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CHILDRENS' HOSPITAL ADMISSIONS AND DEPRIVATION

MSc THESIS

2000

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CHAPTER 1

Introduction and Literature Review

'The very poor are unthinkable and only to be approached by the statistician and the poet'

EM Forster, Howard's End (1910)[1]

1.1. Introduction

Two of the major recent concerns of the public health establishment and politics in general have been the existence of socio-economic and regional inequalities in health. These persist, despite a near unique infrastructure of health care provision, free at the point of access.

Socio-economic deprivation is generally agreed to be the most pervasive non-medical influence on health, but there is very little knowledge about the mechanism by which the two are linked. If the health of deprived groups is to be improved, a more detailed understanding of the way poverty affects health is needed. Much research has been undertaken in this area, some of which is detailed later in this review. One of the most significant theories of recent years is that health in later life is influenced very early in life, even pre-natally. This is part of the rationale behind basing this study around children's hospital records.

There has long been an assumption in public health circles that the effect of deprivation is similar regardless of other features of an area. In actual fact, deprived areas are far from homogenous and examination of the variety of ways in which the health is affected by deprivation might illuminate how services could be improved. Are there, for example, areas where admission rates are low

despite high deprivation? Are there particular areas of Scotland with a different pattern of admissions?

Before arriving at a plan for studying such variation in children's hospital admissions, more detailed consideration of the possible influences upon them is needed. Socio-economic deprivation has already been mentioned, but other frequently studied factors include urbanicity, ethnicity and use of health services. There may also be other, less easy to define cultural or personal traits that predispose to or against frequent admission to hospital. As well as this, there is the nature of hospital services themselves, which vary from area to area in level and character of provision.

1.2.1. Deprivation

Scotland contains a large number of multiply deprived areas as well as some very affluent ones. It is possible that these account for much of the regional variation in the nation's health. In terms of children's hospital admissions, deprivation could exert an effect directly, through influencing admission behaviour, or indirectly through a general health effect. This general effect is widely studied and affects all age groups in a number of ways.

1.2.2. Socio-economic inequalities in health and their origins

In terms of most major causes of morbidity and mortality, as measured by death rates and 'perceived health' (Hunt, McEwen and McKenna 1985)[2] groups classified as being of lower socio-economic status fair worse. The biggest differences exist between the employed and the never employed, but the risk of

ill health appears to be graded throughout the entire social spectrum, even between grades of the civil service (Marmot et al 1980[3]). The presence of these inequities has been a noted concern for over a century now. Since Chadwick (1839) recorded the disparity in life expectancy between different classes of worker numerous attempts have been made to record and explain the patterns of illness and health in society.

Such inequalities still exist and far from improving in recent years, the evidence suggests the gap is widening: between 1981 and 1991 differentials in all cause mortality in the North-East of England increased for all age groups (Phillimore, Beattie and Townsend 1994)[4]. Michael Marmot, speaking at a conference in 1998, commented that if the current inequalities were considered as a form of morbidity, the excess deaths would be on a par with heart disease. In short inequalities in health are significant concern in Britain. The relatively recent Acheson report (Acheson 1998)[5] took stock of the increasing problem and recommended various strategies for tackling it. The report indicated that the problem is one of economic and social deprivation on a broader scale within society that must be tackled holistically.

While there has been much speculation as to the causes of inequalities on a macro-level, surprisingly little is known about their generation on a day-to-day basis. Acheson's independent inquiry does show signs that the structural obstacles to health for individuals are beginning to be considered, for example the presence of 'food deserts': areas where there are no accessible retail outlets selling unprocessed products. These take priority over what Acheson terms

'sexy recommendations' such as water fluoridation or free fruit for schools from the EC surplus. However, the grand theory remains much as it has done since the Black report (Townsend and Davidson 1982)[6]. Causes of inequalities can be considered in four groups: artefactual, health selection, materialist and behavioural.

Artefactual effects might include the ageing of large working class cohorts, and technical problems in the way social status is classified. Such theories have been largely discredited: the indications are that health inequalities are real and that shuffling the data makes them appear larger, rather than smaller (Dahl et al 1991)[7]. Health selection, whereby the physically healthy move up through the social strata and the unhealthy 'sink to the bottom' as a result of their infirmity, is in some ways a close relative of the artefactual hypothesis. From the point of view of this study, health selection and cohort aging are largely irrelevant, as the subjects have not had time to 'fall from grace' and have certainly not aged. Commentators have traditionally favoured materialist explanations, related to factors such as income and housing, but the behaviouralist paradigm is becoming more popular in academic and more practical circles. In response to the East End of Glasgow's poor performance in the 1998 survey of health throughout Britain, Dr Harry Burns referred to the lack of a 'culture of health' in areas such as Shettlestone. This may extend to child health, via the parents.

Wilkinson (1992)[8] introduced the concept of relative as opposed to absolute deprivation as a cause of morbidity to the debate. Examination of national level health and mortality data suggests that inequality per se can determine health:

richer nations with more socio-economic inequalities have lower life expectancies than poorer ones with a more equitable distribution of wealth. This theory, though hard to prove and inconsistent with some of the data, does hold on a more local level, as studies of GP consultations levels and relative deprivation in Bristol have demonstrated (Baker and Taylor 1997)[9]. Other commentators have argued that inequalities represent 'a failure to invest in human capital' (Davey-Smith 1996)[10] or simply the presence of absolute deprivation within society. These studies do not, however, illuminate as to what mechanisms might be causing the observed effect.

1.2.3. Deprivation and health

What is clear from the evidence presented so far is that deprivation is associated with poor health. Various commentators have suggested that this is rooted in a general vulnerability that transcends specific aetiologies (Watt and Ecob 1992)[11]. Furthermore, some also maintain that such processes begin very early in life, even pre-natally (Barker 1992)[12] and continue through childhood and adolescence. The primacy of various possible mechanisms; physiological influences in utero, the 'unhealthy life career', and stress as a result of 'relative deprivation'; are open to debate.

Watt and Ecob (1992)[13] invoke arguments about general vulnerability, beginning in early life, in their comparison of mortality in Glasgow and Edinburgh. They found that Glaswegians had an average 4 year disadvantage in terms of life expectancy, a difference likely to increase in the future due to larger differences in the younger age groups. The disparity could not be explained by cause-

specific mortality: though coronary heart disease is obviously important, all major causes of death seemed to have an influence. As Watt (1996)[14] puts it 'it is age of death, not cause, that counts'. Differences are established by early adulthood, suggesting that programmes targeting the middle aged come too late to get to the root of the problem.

Deprivation appears to be a very relevant factor in this specific instance: both Glasgow and Edinburgh contain pockets of affluence and poverty and the patterns of morbidity and mortality in these are quite similar. Glasgow however has a much greater proportion of the more markedly deprived areas (Womersley 1992)[15]. When data on smoking and lung cancer from the MIDSPAN, a prospective cohort study of more than 15,000 middle-aged men and women from Paisley and Renfrew, was compared with the Whitehall Study, differences in prevalence were found. The source of this difference was not geographical: manual workers in both groups had similar levels of morbidity and mortality. It was simply the case that the Paisley and Renfrew cohort had a higher proportion of individuals in this group.

The playing field into which individuals are born is evidently far from level from the outset on a local and national level. Some individuals begin, 'more equal than others' and continue to become more so as a result of the conditions, social, physical and personal, in which they find themselves. The disadvantaged are 'vulnerable' in ways that appear to transcend cause specific mortality. This disadvantage breeds further disadvantage. In order to try and break the vicious circle attempts have to be made to understand what processes are taking place

that cause person, place and society to act the way they do. It is becoming increasingly clear that such influences act dynamically throughout the life course and in different ways at different stages.

The roles of infancy, childhood and adolescence in the process of accumulating 'health capital' have recently attracted much academic attention. 'Early' life appears to be a pivotal period in many ways for an individual's future well being, encompassing many periods of vulnerability to the social and physical environment. These may begin even before birth, with intra-uterine environment influencing physiology in such a way as to affect birth weight and indeed future susceptibility to a number of morbid conditions (Barker 1992)[16]. Barker and his collaborators in the field have assembled a large body of evidence on the subject, starting with geographical correlations between various factors thought to indicate conditions for mothers and infants[17] and reviewing a number of biologically plausible explanations. For example, bronchitis and pneumonia in infancy was found to be associated with lower FEV (Forced Expiratory Volume) in adulthood, leading to potential problems later in life (Barker et al 1991)[18]. Barker's theory of biological vulnerability as a result of disadvantage is an appealing one and may hold some truth. However, it is clearly not the only reason for social differences in health and requires more supporting evidence (Paneth and Susser 1995)[19]. The process is clearly a complex one, with many interactions between biology and society in a number of different settings. The importance of the various influences will vary throughout an individuals' life span. For example, the very young and old will be most vulnerable to the

physical environment. This is not to understate the indirect influence of the social environment as mediated by parents.

Social differences in early life and youth beyond infancy have been studied through surveys of three British birth cohorts, born in March 1946, March 1958 and April 1970. These studies enabled data to be collected on various aspects of the health of the people concerned including morbidity, mortality and 'health' as well as information about their social development. One publication, entitled 'Born to Fail' was based on the 1958 cohort of the National Child Development Study. It underlines the multiply challenging social factors faced by disadvantaged children, ranging from family formation through education to housing (Wedge and Prosser 1973)[20]. Links between the physical, biological and social spheres are hinted at: for example in reference to the 1 in 22 children who shared (and wet) beds at age eleven the authors comment 'even when disadvantaged children were in bed, the nature of their sleep was likely to be very different from that of ordinary children'. Tired children may find it more difficult to concentrate at school and are therefore vulnerable to either learning less, or becoming disruptive and so on. They may also be less able to fight infections and 'shrug off' minor ailments.

Power et al (1991)[21] also used National Child Development Study data and were able to follow the 1958 and other cohorts further, into young adulthood. They found 'a general trend of higher prevalence of reported disease, symptoms of illness and shorter stature in lower compared to higher classes' (ibid. p152) though an inverse gradient was noted for certain conditions. This study also

observed that the upwardly mobile were healthier than the group they left, but less healthy than average for the strata which they entered. No one component of the factors investigated by the study could explain these differences on their own, but after multivariate analysis it was concluded that much was accounted for by factors measured before the age of 16. This seems to imply that class differences in health are indeed 'an invariant feature of the life course' (West 1997)[22] but finer scale investigation of these age groups revealed that the actual patterns were far from consistent. The pattern is one of initial inequality in very early life, both in terms of morbidity and mortality. There then appears to be some equalisation as individuals enter 'youth', this period being 'characterised more by the absence than presence of class differentiation' (West 1988)[23].

In summary, the evidence that deprivation affects health and particularly that of children is fairly unequivocal. With small children particularly, the influence of all the suggested mechanisms makes intuitive sense: parents mediate social influences and the physical environment can have a very tangible effect on child and later adult health. It is certainly possible therefore that hospital admissions might be affected by socio-economic status. In terms of 'missing' information, despite the huge body of literature, there is a lack of studies comparing one deprived group with another, statistically or qualitatively: in part the intention of this study.

1.3. Urban-Rural Differences

The most widely held view with regard to urban living is that cities are bad for health. There is an element of '18th Century pastoral romantic ideology

regarding the purity and salutary qualities of rural societies' (Verheij 1996)[24] about this, but by and large the evidence does bear out the conclusion. Rates for most conditions are higher in areas classified as urban and opposed to rural, notably respiratory conditions, cancers and mental conditions. The patterns for some illnesses are more marked than others: most types of cancer, for example conform to the pattern, and there are numerous studies demonstrating gradients for asthma and COPD. Thomas and Groer (1986)[25] found urban residence to be a stronger predictor of female systolic pressure than age or body mass. There is however also some evidence that urban-rural gradients have reversed for some conditions: Kruger et al (1995)[26] found that mortality between 1966 and 1970 was significantly greater in urban areas than rural (31% for men and 28% for women). The figures for 1986 to 1989 show an 8% difference the other way.

Examining urban-rural patterns in health is far from simple. A huge number of other factors relating to individual and area interact with urbanicity to produce the final effect, for example gender, ethnicity, employment and levels of education. Urban and rural areas vary widely in their nature, as do the people who live in them. Research has indicated that urban-rural disparities are not related to economic circumstances: one study which used only Medicaid recipients in Georgia as a sample found significantly higher risk ratios for cervical carcinoma in metropolitan Atlanta (Sung et al 1997)[27]. The following table, reproduced from a review by Verheij (1996)[28] summarises some of the interacting effects found in the literature:

Health problem	*Interaction: urbanicity with*	*Specification*	*Explanation*
Mental health	*Race*	*+ black urban* *- black rural*	*learned helplessness*
	Unemployment	*- urban men* *+ rural men*	*informal employment possibilities in rural areas, social support*
	Alcohol consumption	*- urban drinkers* *+ rural drinkers*	*not given*
	Age	*+ elderly urban, - young urban*	*social change*
	Marital status	*- elderly rural, + young rural* *+ urban divorced* *- rural divorced*	*stigmatisation/tolerance*
Well-being	*Physical health status*	*- bad physical health urban* *+ bad physical health rural*	*constraints in physical environment* *street violence, traffic*
	Family status	*+ married no children urban*	*ghettos relatively unhealthy*
	Race	*- married with children urban* *- poor black urban* *+ poor white urban* *+ poor black rural* *- poor white rural*	
Physical Health	*Gender*	*- female urban* *+ female rural*	*women higher exposure to unhealthy city life*
	Not having a partner	*+single urban* *-single rural*	*stigmatisation/tolerance*
	Low education		*relative deprivation*

Signs indicate the relative position of urban versus rural residents in the same (demographic or behavioural) category.
+ indicates better health status, - indicates worse health status.

Urbanicity could clearly have quite a marked effect on hospital admissions per se as well as health. This is particularly true in Scotland, which contains some of the most remote inhabited areas in Europe. In short, if a hospital admission involves travelling a long way, over water in some cases, it is less likely to take place. Ease of physical access may well explain some of the excess in urban rates.

Urban-rural differences are again a very plausible and important influence on health and hospital admissions generally. They also clearly interact with other factors such as deprivation: a feature that will be explored further in this study.

1.4.1 Access to and use of health services

Access to and use of health services is something that varies across Scotland both independently and linked with deprivation, urbanicity and the other factors considered in this review. There is a huge body of literature suggesting that socio-economic disadvantage and social exclusion compounds inequalities in service use: deprived individuals are less likely to receive the care they need. They are also a possible reason for differences between otherwise similar groups: does, for example, the risk of admission for an individual of a particular sex, age and socio-economic status depend on their geographical location within Scotland's health care infrastructure?

1.4.2. The 'Inverse Care Law'

The 'Inverse Care Law' (Tudor-Hart, 1974)[29] was based on observations of practice in the 1960s and 70s to the effect that:

'In areas with most sickness and death, general practitioners have more work, larger lists, less hospital support and inherit more clinically ineffective traditions of consultation than in the lightest areas; and hospital doctors shoulder heavier caseloads with less staff and equipment, more obsolete buildings, and suffer recurrent crises in the availability of beds and replacement staff. These trends

can be summed up as the inverse care law: that the availability of good medical care tends to vary inversely with the need of the population served'

Essentially, the more an individual needs access to care, the less likely it is that they will be in a position to receive it. In theory this should not be the case in Britain, with the NHS providing universal care, free at the point of access. While the situation is undoubtedly worse in countries such as the USA where the health infrastructure is more overtly linked to private finances, there is a large body of evidence that suggests that the delivery of care in the UK is also inequitable. The principle of the Inverse Care Law seems to apply throughout society and to every institution where a service is provided: education, law, recreational facilities, nutrition and so on.

Inequity of access could explain differences in hospital admission patterns in two ways. Firstly, deprived individuals may be more likely to attend hospital as a result of failure to access treatment at a 'lower' level, for example at a GP's practice. This may mean that their condition has through neglect reached such a stage that emergency care is necessary, or that their preferred first point of access is a hospital rather than a clinic. Secondly and perhaps more worryingly, the patterns may indicate that health in deprived areas is actually a great deal worse than the figures suggest. If inequality of access applies even at hospital level, then the numbers of people needing hospital treatment and not receiving it may be highly significant. Differences have been observed in treatment and operation rates between the deprived and the affluent, indicating that even when it comes to secondary and tertiary care, the effects of deprivation are 'amplified'[30]. Again, if

treatment for a chronic condition is deferred or denied, its severity is likely to increase.

Both of these scenarios may apply in the modern NHS, but it seems likely that the former is more widespread than the latter. The case of childhood asthma provides an illustration of how the system may be failing. The prevalence of diagnosed asthma is more or less even across socio-economic categories: in fact, even a slight reverse class gradient has been observed (West 1990)[31]. However, hospital episode rates display a marked correlation with deprivation. Chronic respiratory conditions such as asthma are managed largely through primary care, with acute exacerbations occasionally requiring hospitalisation. This implies that, although the diagnosed condition is as common in affluent as in deprived children, it is milder, or better managed in the former. There are various environmental reasons why deprived children might suffer more, but evidence on these is less conclusive than that suggesting that the children of affluent parents are receiving more effective care. Another possibility is that asthma may be more frequently diagnosed in affluent areas. In this case, differential use of health care results in alternative outcomes for the same condition.

1.4.3. Why is access unequal?

There are several possible reasons why deprived individuals are less likely to receive appropriate care than affluent ones. These operate at various levels of the system and it is not inconceivable that all of them contribute to a certain extent. The first set of issues relate to the actual provision and organisation of services.

Some areas may be better equipped per capita than others, or treatment policies may differ from one district to another. Arguably this will affect the affluent as well as the deprived, but the former will probably have more ways of circumventing any disadvantage than the latter. The second possibility relates to just this kind of situation: where services are adequate or even excellent, deprived people may be less adept at accessing them effectively. Alternatively, the deprived may be equally proficient at seeking care, but encounter more resistance or receive inferior treatment from health professionals, independently of the actual provision of services. There is evidence to support all of these scenarios.

