadian Medical Association Journal*. 1997; 157(Suppl 1): 510-516.
- Romans-Clarkson, S. E.; Walton, V. A.; Herbison, G. P., and Mullen, P. E. Psychiatric morbidity among women in urban and rural New Zealand: psychosocial correlates. *British Journal of Psychiatry*. 1990; 156:84-91.
- Rosenblatt, R. A.; Baldwin, L.-M.; Chan, L.; Fordyce, M. A.; Hirsch, I. B.; Palmer, J. P.; Wright, G. E., and Hart, L. G. Improving the quality of outpatient care for older patients with diabetes: Lessons from a comparison of rural and urban communities. *Journal of Family Practice*. 2001; 50(8): 676-680.

- Rosenblatt, R. A.; Casey, S., and Richardson, M. Rural-Urban Differences in the Public Health Workforce: Local Health Departments in 3 Rural Western States. *American Journal of Public Health*. 2002; 92(7):1102-1105.
- Rost, K.; Kirchner, J.; Fortney, J. C., and Booth, B. M. Rural-urban differences in service use by at-risk drinkers. *Journal of Rural Community Psychology*. 2000; E3 (1).
- Rost, K.; Owen, R. R.; Smith, J., and Smith, G. R. Rural-urban differences in service use and course of illness in bipolar disorder. *Journal of Rural Health*. 1998b; 14(1): 36-43.
- Rost, K.; Smith, R. G., and Taylor, J. L. Rural-urban differences in stigma and the use of care for depressive disorders. *Journal of Rural Health*. 1993; 9(1): 57-62.
- Rost, K.; Zhang, M.; Fortney, J.; Smith, J., and Smith, G. Rural-urban differences in depression treatment and suicidality. *Medical Care*. 1998a; 36(7): 1098-1107.
- Saag, K. G.; Doebbeling, B. N.; Rohrer, J. E.; Kolluri, S.; Mitchell, T. A., and Wallace, R. B. Arthritis health service utilization among the elderly: the role of urban-rural residence and other utilization factors. *Arthritis Care and Research*. 1998; 11(3): 177-185.
- Sample, P. L. and Darragh, A. R. Perceptions of care access: the experience of rural and urban women following brain injury. *Brain Injury*. 1998; 12(10): 855-874.
- Samuelsson, G.; Dehlin, O., and Rundgren, A. Differences in health status and mortality between urban and rural populations. *International Journal of Health Sciences*. 1993; 4 (1): 3-11.
- Saunderson, T.; Haynes, R., and Langford, I. Urban-rural variations in suicides and undertermined deaths in England and Wales. *Journal of Public Health Medicine*. 1998; 20(3): 261-267.
- Saywell Jr.; R.M.; Zollinger, T. W.; Schafer, M. E.; Schmit, T. M., and Ladd, J. K. Children with special health care needs program: urban/rural comparisons. *Journal of Rural Health*. 1993; 9(4): 314-325.
- Schlenker, R. E.; Powell, M. C., and Goodrich, G. K. Rural-Urban Home Health Care Differences Before the Balanced Budget Act of 1997. *The Journal of Rural Health*. 2002; 18(2): 359-373.
- Schultz, A. A. Identification of needs of and utilisation of resources by rural and urban elders after hospital discharge to the home. *Public Health Nursing*. 1997; 14(1): 28-36.
- Seivewright, H.; Tyrer, P.; Casey, P., and Seivewright, N. A three-year follow-up of psychiatric morbidity in urban and rural primary care. *Psychological Medicine*. 1991; 21:495-503.
- Senior, M.; Williams, H., and Higgs, G. Urban-rural mortality differentials: controlling for material deprivation. *Social Science and Medicine*. 2000; 51:289-305.
- Svenson, J. E.; Spurlock, C., and Nypaver, M. Pediatric firearm-related fatalities: not just an urban problem. *Archives of Pediatric and Adolescent Medicine*. 1996; 150(6): 583-587.
- Sheikh, K and Bullock, C. Urban-rural differences in the quality of care for Medicare patients with acute myocardial infarction. *Archives of Internal Medicine*. 2001; 161 737-743.
- Shouls, S.; Congdon, P., and Curtis, S. Geographic variation in illness and mortality: the development of a relevant area typology for SAR districts. *Health and Place*. 1996; 2(3): 139-155.
- Singh, G. K. and Siahpush, M. Increasing rural-urban gradients in US suicide mortality, 1970-1997. *American Journal of Public Health*. 2002; 92(7): 1161-1167.
- Smith, A. J. and Ramana, R. Mental health in rural areas: experience in south Cambridgeshire. *Psychiatric Bulletin*. 1998; 22:280-284.
- Smith, M. H.; Anderson, R. T.; Bradham, D. D., and Longino, Jr. C. F. Rural and urban differences in mortality among American 55 years and older: analysis of the National Longitudinal Mortality Study. *Journal of Rural Health*. 1995; 11(4): 274-285.
- Sobal, J.; Troiano, R. P., and Frongillo Jr. E.A. Rural-urban differences in obesity. *Rural Sociology*. 1996; 61(2): 289-305.
- Speake, D. L.; Cowart, M. E., and Stephens, R. Healthy lifestyle practices of rural and urban elderly. *Health Values*. 1991; 15(1): 45-51.
- Stewart, F. J. and Rosenthal, D. A. Rural and Urban Female Secondary School Students' Attitudes towards and Use of Primary Care Services. *Australian Journal of Rural Health*. 1997; 5:126-131.
- Stiernström, E. L. Holmberg S.; Thelin, A., and Svärdsudd, K. A prospective study of morbidity and mortality rates among farmers and rural and urban nonfarmers. *Journal of Clinical Epidemiology*. 2001; 54:121-126.
- Stuifbergen, A. K. Barriers and health behaviors of rural and urban persons with MS. *American Journal of Health*. 1999; 23(6): 415-425.
- Taubert, G.; Bergmeier, C.; Andresen, H.; Senges, J., and Potratz, J. Clinical profile and management of heart failure: rural community hospital vs. metropolitan heart center. *European Journal of Heart Failure*. 2001; 3:611-617.
- Taylor, M. R. H.; Lennon, B.; Holland, C. V., and Cafferkey, M. Community Study of toxoplasma antibodies in urban and rural schoolchildren aged 4 to 18 years. *Archives of Disease in Childhood*. 1997; 77(5): 406-409.
- Telfair, J.; Haque, A.; Etienne, M.; Tang, S., and Strasser, S. Rural/Urban Differences in Access to and Utilization of Services Among People in Alabama with Sickle Cell Disease. *Public Health Reports*. 2003; 118:27-36.
- Thornicroft, G.; Bisoffi, G.; De Salvia, D., and Tansella, M. Urban-rural differences in the associations between social deprivation and psychiatric service utilization in schizophrenia and all diagnoses: a case-register study in Northern Italy. *Psychological Medicine*. 1993; 23:487-496.
- Tong, S. and Drake, P. Hospital admission and mortality differentials of asthma between urban and rural populations in New South Wales. *Australian Journal of Rural Health*. 1999; 7(1): 18-22.
- Trickett, P.; Titulaer, I., and Bhatia, K. Rural, remote and metropolitan area health differentials: a summary of preliminary findings. *Australian Health Review*. 1997; 20(4): 128-137.
- Vu, H. D.; Heller, R. F.; Lim, L. L.; D'Este, C., and O'Connell, R. L. Mortality after acute myocardial infarction is lower in metropolitan regions than in non-metropolitan regions. *Journal of Epidemiology & Community Health*. 2000; 54(8): 590-5.
- Wackerbarth, S. B.; Johnson, M. M. S.; Markesbery, W. R., and Smith C.D. Urban-rural differences in a memory disorders clinical population. *Journal of the American Geriatrics Society*. 2001; 49(5): 647-650.
- Walters, K.; Breeze, E.; Wilkinson, P.; Price, G. M.; Bulpitt, C. J., and Fletcher, A. Local area deprivation and urban-rural differences in anxiety and depression among people older than 75 yrs in Britain. *American Journal of Public Health*. 2004; 94(10): 1768-1774.
- Weeks, W. B.; Kazis, L. E.; Shen, Y.; Ren, S. X.; Miller, D.; Lee, A., and Perlin, J. B. Differences in Health-Related Quality of Life in Rural and Urban Veterans. *American Journal of Public Health*. 2004; 94(10): 1762-1767.
- Weeks, W. B.; Yano, E. M., and Rubenstein, L. V. Primary Care Practice Management in Rural and Urban Veterans Health Administration Settings. *The Journal of Rural Health*. 2002; 18(2): 298-336.