1.4.4. Unequal provision.

The services offered by the NHS have long been recognised as varying in quality and character across the UK. In the past situations have sporadically arisen where certain operations were routinely performed in one health board area and not at all in another due to differences in policy and provision. Black et al (1995)[32] for example found 'considerable systematic variation' in rates of coronary artery bypass grafting and percutaneous transluminal coronary angioplasty, which related to the location of regional centres and specialists.

In recent years explicit attempts have been made to address this agenda and recent NHS reforms are intended to standardise provision across the country. In Scotland, the recent report 'Fair Shares for All' details the current variation in services and budgets and suggests more equitable ways of resource allocation (Arbuthnot 1997)[33]. The formula (SHARE) currently used to budget for the

various regions is now over 20 years old and part of the report's purpose was to develop an updated version. According to the new formula, the resources allocated to various regions have been above or below what was necessary. Lothian, the board containing Edinburgh, has for example been receiving 4.5% more than its assessment of need, whereas Glasgow and the Western Isles have been 1.7% and 7.2% under funded respectively[34]. In the context of this study, it should be remembered that the new formula was in part based on the demographic make up of the areas. The authors of the report, while careful not to attribute blame, clearly recognise the current situation as problematic and worthy of further investigation. Indeed, their final recommendations suggest that research is needed into unequal provision on levels not considered in their review:

'Recommendations for further work

57. The Review considers that these proposals represent the best possible evidence-based approach currently available. It also recognises that there will always be considerable scope for developing a more precise allocation of resources as fresh data and expertise emerges. Bearing this in mind it has identified the following key areas of further work which it believes could yield considerable benefits in the future:

Research into issues relating to inequalities of healthcare provision:
As mentioned at paragraph 23, the Review intends after the period of public consultation to bring forward firm recommendations for making an adjustment to

the formula to address the different levels of inequality in healthcare existing among Health Boards. In the longer term it also recommends that the Chief Scientist's Office of the Scottish Executive Health Department should make this area, where the evidence base is currently rudimentary, a priority for research funding;

Development of more comprehensive and robust epidemiological data on morbidity to provide more direct evidence on the incidence of disease in the population; further examination of the possibility that a Market Forces Factor may have a material effect in Scotland;

Development of more comprehensive data on activity in general medical services and community health services, and on the excess costs of delivering services in rural and remote areas. These are all areas where data sets are considerably less robust than in the acute hospital sector.'

This work, being a carefully put together report by an independent government committee provides a reasonably reliable base from which to speculate that an individuals location within Scotland could affect their opportunity to receive high quality care. As previously mentioned, the more educated and mobile social classes are better placed to circumvent any inequalities, further compounding the problem of the 'Market Forces Factor' referred to in the report.

Inequity in provision has also been investigated on a finer geographical scale in London (Powell 1986)[35]. This work related the levels of primary care provision

at DHA (District Health Authority) level in the inner part of the city to need, as measured by a number of census based variables similar to those used in the Carstair's and other indices and the area populations. The results were not entirely as predicted and the author summarises the findings as follows:

'while some inner city authorities (such as Paddington and Bloomsbury) seem over provided on most criteria, others (such as Newham and Wandsworth) are under provided. Similarly, while a suburban DHA like Merton and Sutton seems over provided, Barking and Havering appears to be under provided.'

In other words, there is no simple relationship between over stretched facilities and deprived inner-city areas. Variation in service levels exists within these categories. This does not necessarily mean, however, that the inverse care law does not apply. Powell's paper states that it deals exclusively with the quantity of services, meaning that issues of quality are overlooked. A good, but limited set of services operating in one area may have more effect than a large quantity of indifferent ones in another.

There is therefore some debate as to whether simply providing more money for services in some areas and not others will actually improve matters. Research by Manson-Siddle and Robinson (1999)[36] suggests that more resources do have a positive effect on inequalities without targeting the deprived, possibly because 'the needs of the articulate and more demanding affluent were already being met, and additional resources began to meet the needs of the less advocated, less empowered deprived'. Their work concerned the uptake of coronary

angiography services by various 'Lifestyle Groups'. Powell's (1986)[37] research provided worrying evidence to the contrary:

'Tower Hamlets, on the other hand, seems over provided on its staffing levels, yet less well provided considering the number of visits performed. This situation of output appearing worse than input occurs quite frequently with other high need areas, e.g. City and Hackney and West Lambeth.'

The situation in the mid-80s may be different to the present day, but these results still suggest that higher levels of financial and personnel provision do not necessarily entail more effective services, particularly in 'high need' areas.

So, concern about provision is not limited to the level of services. The type and organisation of health care is also important to effectiveness[38]. Certain types of service are judged to be more beneficial to deprived populations: possibly what is needed in some areas is not an increase in, but a reorganisation of facilities. Much of the literature in this area relates to North America, as the problems of unequal provision there are more acute than in Britain. Over a decade ago, for example, concern was being expressed that the closure of Public Hospitals in urban areas would reinforce the existing inequalities by reducing access to care for people living in poverty with no health insurance (Thorpe and Brecher 1987)[39]. At that time the emphasis in American health care policy seems to have been away from public 'welfare state' provision and towards private enterprise, a trend criticised by Smith (1986)[40] whose paper reviews the effects of withdrawal of federal government control on the provision of mental health and alcoholism

services. His conclusion was that neither local government nor grassroots organisations could be relied on to provide appropriate services. For example, AA services tended to be more frequent in areas where 'social pathology is relatively low': in other words not where they were most needed. Any review of health services should be careful to take into account which services they rationalise.

There is plenty of evidence that the organisation of care can affect levels of hospital admission, either artefactually or through better health. Good primary care services are particularly important for certain conditions. International comparisons bear this out: rates of admissions for conditions sensitive to primary care intervention are lower and less variable in Spain than in the US (Casanova and Starfield 1995)[41]. The former has a system of universal access to primary care whereas in the latter access depends on private companies and is influenced by market forces. There are many other reasons why the two countries might differ, but the PHC argument is certainly a plausible one. However, there is also some conflicting evidence to be taken into account. Gill (1997)[42] found that potentially regular access to a primary care provider did not influence the likelihood of admission in Medicaid patients. Efficient Primary Care systems should have a positive effect on health: possibly the benefits are not reflected in reduced hospital admissions rates. Particular characteristics of GP have been shown to be important in the admissions system: Thakker et al (1994)[43] found that GP and child characteristics were associated with particular routes of admission, whereas social class characteristics were not.

Another kind of facility that has been the subject of much research is the GP hospital. This is a sort of 'halfway house' between primary and emergency or hospital care. They are generally agreed to have a positive effect on both health outcomes, possibly through allowing for quicker admissions to take place. In a small number of cases, negative effects have also been observed (2.7% of cases in one study) (Aaraas et al 1998)[44]. GP hospitals also appear to reduce use of general hospitals. In Northern Norway, peripheral areas with GP hospitals were shown to have lower rates (26% for men, 28% for women) of general admission than central areas without similar facilities (Aaraas, Frde, Kristiansen and Melbye 1998)[45]. The motives for general admission were also less likely to be non-medical under this system (Aaraas, Fylkesnes and Frde 1998)[46]. This is quite significant as around 50% of admissions are made for such reasons, for example nursing needs, or distance from a general hospital.

There is some question as to whether low admissions are an entirely positive thing: possibly where they are low, individuals are not gaining access to required assistance. Many of the measures of outcome in health services research seem to be GP rather than patient centred. A good example comes from the trailing of telephone consultation services similar to NHS direct. The South Wiltshire Out Of Hours Projects (SWOOP) demonstrated that phone consultations reduced GPs workloads by 50% and were an effective way of giving medical advice, with no increase in adverse outcomes (Lattimer et al 1998)[47]. This is a positive result, but the service could conceivably discriminate against the extremely deprived: it would not work for families with no connected telephone and a vandalised payphone, for example. Furthermore, to describe symptoms usefully and

accurately over the phone requires a degree of 'biological literacy' that might not be present in some groups.

Arguably the GPs can use the extra time available to them to deal with such cases, but nevertheless care must be taken to include relevant outcome measures when reviewing services. Sometimes strategies aimed at increasing access can reduce admissions in the long run through improving health: one experiment with a 'same day' access chest pain clinic showed improved outcomes among attendees and ultimately reduced admissions (Newby, Fox, Flint and Boon 1998)[48].

To summarise, provision can vary according to extent, character and quality. All clearly have a role to play in generating inequities within the system. It seems likely that the influence of the factors will be differ according to the circumstances of the population being served. Health care is a two way process and services have to be not only provided but also used effectively. The various services described above will affect different groups of people in different ways. The next section addresses this last point further: how important is the behaviour of the 'consumer' of health services in generating differences in service outcomes?

1.4.5. Unequal usage

If provision of health care were uniform, the chances are that its use would not be. There is a great deal of evidence indicating that deprived populations access health care less effectively and less often than the affluent, despite greater need.

Consultations with GPs for example are generally less frequent (Halfon and Newacheck 1993[49], Trinder et al 1999[50]) and on average shorter in deprived areas. Immunisation targets are also less likely to be reached, independent of staffing levels (Lynch 1995)[51]. This said, the opposite has also been found in other work not focussing on adults: Saxena et al (1999)[52] found that childhood consultation rates increase with deprivation as measured by Registrar General's social class, while Cooper et al (1998)[53] 'found no evidence that children and young people's use of health services varies according to their socio-economic status'.

Deprived populations also tend to be heavier users of emergency services. Generally it is recommended that people see their GP before going to casualty, but this is infrequently the case for conditions such as asthma (Partridge et al 1997)[54]. There are issues of both quality and quantity of medical attention at work here: while deprived hospital admissions may be higher, this may be the result of problems not dealt with effectively in Primary care. Residents of deprived areas have been shown to be more likely to be admitted as emergencies for various cancers in south-east England (Pollock and Vickers 1998)[55], while 'self referral' via Accident and Emergency is more common in deprived children with respiratory problems (Stewart et al 1998)[56]. Again here there is some conflicting evidence: Thakker et al (1994)[57] for example found no association between route of admission and social class, though there was a link with GP and child characteristics. This is perhaps unsurprising and there are almost certainly cultural influences on health care seeking behaviour over and above socio-

economic factors. However, on balance it is not inconceivable that deprived populations do access services less effectively.

Why and how then, does this effect operate? Broadly speaking there are two possible mechanisms: firstly deprived populations may face tangible barriers to accessing care, or secondly there may be a problem relating to lack of knowledge or confidence in approaching a health professional. One possibility relating to the latter is that people in poverty may tolerate a higher level of ill health as 'normal' and hence will use primary care less.

Barriers to accessing care may be very practical. Lack of transport is a good example. Deprived people are less likely to have private transport (i.e. a car) and taxis are expensive. This problem will be particularly severe in rural areas: in urban areas access may be feasible, but sufficiently difficult or expensive to deter some people. Where a bus service is available, using it may entail a walk and many might consider public transport unsuitable for sick people. Anecdotal evidence suggests that taxis and even ambulances are reluctant to stop in some areas of large cities, notoriously Possilpark in Glasgow and Chapeltown in Leeds. A recent, albeit journalistic interview with a single parent in Possil uncovered the following anecdote:

'When Gina's [the interviewee] neighbour Anne-Marie's boy collapsed in the night with an asthma attack, lips blue, gasping for breath, she called a cab to take him to hospital because she felt the ambulance wouldn't come; too many doctors have been clobbered for their bags, too many ambulances ransacked'[58]

Whether or not the woman in question was correct in her assumption and the incident was reported faithfully, there is still an indication that people in Possilpark do not necessarily expect medical attention to arrive as planned: hence they may be less likely to seek it.

Other barriers might include fear of crime, or the need to look after other family members. Again anecdotal and journalistic evidence (*The Sunday Times*) suggests that some people, particularly single mothers, are reluctant to leave their homes out of fear of break ins, vandalism or even that the flat will be taken over by drug addicts. Single parents with nowhere to leave young children and no family support face several practical obstacles to getting themselves or their children medical attention without a GP making a house call: a practice which attempts have been made to reduce.

Even where no significant physical barriers exist to presenting, certain groups may also be more reluctant to consult a health professional than others. People in deprived areas tend to be less educated, which could act as a barrier to access in several ways. Firstly, they may be less able to digest information about when and when not it is appropriate to seek medical help. Often 'lay referral' under such circumstances can be equally effective, but support is not always available. This kind of problem may be compounded by a lack of confidence in approaching health professionals, a group who most people would view as highly educated. Some individuals may seek attention, but their management of

treatment might not be ideal, especially for chronic conditions such as asthma. Raymond et al (1998)[59] found that children with mild episodic asthma whose parents 'see greater negative perceived consequences of treatment' in the form of inhalers and other medication had a higher risk of re-admission. In other words, reluctance to use the medication provided resulted in more exacerbations.

A special case in this context (in Britain) are populations for whom English is a second language. This may make them less likely to present, as well as making communication during appointments more problematic. Cultural barriers extend beyond language: Muslim women for example may not wish to see a male doctor. Ethnic minorities tend to be less likely to access services on the various different levels but in some cases however, the situation is reversed: one study found that adolescents of Indian descent were more likely to consult a GP than any other ethnic group (Cooper et al 1998)[60]. Gilthorpe et al (1998)[61] found more variation in asthma hospitalisation rates by ethnicity than by deprivation, which adds support to the role of culture in health seeking behaviour. Families in various areas of the UK have been known to use Accident and Emergency as the first point of access in order to avoid registering with a GP for tax or other reasons.

The culture of different populations will include facets directly relevant to medical care, with traditions of folk medicine and support for the sick. They may also relate to the threshold at which a problem becomes severe enough to be considered worthy of medical attention. It is well recorded that deprived populations 'expect' a greater degree of ill health than affluent ones, and will

'soldier on' as normal. Some GPs (Mary Blatchford[62]) also suspect that their patients endeavour to 'protect' them from what they see as a very heavy workload. Conversely, a common complaint in the medical profession is the level of 'inappropriate' presentations which are either very low severity, or more socially than medically triggered. Some evidence supports this viewpoint: low severity admissions have been found to be higher in American non-white, poorly insured and low income patients (Rosenthal et al 1997)[63] as have 'potentially avoidable hospitalisations' (Pappas et al 1997)[64]. Studies of perceptions of conditions such as fever have been coruscating about patients' knowledge, stating that '*Parents perceive fever as being dangerous. They have a poor knowledge and measure it inaccurately*' and that '*needless consultations and hospital admissions could be avoided by a change in perception*' (Blumenthal 1998)[65]. It is perhaps unsurprising that parents, being emotionally more involved than health professionals in the well being of their children often see situations as more critical than they really are. MacFaul et al (1998)[66] found that parents did think admission was necessary more often than consultants.

1.4.6. Unequal Treatment?

Where patients do consult health professionals, they do not necessarily receive equal treatment. This is either due to a failure in communication between them and the doctor, or more worryingly within the system itself. Decisions made regarding different socio-economic groups are irrefutably different, though how systematically so is open to question. Research on admissions policy and behaviour identifies distinctive patterns for deprived people in terms of level and character of admission, but also in terms of motives.

Gray et al (1995)[67] found powerful evidence contradictory to the general conclusions of Blumenthal (1998)[68] regarding the 'competence' of parents from deprived backgrounds. Through interviews with women in inner city Los Angeles who had recently given birth, they established that such individuals do hold sensible beliefs about childbirth, but that they had difficulty accessing care of a reasonable standard. Optimal prenatal care, for example, was perceived as hard to get, while perinatal care was poor. One specific complaint was the lack of respect shown by doctors towards these women. Other international research on antenatal care supports these findings. Brown and Lumley (1993)[69] also found that deprived women in Australia were less likely to get antenatal care and be satisfied with what care they do receive. This indicates that when deprived individuals do access hospital care, they are treated unequally and inappropriately under certain circumstances.

Medical decisions regarding individuals from deprived areas are frequently based on different criteria to those that would be employed for more affluent patients. Krug et al (1997)[70] found that 'children with lower socio-economic status and limited primary care resources are more likely to be admitted from the ED for non-medical reasons than children with commercial insurance or a private physician'. Non-medical reasons might include the perceived unsuitability of the home environment for the patient, concern about parents competence and so on: in other words there are more extraneous factors which might make admission seem the best option. Cases involving the homeless provide an extreme example of these factors being taken into account: while an admission for an individual

with a comfortable home to return to might be just a safeguard, for an individual lacking shelter or warmth, it could be the difference between life and death. Lissaur et al (1993)[71] found that social factors influenced the decision to admit in 77% of homeless children, compared to 43% of controls. Admissions taking social circumstances into account are probably a positive phenomenon: they indicate that health care does sometimes work equitably rather than simply equally. Social admissions do not however necessarily account entirely for higher admission rates in deprived groups. McConnachie et al (1999)[72], for example, found that the severity of asthma (as measured by worst oxygen saturation) was greater in patients from inner city areas presenting to hospitals, indicating that in some cases at least, higher rates of hospitalisation are the result of 'greater need, not excess utilisation'.

1.4.7. Equal vs. equitable treatment.

The emerging picture is one of multiple factors interacting to make health seeking behaviour a very different experience for different social groups. Generally speaking, people who have less in common with the medical establishment, either in terms of language, education or socio-economic status, seem to gain the least benefit from it. This is the result of features of the patient, the health care infrastructure and the professionals working within it. Unfortunately, those individuals who have the least chance of accessing medical care effectively are often those who need it most: a prime example of both 'deprivation amplification' (Macintyre 1999)[73] and the inverse care law in action. Inequity of access to care does therefore seem a plausible explanation for at least

some of the observed inequalities in health in British society. The question of how to address this problem then arises.

Boddy (1999)[74] suggests three possible 'models' of health care infrastructure: the 'inequitable', the 'equal' and the 'equitable'. These really represent three points along a continuum. The 'inequitable' model is typified by the American system, in which access to care is greatly influenced by personal economic resources, private insurance and so on. An infrastructure constructed on 'equal' lines would mean that the entire population, regardless of background would have equal entitlement to care and services. The British NHS, with its principal of free at the point of access care for all, conforms in theory to this ideal, though in practice there are 'Market Forces Factors' at work, as the Arbuthnot report identifies. Inequity can and does however still exist more systematically within the 'equal' framework and it is on this basis that the 'equitable' model works. Equal entitlement does not necessarily mean that everyone has equal access to services for the reasons described previously in this document. An equitable system might therefore have to involve some positive discrimination in favour of those groups in society who are most excluded. These might include the socio-economically deprived, particular ethnic or linguistic groups, children, the elderly, women, people living in remote areas and so on. The arrangement of services and their public face may also be tailored to the populations concerned to ensure that they are working at their most effective. The NHS at present operates a 'one size fits all' system, whereby once admitted, patients are treated in the same way, but no positive discrimination takes place.

In Scotland, there are many groups who might benefit from an equitable system of health care. The biggest problems, to judge from Arbuthnot, are unsatisfactory access due to socio-economic deprivation and remoteness, combined in some cases. Within urban Scotland, there is also an ethnic and linguistic element, but this is probably less marked than in some English cities. Equitable health care in Scotland would have to take the specific needs and characteristics of excluded groups into account in order to make the services more accessible to them. This might involve logistical or financial support with factors such as transport, alterations to the system to make the interface (i.e. GPs) more 'user friendly' or health education based interventions, which might entail anything from leafleting to literacy programmes. As Virchow famously pointed out *'medicine is little more than politics on a larger scale'*, and equitable health care need not necessarily be limited to the hospital and primary care infrastructure itself: projects on, for example, housing or social problems such as drug culture might also be relevant. The system at present in Scotland does clearly involve some inequity, for reasons which while not mysterious are still not entirely clear: certainly no one is looking to blame any individual working in Scottish health care. It is possibly quite close to an 'equal' system, but given the multiple problems of many areas a shift towards 'equity' might be of benefit. How this shift might be achieved is open to question.

1.5.1. Other influences on health and hospital admissions.

There are plenty of other possible influences on health and hospital admissions as well as those already considered. Many of these relate to the behaviour of the patients themselves, or more likely in the case of this study, their parents. One influence not touched on in detail, for example, is ethnicity. In this context, ethnicity is a by-word for a different cultural complex: the way in which certain groups of people react to a given situation may differ from others. Local culture extends beyond individuals: the convention of offering help to a neighbour for example may exist in some areas but not in others. What may seem like a small thing may in fact offer the necessary logistical support needed to trigger a decision to take a sick child to Accident and Emergency. Such influences on health can be positive as well as negative: identifying the positive would be a useful goal in designing policy in the future.

1.5.2. Resilience

Not everyone who lives under adverse conditions becomes ill. Perhaps one of the most interesting questions, in establishing how to promote health, is how people resist 'the inevitable challenges [to health] in modern living'. Public health policy should, in part at least, be aimed at re-inforcing the ways in which individuals already manage themselves. Suchmann (1963)[75] states this philosophy quite overtly and succinctly:

'Retaining the same basic concepts of classical epidemiology, we seek to change human behaviour in order to (1) decrease the exposure of the host to the inevitable challenges to health in modern living (2) increase the supportive

forces of the social environment of the individual both to help him avoid unhealthy acts and to take advantage of health inducing measures (3) to decrease the effectiveness or virulence of the disease causing process.'

This hints at an alternative way of viewing the processes of health and disease: rather than simply focussing on factors which cause illness (proviso 1), the generation of well-being and resilience, or 'salutogenesis' (Antonovsky 1979)[76] also comes under examination.

Stewart et al (1997)[77]define resilience as 'the capability of individuals to cope successfully in the face of significant change, adversity or risk. This capability changes over time and is enhanced by protective factors in the individual and the environment'. Key elements of this definition are 'change, adversity or risk', 'cope successfully' and 'protective factors in the individual and the environment'. Risk and protection are central and crucial concepts in understanding resilience: essentially, they interact to produce it. The risks or stressors to which individuals are exposed are diverse in nature and specific to varying degrees to the negative outcome they promote. For example, being male is considered a risk factor for behavioural disturbances, as is exposure to damp housing for asthma in children, as are certain aspects of family structure and dynamics for malnutrition (Engle et al 1996)[78].

Protective factors, the sources of resilience, are often partitioned into those encountered on personal, family and community levels: respectively intrinsic features of the individual such as personality traits, life 'at home' and institutions

such as schools which can be considered part of broader society (Engle et al 1996[79], Stewart et al 1997[80]). Like risks these can involve the presence of certain features, for example good parental care in early life (Bradley et al 1994)[81] or the absence of their counterparts.

The precise ways in which stressors and protectors interact will vary according to specifics, but Garmezy et al (1984)[82] provide three generalised models. In the 'compensatory model' stressors act cumulatively to reduce competence, while 'ameliorators'[83] improve it: a 'simple counteractive' mechanism. The 'protective versus vulnerability model' suggests a more direct relationship between risk and protective influences. Resilient individuals remain 'relatively unaffected by increasing stress' while normal or vulnerable individuals become less competent with exposure to higher level of it. The 'challenge' model considers the possibility that low-level exposure to stressors could be a positive influence leading to an increase in competence, while overexposure may cause maladjustment.

'Cop[ing] successfully' is sometimes referred to as competent functioning, though what exactly this entails is open to question in any individual study. In many case this is a difficult concept to operationalise appropriately; for example, measuring social competence purely in terms of behaviour may miss problems such as depression in seemingly 'resilient' individuals. The tentative use of 'cope' indicates that resilience is not considered equivalent to invulnerability: often it is the ability to 'bounce back' from adversity rather than being entirely unaffected by it. Longitudinal studies have demonstrated that while the same

individuals were identifiable as consistently resilient to a given factor at various points in life, the numbers of people in the resilient group and the levels of competent functioning decreased with continued exposure to risk (Farber and Egeland 1987[84], Egeland and Kreutzer 19...[85]). Resilience therefore implies a decrease, rather than a complete absence of vulnerability.

The majority of work on resilience relates to psychological and psychiatric rather than physical outcomes. This is partly the result of the academic circles in which the interest in the term arose and partly because physical outcomes tend to be clearer cut: the need for a concept for researchers to discuss has not arisen as urgently. This does not mean the term is irrelevant however and studies have been performed relating to 'physical' health. These have focussed largely on 'vulnerable groups', particularly children, in the developing world. Vulnerability and protection on a societal level for example underpins much of the academic work on famine and endemic malnutrition (De Waal 1986[86]). Caldwell (1996) reviews the evidence on the role of resilience in children maintaining normal growth under poor nutritional conditions. Attempts have been made to study 'positive deviants' to establish what sets them apart (Pollit 1996[87], Zeitlin et al 1990[88]).

Some consideration has also been given to why children are biologically more 'vulnerable' than adults to the influence of environmental contaminants (Chance and Harmsen 1998)[89]: a plethora of plausible mechanisms could be suggested. It has been suggested that such exposures may have serious repercussions for health in later life (Barker 1992)[90]. As a result of this, this issue of physical

resilience is becoming more of an issue in the developed world. A focus on child health and development is believed by some to be crucial to the problem of the large-scale inequalities in health in Britain (Watt 1996)[91]. Possible measures are likely to be similar to those used in the developing world: negative outcomes may include retarded growth or non-organic failure to thrive[92]. Height and FEV (Forced Exhalatory Volume) have already been considered in relation to class differences and some gradient has been found at age 15 (West et al 1990)[93].

The links between resilience, psychiatric and physical health are of great interest to the Public Health researcher. These can be considered in a number of ways. Firstly, there are evidently direct connections between physical resilience and psychological factors such as cognitive ability. Engle et al (1996)[94] review findings on protein energy malnutrition and cognitive development and explore possible connections mediated by social factors such as the behaviour of the mother towards smaller children. Recent research has also demonstrated that enriched feeds for premature babies result in a higher IQ and lower incidence of cerebral palsy in treatment groups (Lucas et al 1998)[95].

The possibility that the same factors influencing psychological health also have some bearing on physical health is gaining credibility as a theory. Bradley et al (1991)[96] provide evidence that the presence certain positive aspects of childcare relating to stimulating home environments increased the resilience of low birth-weight children in physical terms. Of course the presence of these factors could also be co-incidental with better physical care. The role of factors such as self-esteem has been explored in terms of social and academic outcomes in slightly

older children but its relationship to physical health remains relatively unexplored. The mechanisms mediating such a connection could work in several ways, for example through health behaviours, but physiological links are constantly being uncovered, relating to IgA levels and other factors.

'Salutogenesis' then, can occur on a number of levels. One possible explanation for socio-economic inequalities in health is that this process, and/or the opportunities for it, varies according to class and status. Past studies have often contrasted the very affluent with the very deprived. While valuable conclusions have been drawn from this kind of work, still relatively little is known about the bottom ends of the social scale. Dr Harry Burn's comments, for example, that residents of the East End of Glasgow 'do not seem to have a culture of health' do not stand up to close scrutiny. Firstly, the 'people of the East End' will have a culture of health, just not one that might be considered favourable by a GP. Secondly, any geographical area, even one which is seemingly homogenous in socio-economic terms will contain a wide variety of individuals and families with their own distinct 'cultures' of health. These groups may have more in common with each other than with families in a different area, particularly because they are likely to be experiencing similar structural constraints to their behaviour. Nevertheless differences in how these constraints are handled will surely be present. This kind of effect could explain any differences in hospital admissions and health in general between two seemingly similar areas.

1.6.1. Questions arising from the literature review

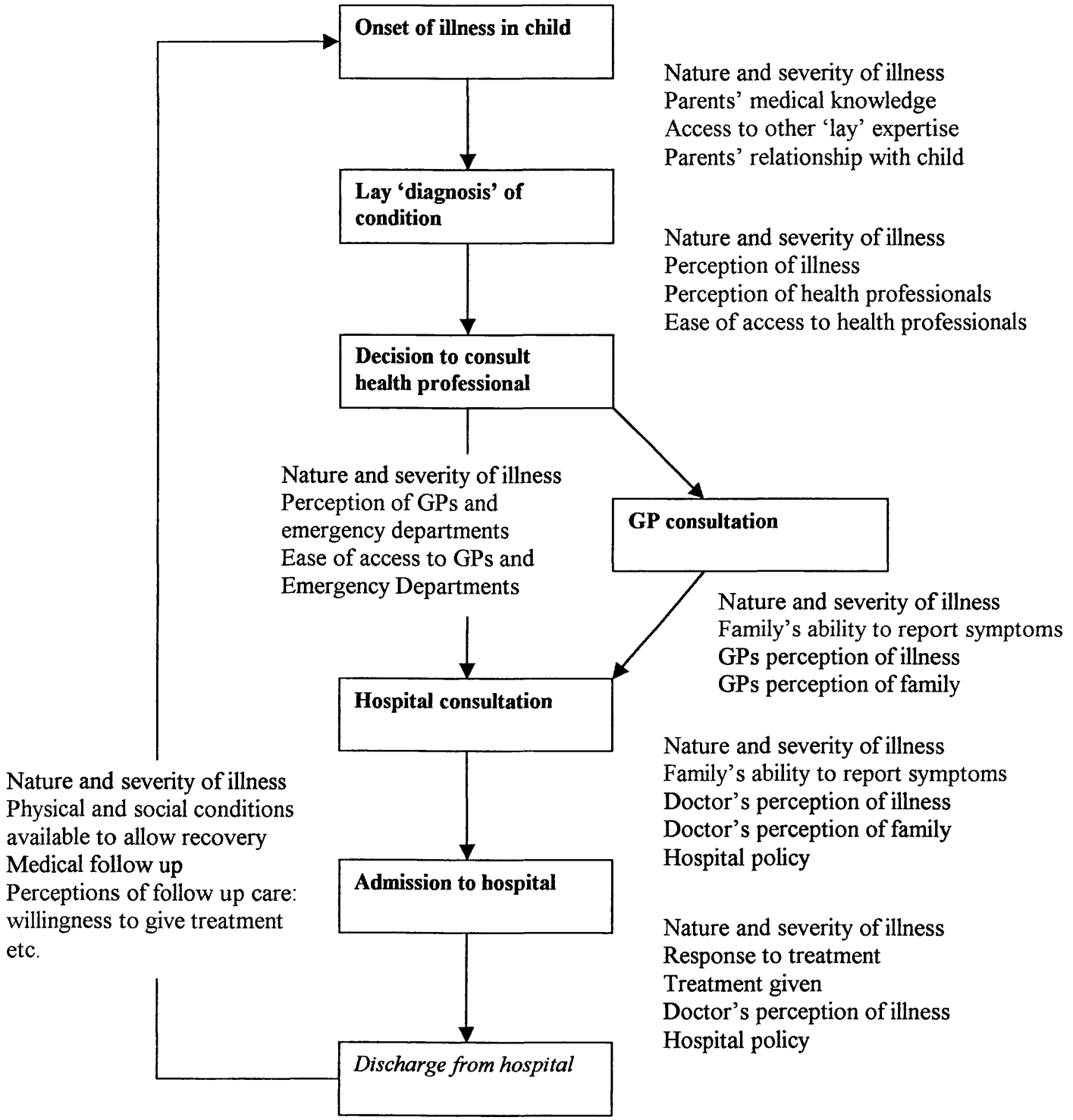
The literature has revealed a situation in which multiple influences impact on hospital admissions: many of these are related to often investigated phenomena such as deprivation, but there are other important factors to consider. The possibility that factors relating to area of residence, patient characteristics or the services themselves is an important one in that action can be taken to make changes for the better relatively easily.

The diagram below summarises some of the possible 'proximal' influences on the process of children's hospital admissions. Larger scale dimensions such as deprivation, urbanicity and local health services influence the importance of many of these factors, but the interaction between them is complex. Most of the proximal influences could conceivably be affected by more than one aspect of the families social standing and all of the factors combined determine the outcome of any potential hospital admission. Variation between individual families independent of deprivation, urbanicity or services doubtless also plays a large role: one family may have better or different medical knowledge or perception of the medical profession regardless of status. Factors such as ease of access could also be randomly distributed in relation to, say, deprivation: Glasgow has poor areas both next to, and isolated from its hospitals.

Possible proximal influences on a standard paediatric hospital admission.

'Constitution'/physical condition
Medical history
Nature of illness

'Stress'/Social environment
Physical environment



Key
Red text = Bio-medical factors
Green text = Social factors
Violet text = Practical/logistic factors
Blue text = Factors relating to health services

If services can be made more effective by simply taking the needs of the users into account, this is surely a worthwhile goal. The particular importance of children's health on long-term outcomes is also clear, therefore a focus on paediatric admissions would be a useful addition to existing work. Examination of the proximal factors requires the kind of detailed information not available from standard data, but evidence of their action can be searched for indirectly. Firstly, the effect of broad scale influences such as deprivation and urbanicity can be assessed, as can the interaction between them. By adding the extra dimension of interaction, more is hinted about the actual underlying causes of any variation. If deprivation acts in a different way in urban and rural areas for example, this suggests that the important proximal factors listed in the summary diagram could be influenced by both dimensions: speculative examples include ease of access, which may be a rural problem, physical and social conditions for recovery, which is a function of deprivation and a host of others, such as parent's medical knowledge, which might be influenced by both.

Secondly, if variation over and above deprivation and urbanicity is controlled for, differences caused by the other factors operating independently are revealed. Comparison of one deprived, urban area with another might yield such results. If the areas are in different administrative regions of the country, factors relating to health services might be the most likely cause. If this regional factor is eliminated, for example by comparing socio-economically similar wards of one city, differences resulting from either local health service variation (such as

'General Practice Effects') or even disparities in the health seeking behaviour in distinct communities remain.

The 'residual' variation in admissions is therefore as interesting as that explained by deprivation. This is true both from an intellectual and a practical point of view. Quick gains in health for deprived communities might be possible by addressing some of the proximal influences alone: if 'positive deviants' can be identified in the data and examined further, the good features of these areas could be transferred to others with beneficial effect. This is not a substitute for efforts to tackle poverty and social exclusion itself: 'antiseptic in the shit' as Julian Tudor-Hart put it on receiving his honorary degree from Glasgow University. However, while the community awaits the impact of longer-term plans, short-term gains can only be welcome.

1.6.2. How can the questions raised be investigated?

At least partial answers to many of the questions raised above can be gained from careful examination of patterns in standard data. The problem can be reduced to three main lines of enquiry:

- What systematic variation exists across Scotland in children's hospital admissions? Do the admissions in any given area or city differ markedly from another?
- What factors appear to be related to any systematic variation? Does deprivation appear to be the dominant influence on admissions, or are the other mooted factors equally important?

- Does 'residual' variation exist over and above that explained by other factors and if so what characterises it? Are there differences between areas similar in other respects?

Investigation of these problems lends itself to a hierarchical structure of analysis, in which variation is examined at several levels, eliminating potential variables as the study progresses. The study may therefore begin with some consideration of patterns on a national level across Scotland, including all social groups. If relationships with factors such as deprivation do emerge, the exact nature of these could be studied in greater detail by focussing on a national subset of deprived areas, with the aim of establishing if, say, the area of the country has an independent effect on admissions. 'Zooming in' further to examine a particular area in more detail may then provide useful insights into variation independent of local hospital policies. In essence the concept is one of focussing on smaller and smaller sub-sections of a national sample, enabling the influence of various factors to be considered independent of each other.

1.6.3. Sources of information

Means of measuring and characterising the following features of areas and individuals are required to attempt the kind of analysis suggested above:

- Areas:

  A means of subdividing the country for comparison at various levels is required. This needs furthermore to be compatible with the other measures being used. This latter requirement limits the number of available options.