Weich, S.; Twigg, L.; Holt, G.; Lewis, G., and Jones, K. Contextual risk factors for the common mental disorders in Britain: a multilevel investigation of the effects of place. *Journal of Epidemiology and Community Health*. 2003; 57:616-621.

White, C.; Halton, P., and Flowerdew, R. Country Strife. *Health Service Journal*. 1999; 20-21.

Wilcox, S.; Castro, C.; King, A. C. Housemann R., and Brownson, R. C. Determinants of leisure time physical activity in rural compared with urban. *Journal of Epidemiology and Community Health*. 2000; 54(9): 667-672.

Wilkinson, D. and Cameron, K. Cancer and cancer risk in South Australia: what evidence for a rural-urban health differential? *Australian Journal of Rural Health*. 2004; 12(2): 61-66.

Wilkinson, D. and Gunnell, D. Youth suicide trends in Australian metropolitan and non-metropolitan areas, 1988-1997. *Australian and New Zealand Journal of Psychiatry*. 2000; 34:822-828.

Wilkinson, D.; Ryan, P., and Hiller, J. Short Report. Variation in mortality rates in Australia: correlation with Indigenous status, remoteness and socio-economic deprivation. *Journal of Public Health Medicine*. 2001; 23(1): 74-77.

Windsor, H. M.; Abioye-Kuteyi, E. A.; Leber, J. M.; Morrow, S. D.; Bulsara, M. K., and Marshall, B. J. Prevalence of *Helicobacter pylori* in indigenous western Australians: comparison between urban and remote rural populations. *Medical Journal of Australia*. 2005; 182(5): 210-213.

Wing, S.; Barnett, E.; Casper, M., and Tyroler, H. A. Geographic and socioeconomic variation in the onset of decline of coronary heart disease mortality in white women. *American Journal of Public Health*. 1992; 82(2): 204-209.

Witt Prehn, A. and West, D. W. Evaluating local differences in breast cancer incidence rates: A census-based methodology (United States). *Cancer Causes and Control*. 1998; 9:511-517.

Yiannakoulis, N.; Svenson, L. W.; Hill, M. D.; Schopflocher, D. P.; Rowe, B. H.; James, R. C. ; Wielgosz, A. T., and Noseworthy, T. W. Incident cerebrovascular disease in rural and urban Alberta. *Cerebrovascular Diseases*. 2004; 17:72-78.

Zimmerman, R. K.; Santibanez, T. A.; Janosky, J. E.; Fine, M. J.; Raymund, M.; Wilson, S. A. ; Bardella, I. J.; Medsger, A. R., and Nowalk, M. P. What affects influenza vaccination rates among older patients? An analysis from inner-city, suburban, rural, and Veterans Affairs practices. *American Journal of Medicine*. 2003; 114(1): 31-38.

## References cited in Research Question 2

Barlow, J. and Williams, B. (Psychosocial Rheumatology Research Centre, School of Health and Social Science, Coventry University). Challenging Arthritis in Rural Communities. Rural Arthritis Project. Arthritis Care, Countryside Agency, Coventry University; 1999.

Bentham, G. and Haynes, R. Evaluation of a mobile branch surgery in a rural areas. *Social Science and Medicine*. 1992; 34(1): 97-102.

Burnett, T. and Mort, M. Improving Access to Healthcare for farming communities: 'The Farmers' Health Project'. 2001; Report to NHS Executive (North West) of Project RDF/LSC/99/0037.

Greener, M., Community Care Manager (Mental Health), Somerset Social Services. Rural Elders and Carers. Mental Health in the Countryside II. South Western Regional Conference Report. 1994.

Haynes, R.; Gale, S.; Mugford, M., and Davies, P. Cataract surgery in a community hospital outreach clinic: patients' costs and satisfaction. *Social Science and Medicine*. 2001; 53:1631-1640.