The most frequently used methods of partitioning areas for ecological analyses are based on postcode sectors, which have the advantage of being readily available and providing reasonably sized populations from which to calculate rates. Postcodes sectors in Scotland aggregate into 52 Local Government Districts (LGDs) and 13 regions, which would provide three potential levels of analysis. They can also be aggregated ad hoc within cities or other areas to define populations representing particular estates or concentrations of population.

There are also disadvantages to using postcode sectors: firstly they were designed for the convenience of delivering mail and therefore do not necessarily define groups of individuals who are homogenous in terms of social background or any other demographic features. There is therefore an element of 'ecological fallacy' involved in their use: an area with a medium rate of admissions or moderate statistical deprivation may well contain a subset of very sick or very deprived individuals who are concealed by the rest of the population. This is particularly true of rural areas, where sectors tend to be larger and more mixed in social composition. Problems may therefore encountered in comparing rural and urban populations of similar socio-economic status.

An additional problem in the context of this study is that Local Government Districts and other postcode aggregations do not necessarily correspond with the way health care provision is organised in Scotland. Health Board Region is available as a means of dividing up the population, but these areas are

larger than the Local Government Districts and many contain quite a diversity of areas. Therefore, while using the Health Board Regions might arguably reflect differences in local policy more accurately, these benefits are offset by increased variability in the character of populations.

- Children's hospital admissions:

Rates of general admissions and admissions for specific conditions or groups of conditions need to be calculated for the various levels of population being considered. Data relating to their character, in terms of features such as diagnosed cause, average length of stay, age of admissions and so on are also important in examining variation over and above rates. Scotland is fortunate in having extensive standard linked data (Scottish Morbidity Record 1 or SMR-1) on individual hospital discharges dating back as far as 1981. A record is added for each consultant episode and a new one begun when, for example, a patient changes specialties. Each set of episodes combines to form a 'Continuous Inpatient Stay' (CIS) ending with discharge from the hospital as an inpatient. The information recorded includes unique individual identifiers for each patient and information on a host of variables, including postcode, mode of admission, diagnosis, length of stay, age at admission, hospital codes and details of any operations.

These data could be used to examine statistical patterns of admission across Scotland. The nature of the databases means that particular age, socio-economic and geographical groups can be identified, albeit imperfectly, on a postcode level. It is therefore possible to compare the overall patterns found

in their admissions records and identify how they vary. Population data from the 1981 and 1991 census are available at postcode sector level and the General Registry Office for Scotland makes an estimate of population for various age groups at local government district every year. Reasonable, but not perfect estimates can therefore be made for denominators[1].

- Deprivation and other social variables:

Approaches to measuring deprivation in the population have traditionally used one of two approaches. The first attempts to categorise individuals according to various features of their lives: the Registrar General's classification, based on occupation is perhaps the best known example of this. Other more sophisticated systems have also been devised: Manson-Siddle and Robinson (1999)[97] developed a scale based on different types of individuals, ranging from 'affluent achievers' to 'hard pressed families' and 'have nots'.

The second set of methods characterises areas rather than individuals. Given the area based focus of this thesis, these are the most appropriate measures to consider. Various different approaches have been developed along these lines, often based on census variables (GGHB 1995)[98]:

Townsend Indicator: This was originally derived from an equally weighted combination of four indicators from the 1981 census (unemployment, car ownership, home ownership and overcrowding). Unemployment and

[1] For further details see Method.

overcrowding were log transformed before being incorporated into the index. Townsend is generally considered to be only applicable to England and Wales and hence is not suitable for use in a thesis based on Scottish data.

Jarman Index: This instrument has its basis in a national survey of General Practitioners relating to the factors they considered added to their workload. The resulting list of census variables included measures of:

- Elderly people living alone
- Children under 5 years old
- Single parent families
- People in Social Class V
- Unemployment
- Overcrowding (not in the Scottish index)
- Transience (people having changed house in the past year)
- Ethnic Minorities (households headed by someone born in the new Commonwealth or Pakistan).

Some dissatisfaction has been expressed with the Jarman score in its guise as the 'underprivileged area index'. For the purposes of this study, which focuses on a particular age group, too many of the variable included in the index are demographically based to make the index worthwhile employing.

Carstair's Scores and DEPCATs (Carstair's 1990)[99]*:* These variables are often viewed as a specifically Scottish version of the Townsend Indicator, being based on a comparable set of census variables (Overcrowding, Male

Unemployment, Low Social Class and Car Ownership). Carstair's allows for more of the kind and level of deprivation encountered in Scotland and specifically Glasgow, which is missed by the Townsend Indicator. The Scores were updated after the 1991 census. DEPCATs (nominally short for deprivation categories) are a set of 7 categories based on the Carstair's Scores. The categories were not intended to contain equal numbers of people and the very deprived and very affluent groups are smaller than the middle, more 'moderate' groups. Carstair's DEPCATs are the most commonly used indicators of deprivation in Scotland, but might be considered too one dimensional for this study.

Principal Components and Neighbourhood types: The previous indices have been fairly uni-dimensional and deliberately constructed methods of measuring an area: they reflect almost purely its socio-economic status. The use of principal components represents something of a departure from these approaches in that a large number of variables are fed into an algorithm that reduces the data in to a number of artificial independent variables, each representing a different 'dimension' of the data.

Principal components analysis involving 29 variables from the 1991 census was used to generate principal components relating to area characteristics. The 1st Principal Component behaves in a very similar way to the Carstair's score, suggesting that it is a reflection of the socio-economic status of the area. The 2nd Principal Component reflects the urbanicity of an area, the 3rd certain aspects of its demography, while the 4th reflects levels of in and out

migration: the 'transience' of a community (McLoone 1999[100]). When used in combination, these variables can give a more two dimensional view of an area than, say, Carstair's used alone.

Cluster analysis is a multivariate technique related to principal components analysis in which a large number of variables are used to identify the presence of groups or 'clusters' of individual cases with similar characteristics. It was used with the same 29 variables employed to construct the principal components to identify 8 'neighbourhood types' within the Greater Glasgow area. These are discussed in more detail in a later chapter, but suffice to say they identify categories of Glasgow areas that 'accord well with public perceptions' (Womersley 1992[101]).

Urban Studies Index:

A more recent attempt to update Carstair's and involve non-census variables in the measurement of deprivation was made in the development of the Urban Studies deprivation index (Gibb, Kearns, Keoghan, Mackay and Turok 1999)[102]. A large number of variables were collected and standardised and the best variables for use in the final index were identified using multiple regression: eventually five were selected. The result was an indicator of a 'bad urban area' which is only really sensitive in such a context. In rural areas or those outside the worst 10% of deprived areas, the index is of little use.

It is not so much the index itself but the range of individual variables compiled by the authors that might be of value in this thesis. As the Index was devised with quite a sophisticated concept of deprivation relating to access to opportunities, many of the indicators might be quite revealing about differences between one deprived area and another: its 'culture of deprivation'. For example, two areas with similar Carstair's scores could differ in terms of non-school participation of 17 year olds, single parents or low birth weight ratios. Such differences may be quite revealing about the reasons for differences in admissions.

1.6.4. Summary

- Children's hospital admissions have been identified as a worthy subject for investigation: child health has a large bearing on outcomes later in life.
- Numerous potential influences on children's hospital admissions have been identified. Broad scale factors include deprivation, urbanicity and the nature of primary care and hospital services. These exert an effect through a host of 'proximal' factors.
- 'Residual' variation in admissions on a more individual or smaller area level may be present as the result of local or individual differences in the 'proximal' factors.
- A number of possible sources of information suitable for investigating some of the questions raise have been identified. These include hospital admissions data, population data and various established measures of the character of an area.

- A hierarchically structured analysis of standard data will allow us to assess the extent of variation in children's hospital admissions and the effects of the potential influences: deprivation, urbanicity, services and 'residual factors'.

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CHAPTER 2

Aims and Objectives

General Aims:

An investigation of the various influences on children's hospital admissions in Scotland needs to investigate several aspects of the problem as a whole. First the actual patterns to be explained must be established. Then the possible relatedness of these patterns to their potential influences must be assessed. The following set of aims could be viewed as a series of questions that define the scope of this study:

a. *How do childrens' hospital admissions vary in Scotland in terms of level and character?*

- Do general rates vary by region, local government district or at finer geographical levels?
- Is there any systematic variation in other features, such as the mean length of stay, age of admission or number of inpatient stays per patient?
- Are admissions for particular condition more prevalent in some geographical areas than others?

b. *What seems to underlie this variation?*

- Do the patterns in rates correlate with measures of socio-economic deprivation, urbanicity or other census based variables?
- Are there any patterns independent of socio-economic variation or urbanicity?
- Might these be explained by local differences in admissions policy on the part of the health care providers, or health seeking behaviour on the part of the users?

c. *How important are these various underlying factors and how do they interact?*

- Which of the aforementioned factors appears to have the greatest effect on hospital admissions?
- Do factors such as socio-economic deprivation affect urban and rural groups in the same way?

Null hypotheses:

The following represent a number of possible specific lines of enquiry that may help answer the more general questions posed by the thesis. The term admission patterns refers to not only level (e.g. General rates per 1000) but also features of the admissions themselves, such as lengths of stay and diagnostic profile: one areas admissions may, for example, be dominated by different conditions to another.

a. An individual's location in Scotland does not affect their likelihood of admission.
b. Variations in admission patterns between local government districts are not related to their socio-economic or urban/rural composition.
c. Rural admission patterns do not differ from urban admission patterns in level or character.
d. Deprived admission patterns do not differ from affluent admission patterns in level or character.
e. All medical conditions react in a similar way to deprivation, urbanicity and regional differences.
f. Deprived rural admission patterns do not differ from deprived urban admission patterns in level or character.

g. There is only one characteristic pattern of admission in deprived areas.

h. Hospital admissions are affected in the same ways by deprivation and urbanicity regardless of location.

i. There is no variation in patterns of admission between deprived urban areas.

j. There is no variation in patterns of admission between areas in Glasgow.

CHAPTER 3

METHODS AND OBJECTIVES

Objectives:

a. To examine the information available in the standard SMR-1 hospital discharge data.

b. To link this with recent census and non-census based data relating to area characteristics.

c. To explore variation in patterns and levels of admission across Scotland on a macro- and micro-level.

d. To explore the various factors underlying this variation.

e. By means of this analysis of standard data and relevant literature, to speculate as to some of the causal mechanisms involved in creating variation in health and admissions.

Method:

The study was based around two cohorts of Scottish individuals born between 1981 and 1983 and 1991 and 1993. Information relating to the hospital admission records of these groups and the areas in which they were born was extracted and examined in various ways.

Data for the project came from a number of separate sources. Hospital admissions material came from the Information and Statistics Division (ISD) of the NHS in Scotland's linked Scottish Morbidity Records (SMR-1) dataset and was accessed via the Glasgow University Public Health Research Unit (PHRU) server by Heather Baillie. Population data were extracted from ONS/OPCS mid year estimates for local

government districts and from the 1981 and 1991 census at postcode level. This was all kindly provided by the General Registry Office for Scotland, with the exception of the 1981 postcode level figures, which were extracted directly from the census database held in the Glasgow University library by the author. The census based socio-economic and urban-rural principal components scores were supplied by Philip McLoone of the MRC Social and Public Health Sciences Unit and the Urban Studies Deprivation Index data came from the Glasgow University Urban Studies Department with permission from the Scottish Office. The various sources of information and the ways in which they were treated are described in more detail below:

SMR-1 data:

Origins: SMR-1 data are compiled from discharge records maintained by all Scottish hospitals. An SMR-1 form is completed for every finished consultant episode and includes various details about the patient (including name, address and date of birth) and the episode itself (including type of admission and up to six diagnoses). A 'finished consultant episode' can end either with discharge from hospital, or transfer within the hospital system, for example to another specialty. These records are linked at ISD by surname (using a name compression algorithm), sex and date of birth to created anonymised datasets with unique identifiers for individuals (Kendrick and Clarke 1993)[1]. At the time of writing complete records were available from 1981 to 1995.

As a result of this process, Scottish hospital admissions data rank among the best in the world in terms of coverage and detail. The linked datasets contain information on 100% of admissions in all Scottish hospitals. It is this high quality that provides the

opportunity for studies such as this one: while standard data exist, it may as well be examined. However, as with any source of information, there are also disadvantages to be borne in mind. As is inevitable with a large body of data not compiled specifically for research there are many quirks and inaccuracies. Diagnoses and ICD diagnostic codings are not necessarily accurate and neither are personal details. The data eventually extracted for this project for example contained a number (admittedly less than 5) of divorced children under the age of 12 months. Individual records are occasionally duplicated or missing and a number of variables generated post-hoc are less reliable as a result, for example the CIS (continuous inpatient stay) variable. These slight inadequacies do not however detract significantly from they usefulness of the data, but should not be forgotten when analysing it.

Treatment:

Data were extracted by Heather Baillie from the PHRU server covering all admissions (i.e. First admissions and subsequent records) for the two three-year birth cohorts (born 1981 to 1983 and 1991 to 1993). As dates of birth are not available in the SMR-1 data, it was necessary to use the age and date of admission variables to define these groups. Data were therefore extracted for:

1981 to 1983 cohort: Individuals aged 0 in 1981

Individuals aged 0 and 1 in 1982

Individuals aged 0, 1 and 2 in 1983

Individuals aged 1, 2 and 3 in 1984

Individuals aged 2, 3 and 4 in 1985

Individuals aged 3, 4 and 5 in 1986

Etc.

1991 to 1993 cohort: Individuals aged 0 in 1991

Individuals aged 0 and 1 in 1992

Individuals aged 0, 1 and 2 in 1993

Individuals aged 1, 2 and 3 in 1994

Individuals aged 2, 3 and 4 in 1995

The records were then 'filtered' more finely using the age in months and date of admission to ensure that no individuals outside the two cohorts had part of their admissions record included in the data.

It was necessary to identify and remove duplicate records from the dataset, including records accidentally entered twice into the full SMR database and records extracted twice as a result of overlap between the age groups in any given year. Syntax was devised to identify these on the basis of unique individual identifiers, CIS, date of admission and discharge, type of admission, diagnoses and any operations.

In fact, no duplicates were identified in either cohort using this method. However, when variables relating to operations (e.g. date of operation) were omitted from the analysis up to 1% were flagged. This suggests that operations are coded as separate records in some Scottish hospitals. The potential for distortion to the findings due to this practice was judged to be small.

Data were cleaned for obviously nonsensical values and some variables recoded for ease of analysis. International Classification of Disease (ICD) codings, used to indicate the diagnosis for each record, were desensitised to three figure codes and then categorised into a number of groups[1].

In order to allow for easier comparison between the two cohorts, a subset of the 1981-3 data was created containing no records with dates of discharge after the 31st December 1985. This meant that the cohorts had been 'running' for the same amount of time and that rate would be directly comparable.

The resulting data sets contained 99732 (1981-83 cohort) and 123647 (1991-93 cohort) records for 59213 and 65967 individuals respectively. This gives an average of 1.7 admissions per person for the 1981-3 cohort and 1.9 admissions per person for the 1991-3 cohort.

Population data:

Origins: In order to calculate admission rates, it was necessary to establish or at least approximate the size of the birth cohort at area, local government district and postcode level. The best available approximation of the first two was the OPCS mid-year population estimates, while the only data available at postcode level came from the 1981 and 1991 censuses. The latter is less reliable, as firstly only five-year age group data were available and secondly this did not correspond exactly to the cohorts being studied. The former was available in one-year age groups, and it was possible to compose a denominator equivalent to the size of both cohorts at birth.

[1] See Appendix 1

Treatment:

1. The following data were obtained from Peter Jamieson at the General Registry Office for Scotland (GRO Scotland) and the GRO CD Rom held by the Glasgow University Library:

i. Mid-year population estimates by one-year age groups (ages 0 to 15) for Local Government Districts in Scotland, 1981 to 1995.

ii. Census population figures by postcode sector, including part postcodes, in 1981 (GU Library) and 1991 (GRO) for the 0-4 year old age group in the former and 0 to 15 by five year age groups in the latter.

2. The denominators were composed as follows:

Local government district level: Using Mid-year population estimates:

1981-3 cohort at birth: Individuals aged 0 in 1981, 1982 and 1983

1991-3 cohort at birth: Individuals aged 0 in 1991, 1992 and 1993

Local government district codings and in some cases boundaries were changed in 1986. The pre 1986 LGD were recoded to correspond with their closest post-1986 equivalents, but the 1981 and 1991 data are therefore not entirely comparable. Fortunately the change took place after the period of retrospective study for the 1981-3 cohort so the LGD rates will remain reliable.

Postcode level: Using 1981 and 1991 census data as appropriate the size of the cohorts at birth were estimated using the following method:

1981-3 cohort: Individuals aged 0-4 in 1981, divided by 5 then multiplied by 3

1991-3 cohort: Age 0-4 in 1991 divided by 5 then multiplied by 3

An assumption was made that the number of individuals in each year group at postcode level was equal. The alternative would have been to take proportions from the one-year age groups by local government district. However these were unlikely to be representative of the demographic situation in all of the areas within them. The method used here, therefore, makes fewer potentially erroneous assumptions.

Area level: Area denominators were calculated by totalling the local government district populations as appropriate.

Area based data:

There are many possible ways to characterise areas and a host of information available to do so as discussed in the literature review. The most commonly used area measures in Scotland are Carstairs DEPCATs (Deprivation Categories). However, the measures chosen for this study include the socio-economic and urban-rural principal components developed from the 1991 census, the Glasgow 'Neighbourhood Types' and individual sets of data from the Urban Studies Index[2]. These indices were chosen on the grounds that Carstair's scores were becoming overused and too one-dimensional for a study of this nature. The principal component are based on more information than Carstair's and the urban-rural index provides a valuable extra dimension, as do the individual variables from the Urban Studies index work. This said, the socio-economic principal component does approximate closely to Carstair's Scores (McLoone 1999[2]). The 'Neighbourhood Types' classification offers an

[2] See Literature Review, Section 1.6.3. for further details of these measures.

excellent system of distinguishing between areas specific to Glasgow which is extremely useful for finer scale analysis[3]. There was also an element of convenience: all of the indices were developed in Glasgow and were available through the University.

Principal components:

Standardised scores for these variables were obtained for postcodes and part postcodes from Philip McLoone. Scores were totalled and a mean value calculated to give some indication of the character of Local Government districts and region in relation to each other.

Neighbourhood types:

The classification for each Glasgow postcode was read from a map included in The Annual Report of the Director of Public Health for Glasgow (1990)[3] by the author.

Urban Studies Deprivation Index: individual variables:

While not all of the variables examined by the working group were included in the final index, standardised scores were generated for a large number of variables. These were available at postcode but not part postcode level. The scores were accessed via the Urban Studies department with permission from the Scottish Office.

Databases were created in SPSS linking all the information compiled on using postcode and local government district as markers. It was then possible to generate rates and confidence intervals and manipulate the data in various ways.

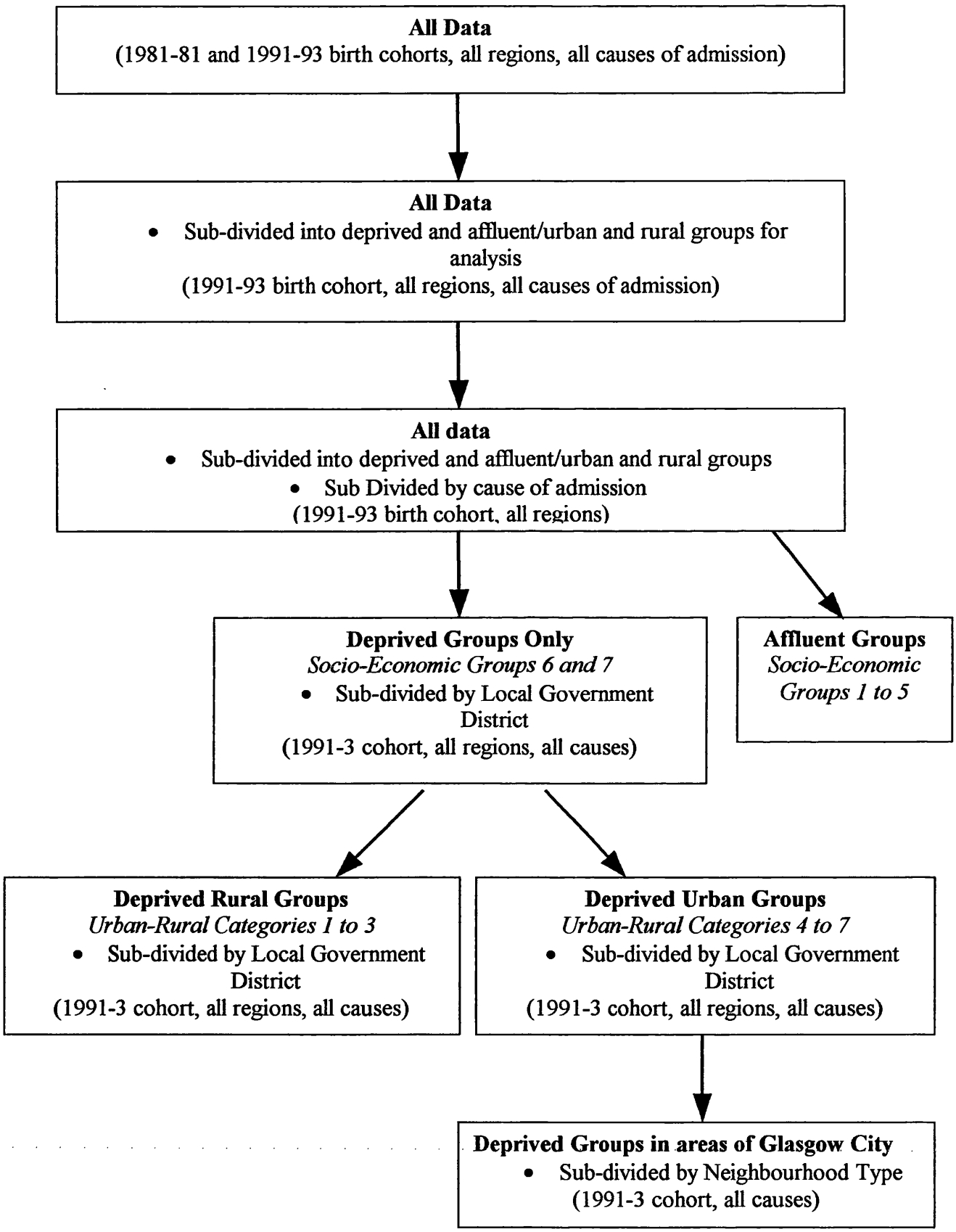
[3] See Chapter 12 for further details

Data analysis strategy:

With such a large amount of data and a relatively complex problem to be tackled, a strategy was needed for analysis of the data. The idea of a hierarchical approach, focussing increasingly on smaller and smaller subsets of the data has already been discussed.

The chart below represents the plan of analysis diagrammatically: as can be seen the early chapters use all of the cohort data broken down in various ways. Later, affluent groups are discarded and the analysis focuses only on the most deprived two of seven socio-economic groups. More detail on how these groups were created will be given in the relevant chapters for the sake of clarity. The deprived groups were then further divided into those from urban and rural areas for comparison and finally a subset solely from within the Glasgow City local government district was extracted and sub-divided by the neighbourhood type discussed in the literature review and method.

Diagrammatic representation of data analysis strategy:



A thumbnail of the preceding chart will be reproduced at the beginning of each chapter, shaded to make clear exactly which subset of the data is being examined. Some chapters may also contain a further method section, giving details of any data handling specific to that particular section omitted here for the sake of clarity.

Summary:

- Data were extracted giving information on hospital admissions, population size and various area based measures for two birth cohorts. These include all children born in Scotland in the periods 1981-1983 and 1991-1993.
- The source of information on hospital admissions was the Scottish Morbidity Record 1 (SMR-1) dataset which contains records of every hospital episode which occurred throughout Scotland from 1981-1995.
- Population data were extracted from mid year population estimates at local government district level and from census data at postcode level.
- Values for area based data on socio-economic deprivation, urbanicity and other specific features were assigned to postcode sectors. Patients and records were linked to postcode through the SMR-1 dataset.
- The measures of socio-economic deprivation and urbanicity used were the 1st and 2nd Principal Components devised by Philip McLoone from 1991 census data. Other information came from individual variables used in the construction of the Urban Studies index.
- A hierarchical approach was adopted as a strategy of analysis. Some of the chapters focus on particular subsets of the data.
- Further technical details of the analysis will be given in each chapter.

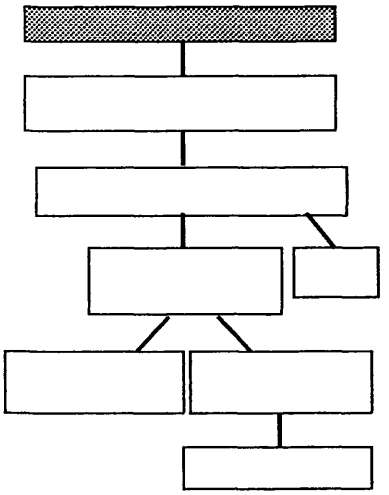
[1] Kendrick S, Clarke J. The Scottish Record Linkage System. *Health Bulletin* 1993; 51(2): 72-79.

[2] McLoone, P. Personal Communication. 1999.
[3] Glasgow Greater Health Board. 'The Annual Report of the Director of Public Health' 1990.

CHAPTER 4

Variation in children's hospital admissions across Scotland at regional level

Data being used (See Chapter 3 for full size diagram):



All Data
(1991-93 birth cohort, all regions, all causes of admission)

Relevant null hypotheses:

- An individual's location in Scotland does not affect their likelihood of admission.
- Variation in admission rates between local government district is not related to their socio-economic or urban-rural composition.

4.1. Introduction:

This chapter starts the analysis at its broadest scale: examining the variation across the whole of Scotland for children of all social backgrounds. The aim is at least partly exploratory: to investigate the extent of variation present in the 1981-3 and 1991-3 cohorts without paying too much attention to what underlies it. This 'variation' encompasses the level of hospital use in terms of general admission (or more accurately discharge[1]) rates, the character of the hospital episodes the children are experiencing and the range of conditions for which they are being admitted.

The two cohorts will be compared in these terms to give an impression of if and how the situation in Scotland has changed over time. Have general admissions rates increased overall? Is there more variation between regions now than there was previously? If changes have occurred, where have they happened? This provides a useful context for the whole study and gives an impression of how typical the two cohorts are.

Comparisons will also be made between areas at two levels: the 12 former regions and the 56 local government districts. This should reveal some answers to the first suggested null hypothesis: some regions or local government districts may display a distinctive level or character of admissions. The next stage of the analysis relates to both null hypotheses and involves assessing how systematic any variation is. There may be marked geographical patterns in admissions: an east-west divide for example. General admissions rates and characteristics may also correlate with the Principal Component measures of deprivation and urbanicity being employed throughout this study. On the evidence presented so far, it seems likely that the more urban and deprived regions and local government district will have higher rates.

4.2. The regions of Scotland: size of the study cohorts and general character

The largest aggregations of population studied were the 12 former regions of Scotland. These represent administrative districts to a certain extent, and vary greatly in the size of the study population. Orkney, for example contained only 729 individuals in the 1991 cohort, while Strathclyde's cohort numbered 89640. A mean value for the principal component variables was calculated for each region by totalling the individual

[1] Scottish Morbidity Record-1 (SMR-1) data record discharges from hospital rather than admissions.

values for postcode sectors and dividing appropriately. This was used to reflect quantitatively the character of the various areas. The cohort populations and these census-based figures are given below:

Table 4a:
The size of the study cohort and the socio-economic/urban rural character of the Scottish regions.

Area	*Cohort Population 1981-83*[2]	*Cohort Population 1991-93*[3]	*Value of Socio-economic PC*[4]	*Value of Urban-Rural PC*[5]	*Carstair's Score 1991*
Borders	*3358*	*3724*	*-.11*	*-1.03*	*-2.14*
Central	*10305*	*10418*	*.02*	*.02*	*-1.72*
Dumfries	*4581*	*5348*	*.21*	*-1.05*	*-1.23*
Fife	*13672*	*13144*	*.04*	*.11*	*-.98*
Grampian	*19440*	*20432*	*-.41*	*-.60*	*-2.72*
Highland	*8078*	*7988*	*.15*	*-1.05*	*-.94*
Lothian	*26942*	*28927*	*-.50*	*.55*	*-1.34*
Strathclyde	*96107*	*89640*	*.21*	*.47*	*.80*
Tayside	*14386*	*14621*	*-.10*	*-.33*	*-1.41*
Orkney	*709*	*729*	*.11*	*-1.41*	*-1.60*
Shetland	*989*	*991*	*-.04*	*-.83*	*-1.85*
Western Isles	*1162*	*993*	*.52*	*-1.01*	*.95*
SCOTLAND	*199729*	*196955*	*0.0*	*-0.51*	*-1.18*

The size of the study cohort in all the areas remained relatively constant between 1981 and 1991, meaning that it is reasonable to compare admissions rates for these two periods: there have been no potentially distorting demographic changes over time. There is a fair amount of variation in the character of the regions as measured by the various census-based measures. The Carstair's scores correspond reasonably well with the socio-economic principal component, with regions scoring as deprived on one being assessed as similar by the other. The Western Isles is the most deprived region on both scales, with other low status areas including Strathclyde, the Highlands,

[2]Population aged 0-36 months in 1983
[3]Population aged 0-36 months in 1993
[4] Higher values imply more deprived, lower values imply more affluent on average.

Orkney and Dumfries. Affluent areas include Lothian, Grampian and the Borders. The urban-rural distribution is arranged much as might be predicted, with Orkney at one end and regions containing the Scottish urban centres at the other. Interestingly, with the exception of Strathclyde, the more rural regions tend to be the most deprived.

4.3. General admission rates for the Regions

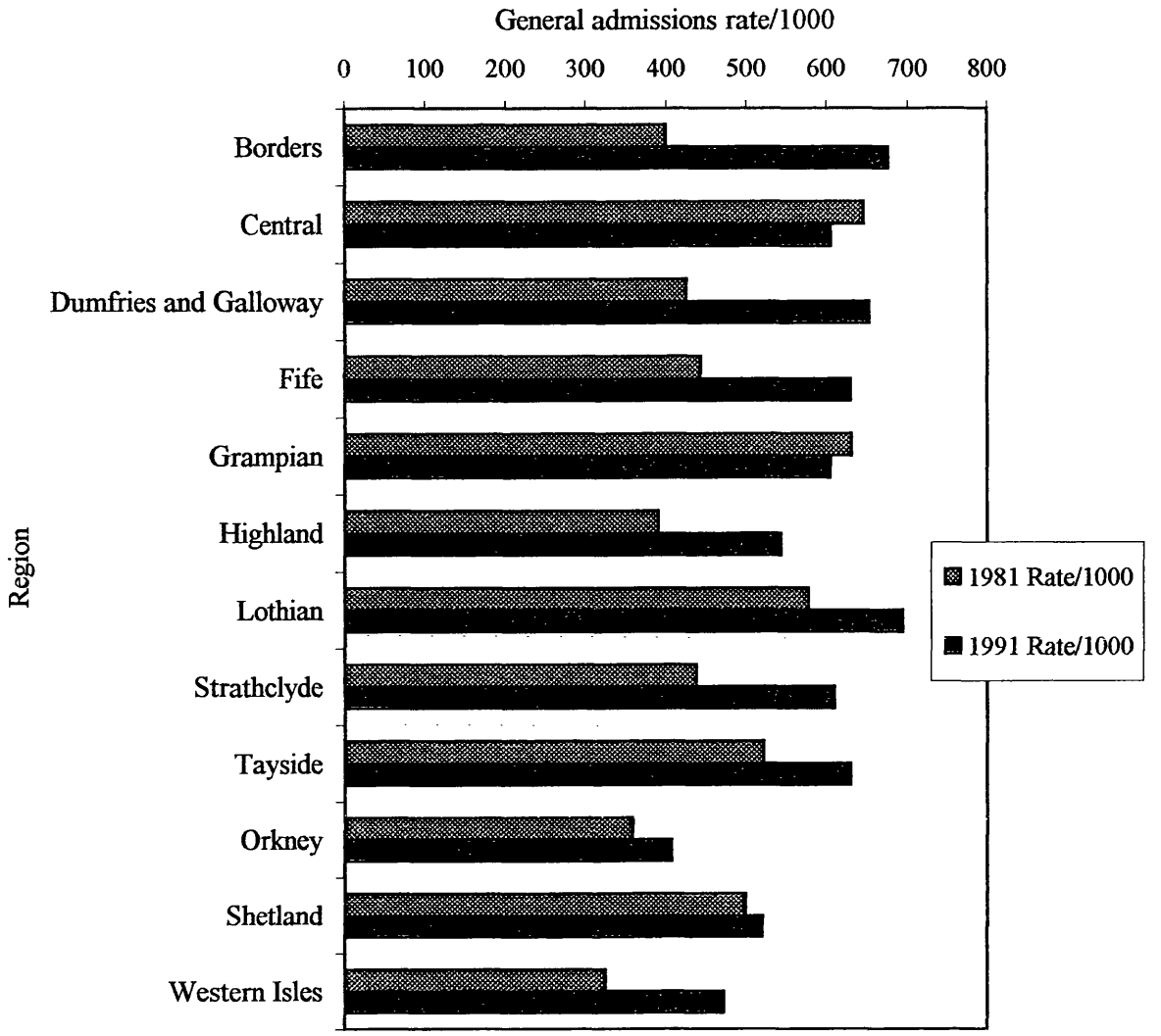
The following table investigates general changes in level of admission over time and attempts to establish the presence or absence of systematic variation in the likelihood of admission across Scotland. Rates per 1000 were calculated for 1981 and 1991 data in each area. These are reproduced below, with confidence intervals:

Table 4b: General admission rates for the 1981-3 and 1991-3 cohorts by region

Area	*1981 Rate/1000*	*95% Confidence Interval*	*1991 Rate/1000*	*95% Confidence Interval*
Borders	*399.34*	*382.40 - 416.30*	*676.15*	*660.8 - 691.5*
Central	*647.06*	*637.70 - 656.50*	*605.87*	*596.3 - 615.5*
Dumfries and Galloway	*424.80*	*410.20 - 439.40*	*653.33*	*640.3 - 666.3*
Fife	*443.39*	*434.90 - 451.90*	*630.25*	*621.8 - 638.7*
Grampian	*630.81*	*623.90 - 637.70*	*605.37*	*598.5 - 612.2*
Highland	*388.96*	*378.10 - 399.80*	*541.56*	*530.4 - 552.7*
Lothian	*577.20*	*571.20 - 583.20*	*693.23*	*687.8 - 698.7*
Strathclyde	*437.92*	*434.70 - 441.10*	*609.52*	*606.3 - 612.8*
Tayside	*519.88*	*511.60 - 528.20*	*630.39*	*622.4 - 638.4*
Orkney	*356.84*	*320.90 - 392.80*	*406.08*	*369.7 - 442.4*
Shetland	*497.47*	*465.70 - 529.30*	*518.67*	*486.9 - 550.4*
Western Isles	*323.58*	*296.10 - 351.00*	*471.30*	*439.6 - 503.0*
Mean Rate	*470.60*		*586.81*	

Figure 4a: General admission rates for the 1981-3 and 1991-3 cohorts by region

[5] Higher values imply more urban, lower values imply more rural on average.