Kestin, K. J. and Savage, R. V. Geriatric screening in a rural practice: the financial implications. *British Journal of General Practice*. 1990; 40:513-515.

Leese, G. P.; Ahmed, S.; Newton, R. W.; Jung, R. T.; Ellingford, A.; Baines, P.; Roxburgh, S., and Coleiro, J. Use of mobile screening unit for diabetic retinopathy in rural and urban areas. *British Medical Journal*. 1993; 306(6871): 187-189.

McCavana, P. Delivering chemotherapy in rural areas: can it work? *Nursing Times*. 2000; 96(35): 35-36.

Tedesco, D. Exercise for the elderly in a rural community. *Health Visitor*. 1997; 70(1): 32-33.

## Other References

Acheson Report. Report of the independent inquiry into inequalities in health. London: Stationery Office; ISBN: 0113221738.

Black Report. Inequalities in health: report of a research working group. London:D.H.S.S.; 1980.

Bibby, P. R. and Shepherd, J. ( University of Sheffield and Birkbeck College, London). Developing a new classification of urban and rural areas - the methodology. <http://www.e-consultation.net>; 2004.

Booth, B. M. and McLaughlin, Y. S. Barriers to and need for alcohol services for women in rural populations. *Alcoholism: Clinical and Experimental Research*. 2000; 24(8):1267-1275.

British Medical Association, Board of Science. Healthcare in a rural setting. <http://www.bma.org.uk>; 2005.

Buller, H.; Morris, C., and Wright, E. (Countryside and Community Research Unit, University of Gloucestershire). The demography of rural areas: a literature review. Research report to DEFRA (draft final). 2003.

Cox, J. Poverty in rural areas. *BMJ* 1998;316:722-724

DEFRA. Activity under the England Rural Development Programme in 2001. 2002.

DEFRA. Rural policy issues for the next 3 to 5 years. A strategic framework for policy delivery. 2003.

Department of Health (Health Inequalities Unit, Department of Health). Accessibility planning: an introduction for the NHS. 2004.

Department of Health. National Service Framework for Older People. London, England; 2001 May 24; 23633.

Department of Health. Tackling health inequalities: a programme for action. 2003 Feb 7; 32366.

Jones, A.; Haynes, R.; Zhao, H.; Sauerzapf, B.; Crawford, M. and Forman, D. Report on Patient Survey. University of East Anglia. 2005

Maheswaran, R. and Elliott, P. Stroke mortality associated with living near main roads in England and Wales: a geographical study. *Stroke*. 2003; 34:2776-2780.

Muellemann, R. L. and Mueller, K. Fatal motor vehicle crashes: variations of crash characteristics within rural regions of different population densities. *Journal of Trauma*. 1996; 41(2):315-320.

Peak District Rural Deprivation Forum. Hard Times: a research report into hill farming and farming families in the Peak District.

<http://www.pdrdf.org.uk/>; 2004.

Syson-Nibbs, L. Farm Out: A participatory health needs assessment of the local agricultural community. High Peak and Dales Primary Care Trust; 2003 High Peak and Dales Primary Care Trust, Newholme Hospital, Baslow Road, Bakewell, DE45 1AD.

Winter, M. and Rushbrook L. Literature review of the English rural economy. Final report to DEFRA.

[http://www.defra.gov.uk/rural/pdfs/research/lit\\_rev\\_rural\\_econ.pdf](http://www.defra.gov.uk/rural/pdfs/research/lit_rev_rural_econ.pdf); 2003.

## **Acknowledgements**

The authors would like to acknowledge the collaboration of John Shepherd and Peter Bibby, Director and Deputy Director respectively, of the Rural Evidence Research Centre in this work.

The involvement of our steering group members David Read and Stephen O'Leary (DEFRA), Linda Syson-Nibbs (High Peak and Dales Primary Care Trust), Jan Rigby (Department of Geography, University of Sheffield), Liddy Goyder, Hannah Jordan and Andrew Booth (School of Health and Related Research, University of Sheffield) and Helen Swindlehurst and Jenny Deaville (Institute of Rural Health) was greatly appreciated.

We would also like to express our thanks to DEFRA for providing funding to undertake this work.