The pattern shown by these data is one of increase and equalisation, with rates rising over time especially in those areas with low rates for the 1981-3 cohort. This is consistent with patterns observed elsewhere (Hyndman 1996).

The 1991-3 cohort's general admission rates are higher overall with a mean of 586 per 1000 as compared with 470.6 per 1000 for the 1981-83 cohort. There is more uniformity in the later cohort: the standard deviation decreases from 100.6 per 1000 to 82.38 per 1000, due largely to apparent increases in the lower rate areas. The

Grampian and Central regions are the only exceptions to the overall trend of increase: both appear to have experienced a slight fall in general admission rates.

The 1981 data show a rough dichotomy between rural and urban Scotland in terms of overall rate. Areas with a negative score on the urban-rural principal component (Borders, Highland, Orkney, Dumfries and Galloway and the Western Isles) form a group with discharge rates mostly between 300 and 450 per 1000: low in comparison to more traditionally urban or populated areas such as Central Scotland, Tayside and Lothian, which have rates in excess of 500 per 1000. There are a few unpredictable results suggestive of 'residual' variation: the Grampian region, which ranks as moderately rural, has a very high admission rate, while the figure for Strathclyde, the highly urban region containing Glasgow, is surprisingly low at 437.93 per 1000. Unlike Shetland, which is also unusually high, both of these rates are based on large denominators and hence are fairly reliable. One possibility is that both Grampian and Strathclyde are fairly large regions containing a number of contrasting areas that would behave more predictably were they to be investigated.

The 1991-93 figures demonstrate an equalisation in admission rates as well as the general rise already discussed. The largest increases in rates are in the rural but accessible regions such as the Borders and Dumfries and Galloway. Strathclyde has increased to a level still below, but realistically close to the rest of urban Scotland, while rates in Grampian have actually fallen slightly. Orkney, Shetland and the Western Isles remain relatively low, but these could be considered special cases, both geographically and statistically. The picture for the 1991-3 cohort is therefore one of more limited, but less explicable variation in area rates.

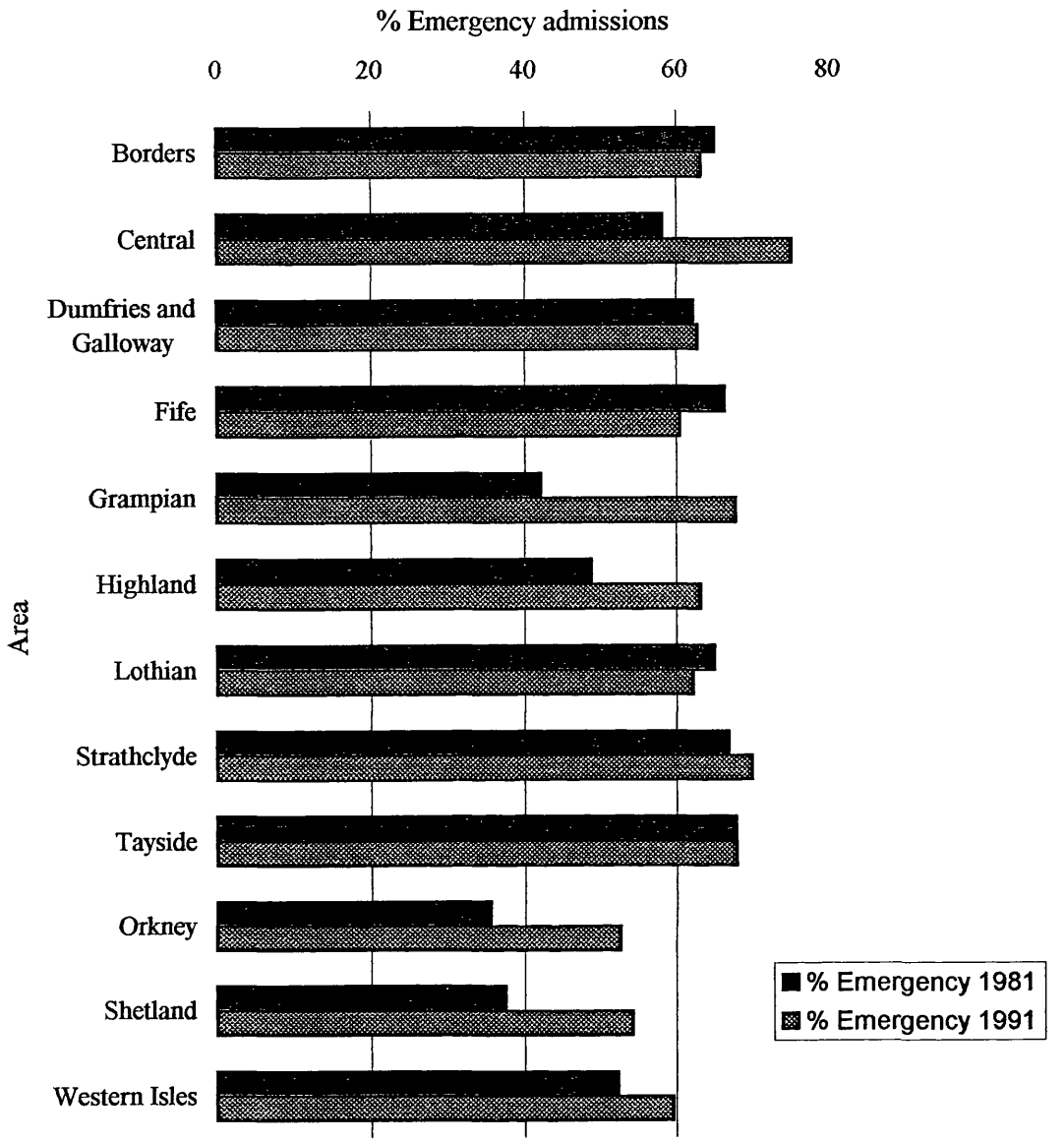
4.4. The character of admissions in the regions: the proportion of emergency admissions.

Perhaps the simplest indicator of the character of hospital admissions in an area is the proportion of hospital episodes where the patient is admitted as an emergency. These are clearly quite different in nature to elective admissions, both in the manner in which children arrive at hospital but also in the build up to this and the kind of services needed to manage them. The nature of admission to hospital is recorded for each record (one record per continuous inpatient stay) in the SMR-1 hospital admissions data and these codings were used to identify emergency admissions. It was therefore simple to work out a proportion for each area. These figures are expressed below as percentages:

Table 4c: Percentage of emergency admissions, 1981-3 and 1991-3 cohorts

Area	*% Emergency Admissions 1981-3*	*95% Confidence Interval*	*% Emergency Admissions 1991-3*	*95% Confidence interval*
Borders	*65.2*	*62.65 to 67.75*	*63.4*	*60.82 to 65.98*
Central	*58.2*	*57.02 to 59.38*	*75.1*	*74.06 to 76.14*
Dumfries and Galloway	*62.3*	*60.15 to 64.45*	*62.9*	*60.75 to 65.05*
Fife	*66.5*	*65.31 to 67.69*	*60.5*	*59.27 to 61.73*
Grampian	*42.2*	*41.33 to 43.07*	*68.0*	*67.17 to 68.83*
Highland	*49.0*	*47.25 to 50.75*	*63.3*	*61.61 to 64.99*
Lothian	*65.1*	*64.35 to 65.85*	*62.2*	*61.44 to 62.96*
Strathclyde	*67.1*	*66.65 to 67.55*	*70.1*	*69.66 to 70.54*
Tayside	*68.0*	*66.94 to 69.06*	*68.1*	*67.04 to 69.16*
Orkney	*35.6*	*29.70 to 41.50*	*52.7*	*46.55 to 58.85*
Shetland	*37.6*	*33.32 to 41.88*	*54.3*	*49.90 to 58.70*
Western Isles	*52.4*	*47.35 to 57.45*	*59.6*	*54.64 to 64.56*
Mean	*55.8*		*63.4*	

Figure 4b: Percentage of emergency admissions, 1981-3 and 1991-3 cohorts



The proportion of emergency admissions has increased overall over time, from a mean of 55.8% for the 1981-83 cohort to 63.4% for the 1991-93 cohort. This rise is far from universal however, with the majority of the increase in areas that in 1981 had a low percentage of emergency admissions. Accordingly, the distribution of proportions has become more uniform, resulting in a fall in the standard deviation from 11.5% to

6.1%. In effect, the more remote areas appear to have 'caught up', possibly due to improvements in transport and logistical access generally.

For the 1981-3 cohort, a perhaps unsurprising divide appears to have been present between remote, rural Scotland and the more populated, accessible areas. The remote areas have a markedly lower proportion of emergencies. Interestingly, Grampian, despite its high general discharge rate, falls into line with the more rural areas in the number of admissions that were emergencies.

The proportion of emergency admissions has undergone a similar change to general rates with increases in the proportion in most of the more remote and rural reasons and limited change in urban Scotland. The most noticeable trend within the cohort data is a tendency for rates to increase with urbanicity.

4.5. Relationship of the general and emergency admission rates with the character of the regions: correlations with the socio-economic and urban-rural principal components

Examining the data qualitatively, some suggestion of a systematic relationship between urbanicity and general admissions rates is evident. This idea needs testing more formally, as does the possibility of a relationship with deprivation. Values for both the socio-economic principal and urban-rural principal component have been established for each of the regions, as have admission rates. It remains only to combine the two.

Pearson correlations between the general and emergency rates and the regional principal component values were generated for the 1991-3 cohort. No correlations were generated for the 1981-cohort data as the principal components are based on data from 1991 and the meaning of any relationship would have been limited. The correlation matrix giving values of R for each of the paired relationships is given below:

Table 1d: Pearson correlations between regional general rates, emergency rates and the socio-economic and urban-rural principal components (PCs) at regional level.

		Value of socio-economic PC	*Value of urban-rural PC*	*General Admissions Rate*	*Emergency Admissions Rate*
Value of socio-economic PC	*Pearson Correlation*	*1.000*			
	Sig. (2-tailed)	.			
	N	*12*			
Value of urban-rural PC	*Pearson Correlation*	*-.381*	*1.000*		
	Sig. (2-tailed)	*.221*	.		
	N	*12*	*12*		
General Admissions Rate	*Pearson Correlation*	*-.087*	*.709***	*1.000*	
	Sig. (2-tailed)	*.787*	*.010*	.	
	N	*12*	*12*	*12*	
Emergency Admissions Rate	*Pearson Correlation*	*-.062*	*.692**	*.999***	*1.000*
	Sig. (2-tailed)	*.847*	*.013*	*.000*	.
	N	*12*	*12*	*12*	*12*

*** = significant at the 0.05 level*
** = significant at the 0.10 level*

Strong positive correlations can be seen between urbanicity and both general (r = 0.709) and emergency admissions (r = 0.692). This suggests that the regional general and emergency admission rates do vary according to the urbanicity of a region. Numerous reasons could be suggested as to why this is the case.

By contrast, the effect of deprivation appears to be negligible in terms of both statistical and actual significance. There is a weak and insignificant negative correlation between urbanicity and deprivation: not enough to be considered a distorting factor. Why this should be is open to debate: a relationship with deprivation was perhaps to be expected. One possibility is that the effect of deprivation is 'diluted' by the presence of more affluent individuals in such large areas: the ecological fallacy. Another is the presence of a stronger 'hospital culture' in some areas: hospitals behave more uniformly in terms of the people they actually admit.

1.5. Summary and discussion of the findings

The main findings of this chapter are as follows:

- General admission rates rose and became more uniform throughout the 1980s.
- The proportion of emergency admissions had also risen and equalised.
- Most of the changes have take place in the more rural regions, suggesting that perhaps services there were undergoing a process of 'catching up'.
- There is a certain amount of variation in rate and character of admissions on a regional level for the 1991-3 cohort, but this is far from marked.
- An urban-rural gradient is present: regional urbanicity correlates significantly and positively with both general and emergency admission rates for the 1991-3 cohort.
- There is no significant correlation between general or emergency rates and socio-economic deprivation.

It is too early in the analysis to conclude anything concrete, but some insight into the problems posed by the null hypotheses can be gained here. Firstly, it is evident that

location within Scotland does have some bearing on an individual's risk of admission: rates for the 1981-3 and 1991-3 cohorts do differ significantly by region. The likelihood of the admission being an emergency also varies geographically for both cohorts. The effect on risk of admission of living in a particular region has however decreased with time: the 1991-3 cohorts data are much less variable, suggesting that location now has less of an impact than once was the case.

The presence of an urban-rural gradient in admissions suggests some of the reasons for the regional effects observed. Admissions for more rural regions are lower, particularly for the 1981-3 cohort. This implies that factors relating to access to services are at work here: it is harder to get to hospital in a rural area and hence people are less likely to try or 'succeed'. The changes in rural areas over the 1980s adds further credibility to this theory: over this period communications and access to private transport has improved, while services will have become more extensive and accessible. The lack of a deprivation effect is interesting and unexpected, but its presence should not be ruled out at this stage. As mentioned previously, the regions may be too large geographically and demographically to reveal much of an effect. Alternatively, regional rates may be more dependent on resource availability and allocation that the actual composition of the patient population. Within the regions, factors such as urbanicity and deprivation would then come into play.

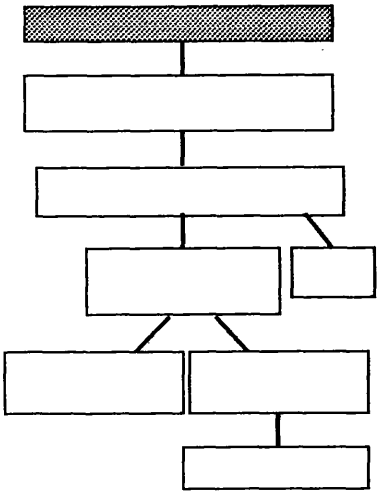
Rates and proportions at this level are fairly reliable, being based on large populations, so we can be reasonably confident about the conclusions drawn. However, it is hard to characterise such large areas accurately and appropriately in terms of their socio-economic and other area characteristics. The next stage therefore is to examine the

data at the next level: local government districts. These partitions remove some of the heterogeneity present within the areas and allow sounder conclusions to be drawn.

CHAPTER 5

Variation in the rate and character of children's hospital admissions across Scotland at Local Government District level

Data being used:



All Data
(1981-3 and 1991-93 birth cohort, all regions, all causes of admission)

Relevant null hypotheses

- An individual's location in Scotland does not affect their likelihood of admission.
- Variation in admission rates between local government district is not related to their socio-economic or urban-rural composition.

5.1. Introduction:

The previous chapter established the presence of variation at a regional in children's hospital admissions. This has reduced over time and appears to be related to the urban-rural composition of the regions in question. The aims and methods of this chapter are similar but the analysis is at a finer geographical scale: the Local Government District. The regions comprise very large and potentially heterogeneous areas of the country and hence relationships with the census-based variables may have been lost. Examining the variation of rate and character for smaller areas might

reveal trends related to the composition of the area in terms of deprivation and urbanicity. The presence of Local Government Districts with high or low rates which are harder to explain in these terms would also hint at the effect of the service related or 'residual' factors.

Examining the data at a level that essentially subdivides the regions also goes some way toward testing the validity of the first chapter's findings. The figures for a given region may be the result of similar admissions behaviour throughout, or the presence of several distinct patterns that produce the results observed when averaged. One interesting possibility is predictable patterning of rate and character within the regions themselves: for example, does each region contain one local government district (say, the administrative centre) with a particularly high rate and several others at a lower level, or are rates homogenous throughout?

5.2. Local Government Districts: Technical details

The regions of Scotland are further subdivided into 56 Local Government Districts (LGDs) with a certain amount of administrative independence. Their boundaries are related to, but not the same as the Health Boards, which may comprise several whole or part LGDs. A decision was made to use the latter rather than the former boundaries on the grounds that Health Boards often contain several areas quite different in character and are hence more susceptible to the ecological fallacy. The same is true to a certain extent of LGDs, but as they are geographically smaller, the problem is at least diminished. Another potential complication arises from a change in LGD boundaries and codings in 1986. The latter problem was easily solved, but the boundary changes mean that some of the LGDs referred to in the 1981-3 cohort

data are geographically slightly different to their counterparts in the 1991-3 cohort data. In a small LGD where boundaries were altered to include or exclude, for example a particularly deprived or affluent area, this could have some effect on the results, but otherwise the data are reasonably sound.

5.3. General admission rates for the 1981-3 and 1991-3 cohorts for individual Local Government districts

The first stage of analysis involves comparing the general rates of admission qualitatively over time and between the LGDs. Rates per 1000 were calculated for general and emergency admissions in each LGD for both cohorts. These results are reproduced below:

Table 5a: General rates of admission by Local Government District, 1981-3 and 1991-3 cohorts[1]

Region	*LGD*	*1981-3 Rate*	*1991-3 Rate*	*Percentage change*
Borders	*Ettrick & Lauderdale*	*452.78*	*799.68*	*176.62*
	Tweeddale	*431.25*	*626.62*	*145.30*
	Berwickshire	*329.84*	*649.12*	*196.80*
	Roxburgh	*364.61*	*591.63*	*162.26*
(Regional rate)		*(399.34)*	*(676.15)*	*169.32*
Central	*Stirling*	*614.4*	*647.06*	*105.32*
	Clackmannan	*618.38*	*591.23*	*95.61*
	Falkirk	*673.56*	*590.51*	*87.67*
(Regional rate)		*(647.06)*	*(605.87)*	*93.63*
Dumfries	*Wigtown*	*439.3*	*697.19*	*158.70*
Galloway	*Annandale & Eskdale*	*374.23*	*630.45*	*168.47*
	Nithsdale	*484.08*	*675.79*	*139.60*
	Stewartry	*358.64*	*562.42*	*156.82*
(Regional rate)		*(424.80)*	*(653.33)*	*153.80*
Fife	*Kirkcaldy*	*501.91*	*652.66*	*130.04*
	Dunfermline	*432.56*	*663.63*	*153.42*
	North East Fife	*308.96*	*495.54*	*160.39*
(Regional rate)		*(443.39)*	*(630.25)*	*142.14*
Grampian	*Aberdeen City*	*778.25*	*729.1*	*93.68*
	Banff & Buchan	*542.6*	*564.27*	*103.99*
	Kincardine & Deeside	*663*	*518.35*	*78.18*
	Gordon	*532.13*	*485.28*	*91.20*
	Moray	*473.29*	*531.42*	*112.28*
(Regional rate)		*(630.81)*	*(605.37)*	*95.97*
Highland	*Inverness*	*434.39*	*658.3*	*151.55*
	Ross & Cromarty	*407.01*	*592.59*	*145.60*
	Sutherland	*379.17*	*455.61*	*120.16*
	Badenoch & Strathspey	*338.9*	*403.69*	*119.12*
	Skye & Lochalsh	*517.59*	*470.02*	*90.81*
	Nairn	*397.96*	*435.9*	*109.53*
	Lochaber	*350.36*	*378.05*	*107.90*
	Caithness	*278.66*	*419.48*	*150.53*
(Regional rate)		*(388.96)*	*(541.56)*	*139.23*
Lothian	*Edinburgh City*	*666.89*	*712.21*	*106.80*
	Midlothian	*539.32*	*693.27*	*128.55*
	West Lothian	*428.37*	*650.06*	*151.75*
	East Lothian	*480.27*	*681.2*	*141.84*
(Regional rate)		*(577.20)*	*(693.23)*	*120.10*

[1] For a full table with confidence intervals, see Appendix 2

Region	*LGD*	*1981 Rate*	*1991 Rate*	*Percentage Change*
Strathclyde	*Cumnock & Doon Valley*	*505.36*	*764.22*	*151.22*
	Monklands	*555.6*	*686.13*	*123.49*
	Motherwell	*450.9*	*674.93*	*149.69*
	Renfrew	*431.37*	*660.88*	*153.20*
	Inverclyde	*534.9*	*642.26*	*120.07*
	Clydesdale	*412.87*	*675.51*	*163.61*
	Hamilton	*368.78*	*658.69*	*178.61*
	Glasgow City	*484.02*	*640.49*	*132.33*
	Kyle & Carrick	*479.83*	*621.54*	*129.53*
	Cunninghame	*480.25*	*641.01*	*133.47*
	Clydebank	*386.6*	*568.62*	*147.08*
	Argyll & Bute	*288.43*	*545.06*	*188.97*
	Kilmarnock & Loudoun	*401.87*	*559.15*	*139.14*
	Bearsden & Milngavie	*330.41*	*501.16*	*151.68*
	Strathkelvin	*354.58*	*501.08*	*141.32*
	Cumbernauld & Kilsyth	*341.16*	*472.88*	*138.61*
	East Kilbride	*334.73*	*449.53*	*134.30*
	Dumbarton	*302.18*	*391.03*	*129.40*
	Eastwood	*251.04*	*418.42*	*166.67*
(Regional rate)		*(437.92)*	*(609.52)*	*139.19*
Tayside	*Dundee City*	*621.4*	*688.72*	*110.83*
	Perth and Kinross	*447.07*	*658.45*	*147.28*
	Angus	*409.19*	*492.31*	*120.31*
(Regional rate)		*(519.88)*	*(630.39)*	*121.26*
	Orkney	*356.84*	*406.04*	*113.79*
	Shetland	*497.47*	*518.67*	*104.26*
	Western Isles	*323.58*	*471.3*	*145.65*

5.4. Patterns within the raw data on General admission rates

The individual figures for the LGDs are consistent with the increase and equalisation in general rates seen at area level: on average areas' general admissions increase by a factor of 1.35. The mean general admissions rate for the 1981-3 cohort was 445.4 per 1000 compared with 581.4 per 1000 for 1991-3. The biggest change occurred in Berwickshire, with a factor of 1.97, while at the opposite end of the scale, Kincardine and Deeside decreases by a factor of 0.78. Generally, it appears to be the rural areas that show the largest increases but there is a great deal of variability: Skye and Lochalsh actually decreases. The major Urban areas vary in the amount they increase or decrease: Glasgow City increases by a factor of 1.32 while Edinburgh and Aberdeen remain relatively constant (factors of 1.07 and 0.94 respectively).

The variability of the local government district data decreases less than the regional data over time: the standard deviation of rates remains relatively constant at 104.9 general admissions per 1000 for the 1991-3 cohort compared to 111.9 for the 1981-3 group. In both cases there is a greater range of rates than at regional level, where the standard deviations were 100.6 admissions per 1000 (1981-3) and 82.38 admissions per 1000 (1991-3). In short, the local government district rates are very variable and more so than the regional rates.

One-way analysis of variance, however, suggests that the differences between the regions are still important at this level. The variance of general admission rates within the regions is not as great as that between them. This is more marked for the 1981-3 cohort ($F = 5.033$, $p = 0.000$) than the 1991-3 cohort ($F = 2.961$, $p = 0.007$)

but both results are still highly significant. It seems therefore that region is a more important influence on admissions than local government district.

As an effect of their overall increase, the order of rates within particular areas has remained more or less the same. Large urban areas within any given part of Scotland usually have higher rates than the neighbouring, more rural districts: Aberdeen, for example has a rate of 729.1 for the 1991 cohort, while none of the other districts in the Grampian region exceed 564.27 (Banff and Buchan). Edinburgh City is also significantly above the rest of Lothian for both cohorts, though the disparity has decreased over time. Glasgow City however provides and exception to this general rule, displaying only moderate discharge rates in relation to the rest of Strathclyde. Patterns within Strathclyde are somewhat distinct in many respects, possibly because it is the largest, most populated and urbanised region. The order of rates in more rural areas such as the Borders and Highland regions is more variable, but usually those districts with the highest rates for the 1981 cohorts are also those with high rates in 1991-3.

5.5. Do deprivation and urbanicity affect the level of admissions at Local Government District Level? Relationship of general and emergency admission rates with the census based data

The preceding results have established the presence of variation in general admission rates at local government district level and qualitative examination suggests that this is related to urbanicity. In order to investigate this relationship further, correlations between general and emergency admission rates and the socio-economic and urban-

rural principal component have been generated for the 1991-3 cohort. The co-efficients are reproduced below:

Table 5b: Correlations between general and emergency rates in the 1991-3 cohort and the socio-economic and urban-rural principal components

		Mean value of socio-economic PC	***Mean value of urban-rural PC***	***General Admissions Rate***
Mean value of socio-economic PC	*Pearson Correlation*	*1.000*		
	Sig. (2-tailed)	.		
	N	*56*		
Mean value of urban-rural PC	*Pearson Correlation*	*-.151*	*1.000*	
	Sig. (2-tailed)	*.267*	.	
	N	*56*	*56*	
General Admissions Rate	*Pearson Correlation*	*.209*	*.269**	*1.000*
	Sig. (2-tailed)	*.123*	*.045*	.
	N	*56*	*56*	*56*
Emergency Admissions Rate	*Pearson Correlation*	*-.216*	*.371***	*.925***
	Sig. (2-tailed)	*.109*	*.005*	*.000*
	N	*56*	*56*	*56*

*** = Result is significant at the 0.05 level*

** = Result is significant at the 0.10 level*

These results bear out the presence of an urbanicity effect on both general and emergency admission rates at local government district level: districts which are more urban on average tend to have higher rates. General and emergency admissions correlate significantly with the urban-rural principal component, albeit with a relatively low co-efficient. The relationship with emergency admissions is the stronger of the two. This again encourages speculation that factors relating to access to services are at work: fast access to a hospital is most important in emergency admissions, therefore the relationship is stronger with these.

The absence of a significant relationship with socio-economic deprivation is again notable. Given the strong association between health and hospital admissions found in other research[2] a positive relationship might be expected. Two possible explanations for the lack of an evident relationship seem likely. Firstly, there may genuinely be no relationship present in young children or secondly, the relationship may be lost in the still relatively large and socially homogenous areas covered by the local government districts. The latter explanation seems more likely, given evidence from elsewhere. Further investigation on a finer scale is evidently needed to decide.

5.6. Are all admissions the same? Differences in character of children's hospital experiences at Local Government District level

Disparities in admissions are not entirely based on discharge rates. The characteristics of the admissions may also vary systematically. For example, areas with low admissions might have longer average lengths of stay. The following results investigate the relationship of various key aspects of the average hospital episode for each local government district with general rates and the socio-economic and urban-rural principal components. These include the mean age at first admission, the mean length of stay and the proportion of admissions that correspond to particular continuous inpatient stays (CIS).

These latter variables reflect aspects of the average 'admission career' for each district. In areas with a high proportion of admissions where 'CIS = 1', more patients will only have been admitted just once. The pattern of 'careers' for such an area could then be implied to be one in which individuals are quite likely to be admitted,

[2] See Literature Review

but often only on one occasion. This is a different pattern from areas with a high proportion of stays coded at CIS = 2 to 5, in which a relatively large subset of individuals are admitted a moderate number of times. A high proportion of admissions with a CIS coding greater than 5 (CIS > 5) implies that a small subset of individuals are being admitted on multiple occasions. These variables are intended to give some indication as to the cross section of the population being admitted to hospital: in an area where a small proportion of children are sickly and constantly readmitted, CIS = 2-5 and CIS = 6 will be high.

5.7. The average admission and the extent variation within the local government district sample

Descriptive statistics for the various admission characteristics were generated, to give some idea of normal values and the amount of variation present at LGD level. These are reproduced below:

Table 7: Mean values of the key admission characteristics at LGD level for the 1991-3 cohort

	Mean	***Minimum individual LGD value***	***Maximum individual LGD value***	***Standard Deviation***
Mean age of admission (months)	*20.06*	*17.26*	*22.64*	*1.18*
Mean length of stay (days)	*2.81*	*2.00*	*4.15*	*0.45*
% Admissions where CIS = 1	*56.53*	*47.9*	*65.9*	*3.72*
% Admissions where CIS = 2 to 5	*35.62*	*30.7*	*40.0*	*2.40*
% Admissions where CIS > 5	*7.85*	*0.6*	*15.5*	*3.07*

The most striking feature of these data is that there seems to be very little variation present. On average, patients are admitted a few months before their second birthday and stay just under three days. About half of patients in the cohort are being admitted

for the first time. Few of the districts deviate much from this, but there is a certain amount of disparity in the proportions of the different continuous inpatient stays: at one end of the spectrum there are areas with up to 30 times the number of individuals being admitted for the fifth time or more, while at the other end, 65% of patients have never been admitted before. It will be interesting to unpack exactly which kinds of areas display these two extremes, and if such variation is patterned.

5.8. Relationship of the features of admissions to general rates and census based variables: Correlations.

Correlations between the average values of each of these aspects for each local government district, the values of the socio-economic and urban-rural principal components and the general admission rates for both cohorts were generated. The co-efficients are reproduced below:

Table 7: Correlations between features of the average stay for each Local government district and general admission rates, deprivation and urbanicity

		1981-3 General Admissions Rate	***1991-3 General Admissions Rate***	***Mean value of socio-economic PC***	***Mean value of urban-rural PC***
Mean age of admission	*Pearson Correlation*	*-.318**	*-.220*	*.010*	*-.026*
	Sig. (2-tailed)	*0.017*	*.103*	*.940*	*.847*
Mean length of stay	*Pearson Correlation*	*.032*	*-.140*	*.037*	*.122*
	Sig. (2-tailed)		*.302*	*.787*	*.369*
% of admissions where CIS =1	*Pearson Correlation*	*-.296**	*-.695***	*.003*	*-.283**
	Sig. (2-tailed)	*.027*	*.000*	*.981*	*.035*
% of admissions where CIS = 2 to 5	*Pearson Correlation*	*.224*	*.496***	*-.020*	*.264**
	Sig. (2-tailed)	*.098*	*.000*	*.883*	*.049*
% of admissions	*Pearson Correlation*	*.184*	*.455***	*.012*	*.136*

where CIS > 5	*Sig. (2-tailed)*	*.174*	*.000*	*.931*	*.316*

These results contain some interesting material which hints at how high admissions at local government district level might be predicted. Several patterns can be observed. Firstly, mean age of admission is correlated inversely with general admissions in the 1981-3 cohort at the 0.05 level meaning that areas where children are admitted young tend to have higher rates. This makes both mathematical and medical sense: firstly, younger children have more time to be admitted on subsequent occasions and secondly, early admissions are suggestive of either worse health or and increased tendency to use services in a population. A similar correlation coefficient is present for the 1991-3 cohort, but the result is not significant. Neither are any significant relationships with deprivation or urbanicity observed. Mean length of stay shows no significant relationship with any of the other factors: there may be no relationship. Lengths of stay could quite feasibly be determined almost entirely by medical concerns coupled with hospital policy.

The correlations with the continuous inpatient stay variables are less equivocal. The relationships are particularly significant with the 1991 rates. Both the 1981-3 and the 1991-3 general rates are significantly (at the 0.05 and 0.01 levels respectively) inversely correlated with the proportion of admissions where the patient is being admitted for the first time (CIS = 1). In other words, high proportions of individuals with only one admission are associated with a low rate. Conversely, for the 1991-3 cohort data at least, a greater proportion of multiply admitted patients predicts a high rate: general admissions rates show a strong positive association with both CIS = 2 to 5 and CIS > 5, significant at the 0.01 level on both cases. This is to a certain extent a

mathematical inevitability: multiple admissions unavoidably create high rates. However, these could also be the result of a large number of children being admitted on a small number of occasions. The findings demonstrate that high admissions rates in Scotland are often the result of a subset of individuals who are frequently admitted, rather than a universal risk of admission throughout the population. This is an important finding, and identifying these individuals may be a useful task.

Urbanicity as measured by the urban-rural principal component also correlates with the spread of 'admission careers' identified by the CIS variable. Urban living is negatively associated ($r = -.283$, $p = .035$) with the proportion of first admissions, but positively related to the proportion of second to fifth admissions ($r = .264$, $p = .049$). Individuals who live in towns and cities are more likely to be admitted more than once. As with the other trends relating to urbanicity, this may reflect something about the intrinsic 'unhealthiness' of urban living or be a function of easier access to services in urban areas.

5.7. Summary and discussion

The main findings of this chapter are as follows:

- The increase in rates at regional level is mirrored by a similar change in the local government district rates.
- The local government district rates are more variable than the regional general admission rates and show less equalisation over time.
- The variation in general admission rates between regions is greater than that within them, suggesting that some patterning by region still applies at this level.

- It is hard to qualitatively predict the general admission rates for specific local government districts as many do not behave as expected: could this be the presences of variation in services or 'residual' factors?
- The presence of a positive relationship between urbanicity and both general and emergency rates is borne out by significant correlations between the various relevant factors.
- As with the regional data, no significant relationship between deprivation and general admission rates appears to be present.
- Patterns of individual admission are a highly significant correlate of general admission rate. Areas with a high proportion of first admissions have lower rates, while those dealing with greater number of multiple admissions have higher rates. This may seem inevitable, but does reflect that high rates in Scotland are frequently the result of the same people being re-admitted rather than new patients arriving.
- The patterns of individual admission show a similar relationship with urbanicity, suggesting that multiple admissions are more of an urban phenomenon. The reasons for this may be medical or relate to access.

Reconsidering the null hypotheses at the beginning of the chapter, the conclusions emerging are fairly similar to those reached through examination of the regional data. There is evidently a great deal of variation in general admissions rates at local government district level as well as at regional level. While the results of the analysis of variance indicates that region is the more important determinant of the likelihood of admission for a given person, location within a region is also a factor. The differences between the local government districts are not explained by disparities in

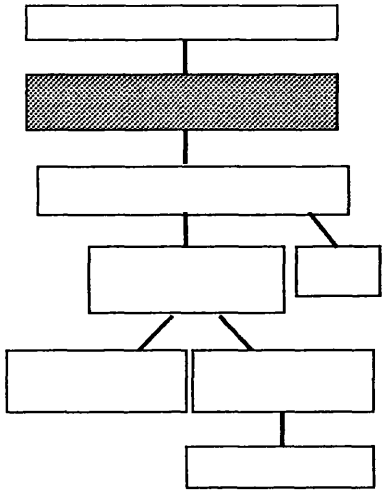
their socio-economic make up, but an urban-rural effect does appear to be in operation. The absence of a deprivation effect is puzzling and merits further investigation.

There is a less marked amount of variation in the character of admissions, but some of it does appear to be systematic. The CIS variables' correlations with urbanicity are interesting and provide further clues as to why rates may differ in urban and rural areas: a subset of city dwellers goes to hospital more often with their children. The next logical stage involves examining the urban-rural effect in more detail and establishing whether or not a deprivation effect does or does not exist.

CHAPTER 6

Variation in children's hospital admissions across Scotland in relation to socio-economic deprivation

Data being used:



All Data
- Sub-divided into deprived and affluent/urban and rural groups for analysis

(1991-93 birth cohort, all regions, all causes of admission)

Relevant Null Hypotheses:

- Deprived admission patterns do not differ from affluent admission patterns in level or character.

6.1. Introduction

The countrywide data demonstrated that variation exists between local government districts and that some of this may relate to the urban or rural character of the districts. There was no correlation with deprivation at this level. The reasons were unclear. Either a relationship did exist which operated within the local government districts and hence was not apparent in the analyses so far, or there deprivation genuinely does have only a limited effect on admissions in these cohorts.

The next two chapters will analyse the effect of deprivation and urbanicity on general rates independently of local government district and region. Data from postcode

sectors of similar socio-economic and urban-rural character from across Scotland will be aggregated to form groups. These will then be compared in terms of general admission rates, the characteristics of these admissions and the spread of conditions for which children were treated. The aim is to establish the presence or absence of a deprivation effect in the data and to characterise the relationship between admissions and urbanicity in more detail.

6.2. Creating socio-economic and urban-rural groups for analysis

A system of grouping needed to strike a balance between two requirements. Groups needed to be large enough to ensure the statistical validity of any rates or characteristics generated, while maintaining a sufficient number of sub-divisions to reveal trends in detail. Other attempts to categorise socio-economic and other gradients have employed between 4 and 10 categories: Chaturvedi and Ben-Schlomo (1995)[1] for example use quartiles of Townsend deprivation scores, while Manson-Siddle and Robinson (1999)[2] identify 10 lifestyle groups. The most frequently used system in Scotland, Carstair's DEPCATs has 7 groups, a figure which seems to strike a happy medium. There are also other benefits associated with fitting in with current conventions.

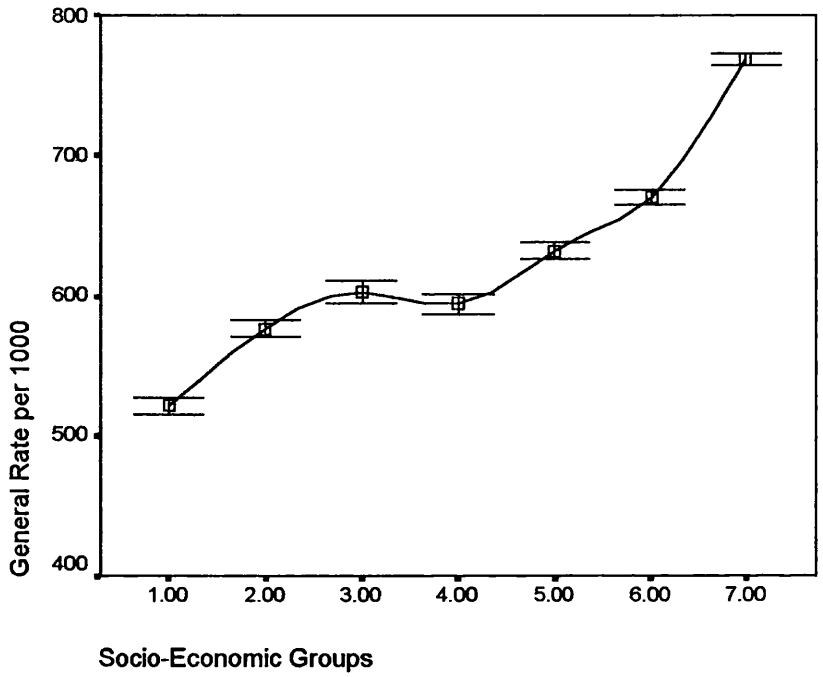
While DEPCATs could have been used, it was decided to use the socio-economic and urban-rural principal components as the basis for grouping. This was in order to maintain a certain amount of consistency with the rest of the thesis. Groups were created by determining the range of postcode scores for each principal component and dividing this into 7 equally spaced sets of boundaries. Postcodes were then assigned to categories according to these criteria and populations aggregated accordingly to provide population denominators. The result was 7 socio-economic and urban rural groups with different populations but a similar spread of characteristics. The

members of each group were drawn from the whole country. The basis on which Carstair's (1990) divided up her scores into DEPCATs was slightly different and based on the distribution of population within each groups, but the system employed here seems adequate for the purpose.

6.3. The effect of socio-economic group on general admissions rate

General admissions rates and 95% confidence intervals were calculated for each of the socio-economic groups (Group 1 being the most affluent and Group 7 the most deprived). The results are represented below:

Figure and Table 6a: The relationship between general admission rates and deprivation: General admission rates by socio-economic category, 1991-3 cohort



Socio-Economic PC group	***Most Affluent***						***Most Deprived***
	1	***2***	***3***	***4***	***5***	***6***	***7***
General admission rate	*521.38*	*576.58*	*602.80*	*594.10*	*632.29*	*670.66*	*767.66*
95% Confidence Interval	*515.72-527.04*	*570.26-582.90*	*595.36-610.23*	*587.08-601.12*	*626.53-638.06*	*665.49-675.83*	*763.65-771.66*

A clear trend whereby general admission rates increase with deprivation, as measured by the socio-economic principal component, is evident. The factor of increase between the most affluent and the most deprived groups is 1.4. It can be concluded fairly safely therefore that a relationship between socio-economic status and admissions does exist for the 1991 cohort. Given that this was not present in the data at regional level, it seems likely that the effect operates within individual local government districts: the most deprived groups in a given LGD have a lower admission rate than the affluent in that district, but these are not necessarily comparable with similar populations in another.

There is some suggestion of a 'step' in the trend, with groups 5, 6 and 7 having high and increasing rates, while groups 1 to 4 cluster at a lower level. The largest differences between neighbouring groups involve the most affluent and the most deprived categories, which display general rates respectively lower and higher than the rest of the data. This suggests that the effect of socio-economic status is at its greatest at the two extremes. This could be the result of either genuine medical or social factors, or an artefactual product of the statistics: the extreme categories will contain a 'purer' concentration of deprivation and affluence, while the greater social mix of the middle categories has a homogenising effect on rates.

6.4. Differences in the character of admissions between socio-economic categories

Socio-economic status evidently has an effect on the levels of admission in an area, but the differences may not end there. Deprived areas may not simply have more of

the same kind of admissions as affluent areas: the character of the hospital episodes experienced by children in these areas may be quite different. The following results are intended to investigate this possibility: various key features of the general admission patterns have been generated, reflecting things such as the age at which children are admitted, how they arrived, what they were admitted for, how long they remained in hospital and the medical history of the average patient[1]. The results are presented below in tabular and graphic form:

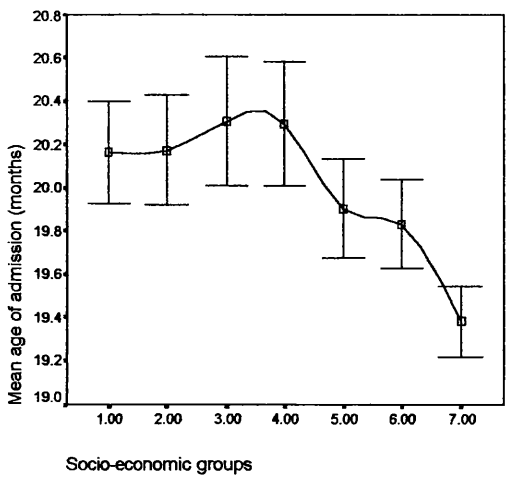
Table 6b: Key characteristics of admission patterns for groups of differing socio-economic status, 1991-3 cohort[2].

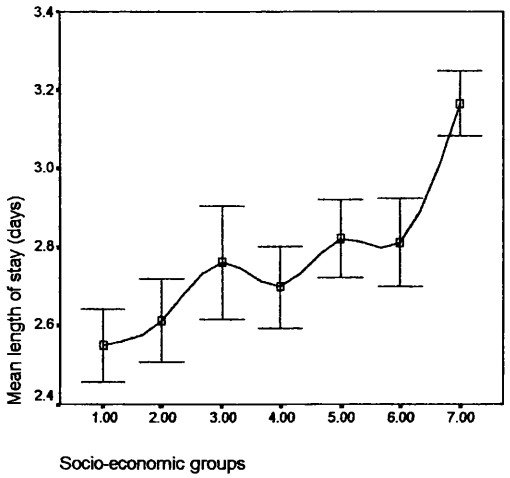
	Most Affluent		***Socio-economic group***			***Most Deprived***	
	1	***2***	***3***	***4***	***5***	***6***	***7***
Mean age of admission (months)	*20.16*	*20.17*	*20.31*	*20.29*	*19.90*	*19.83*	*19.39*
% Emergency admissions	*62.8*	*64.6*	*64.9*	*65.8*	*65.9*	*68.7*	*71.7*
% 'Acute' admissions[3]	*55.1*	*55.4*	*56.3*	*55.9*	*55.6*	*57.7*	*59.6*
Mean length of stay (days)	*2.55*	*2.61*	*2.76*	*2.70*	*2.82*	*2.81*	*3.16*
% of admissions where CIS = 1	*57.8*	*57.7*	*55.1*	*56.6*	*54.8*	*54.2*	*51.8*
% of admissions where CIS = 2 to 5	*37.4*	*37.8*	*39.7*	*38.0*	*40.1*	*40.8*	*42.1*
% of admissions where CIS > 5	*4.8*	*4.5*	*5.2*	*5.4*	*5.1*	*5.0*	*6.1*

[1] See Chapter 5 for a more detailed discussion of some of these variables.
[2] Confidence intervals are presented graphically in the graphs that follow.
[3] Admissions for diagnostic groups deemed arbitrarily to be 'acute' in nature for the purposes of this study: non-chronic respiratory, gastro-intestinal infections, other infections, accidents and poisonings and symptoms and ill-defined conditions.

Below left Figure 6b: Mean age of admission (months) by socio-economic group

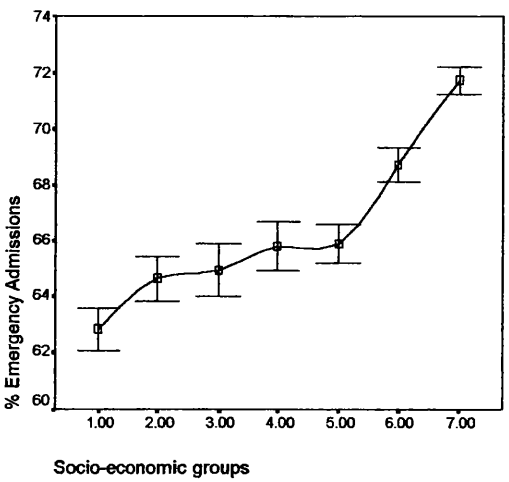
Below right Figure 6c: Mean length of stay (days) by socio-economic group





Below left Figure 6d: % Emergency admissions by socio-economic group

Below right Figure 6e: % Admissions for 'acute' conditions by socio-economic group



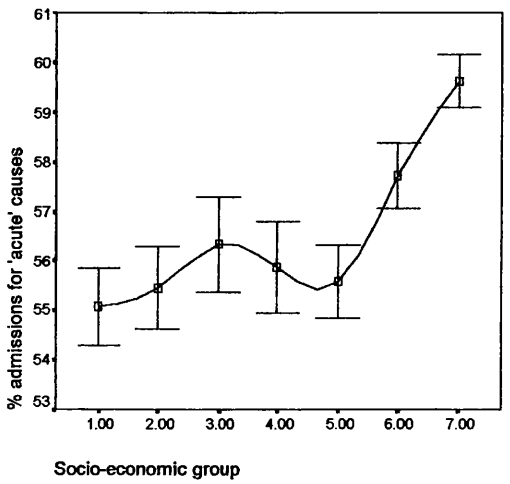


Figure 6f: % Admissions where patient had not been previously admitted

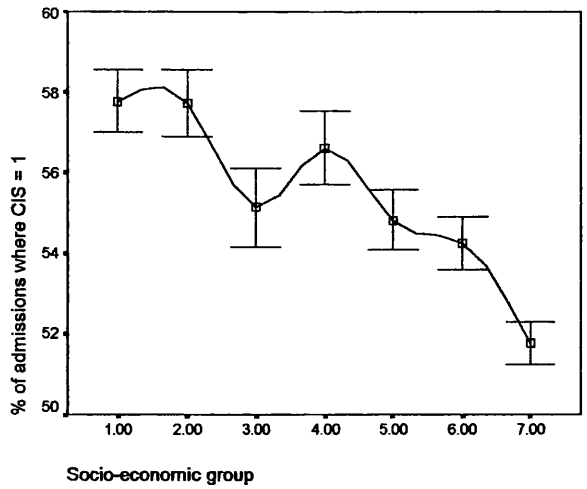


Figure 6g: % Admissions where patient was being admitted for the 2nd to 5th time

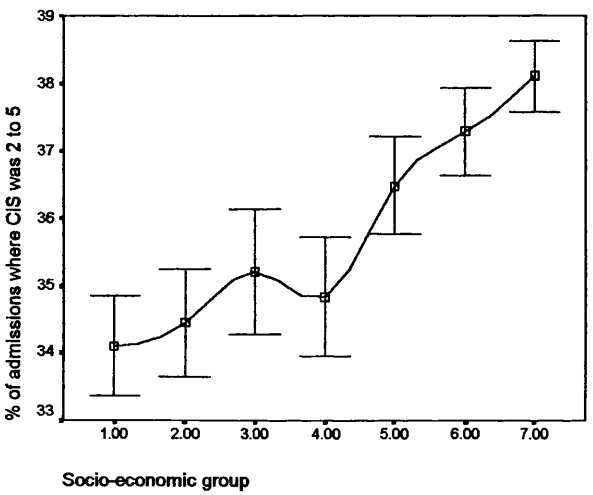
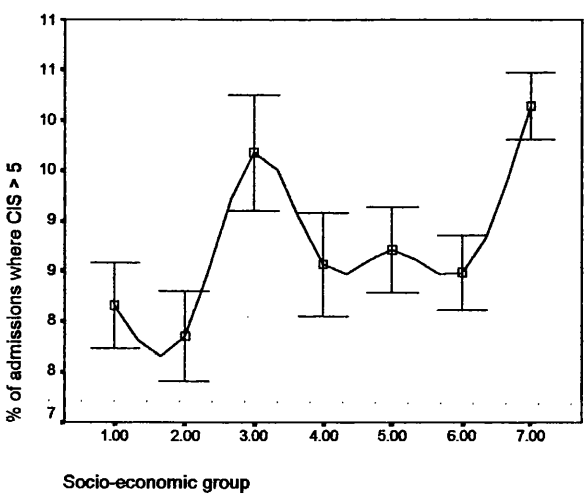


Figure 6h: % Admissions where patient had been admitted more than 5 times



Some notable trends are evident here. Firstly, on a general level, there is an indication of a similar 'threshold effect' to that observed in the rates. All four variables are fairly constant at the more affluent end of the scale, but show marked gradients in the more deprived categories. This suggests that the effective influence is deprivation rather than affluence: below a particular 'level of living' (Macintyre 1999)[3] admissions such as hospital admissions start to be affected. Patterns specific to the particular variables are described below:

Age of admission: More deprived areas have a younger mean age of admission, suggesting that children in such postcodes are less likely to go through early childhood without experiencing an admission. This may reflect differences in health generally or the presence of factors relating specifically to early childhood and parenting.

Length of stay: While a gradient through the groups is evident, only the most deprived groups stay in hospital significantly longer on average. Length of stay could be viewed as a reflection of the conditions for which patients are admitted and the perceived severity of their consequences by the health professionals. Possibly it is only in the most deprived individuals that differences in the severity of symptoms or personal circumstances sufficient to merit a longer stay are seen.

% Emergency Admissions: This feature shows perhaps the strongest socio-economic gradient: more deprived groups have a higher proportion of emergency admissions. Again, this trend is only particularly marked towards the more deprived end of the

spectrum. Emergency admissions are an potential indicator of both worse health and a different (inferior?) method of accessing medical care: deprived children may be more likely to have conditions symptoms meriting an emergency admission or be more likely to seek one for the same symptoms.

% Admissions for 'acute' causes: The trend here matches closely that for emergency admissions, with the two most deprived groups displaying a much higher proportion than the rest. This suggests that the pattern of emergency admissions results from deprived children's greater tendency to suffer from conditions needing emergency treatment and not differences in admissions behaviour.

Variables relating to individual 'admission careers' (Figures f, g and h): These three graphs combine to reveal a pattern in which more deprived areas contain more individuals with multiple admissions. The difference in general admission rates may be due to the presence of large or small subsets of these children, rather than a greater universal risk of admission. To put it another way, once a child has been admitted in a deprived area they are more likely to be admitted again on subsequent occasions than one from the other end of the socio-economic spectrum. This is not to underestimate the statistical importance of children who are being admitted for the first time: they are still in the majority even in the most deprived areas. The increased risk of re-admission applies to children who are admitted a 'medium' (i.e. 2 to 5) times as much as it applies to the small subset who have reached more than 5 admissions. This latter group is again markedly higher in the most deprived area than

in any other groups, indicating again that the degree of deprivation is as important as the simple absence of affluence.

Arguably this is what might have been predicted from the overall rates: the features increasing with deprivation are indicative of poorer general health; those, which decrease, are correlates of good health. However, the data do support several important findings. Firstly, higher rates in the more deprived groups are not the result of a general and evenly balanced increase in all kinds of admissions. The kinds of admissions producing the excess are most likely to be emergencies where the patient has already experienced one continuous inpatient stay.

Secondly, there does appear to be a 'deprived' pattern of admission that contrasts with the kind of admissions experienced by the affluent and medium groups. Children from deprived postcodes are admitted younger, more often and stay in hospital longer on each occasion. The cause of their admission is more likely to be an 'acute' rather than a chronic condition and their risk of being admitted again is greater. In short, deprived admissions are more 'severe' than those for children from better of or middling socio-economic backgrounds.

Lastly, within the groups that might be considered as 'deprived' the degree of deprivation appears to have an exponential effect on the severity of admissions. Being in a group 7 area is much less advantageous than it is to be in category 5 or 6. Possibly it is at this level of deprivation that choice is constrained to such an extent that the coping strategies employed by families cease to be effective. Alternatively,

the effect could be an artefact of the ecological fallacy: the difference between a type 5 or 6 and type 7 area may be the concentration of people living below a certain level of deprivation. The statistical effect of these families is 'diluted' to varying degrees by the presence of differing proportions of more affluent individuals.

6.5. Differences in the causes of admissions between socio-economic categories

The results relating to the proportion of acute conditions have already hinted that the kinds of conditions for which deprived children are admitted to hospital differ from those suffered by the affluent and moderately well off. This section investigates this phenomenon in more detail. Conditions were categorised into ten broad medical categories on the basis of the ICD-9 codings earlier in the study[4]. The 'diagnostic profile' of admissions in terms of these categories for each of the socio-economic groups is reproduced below (all figures are percentages):

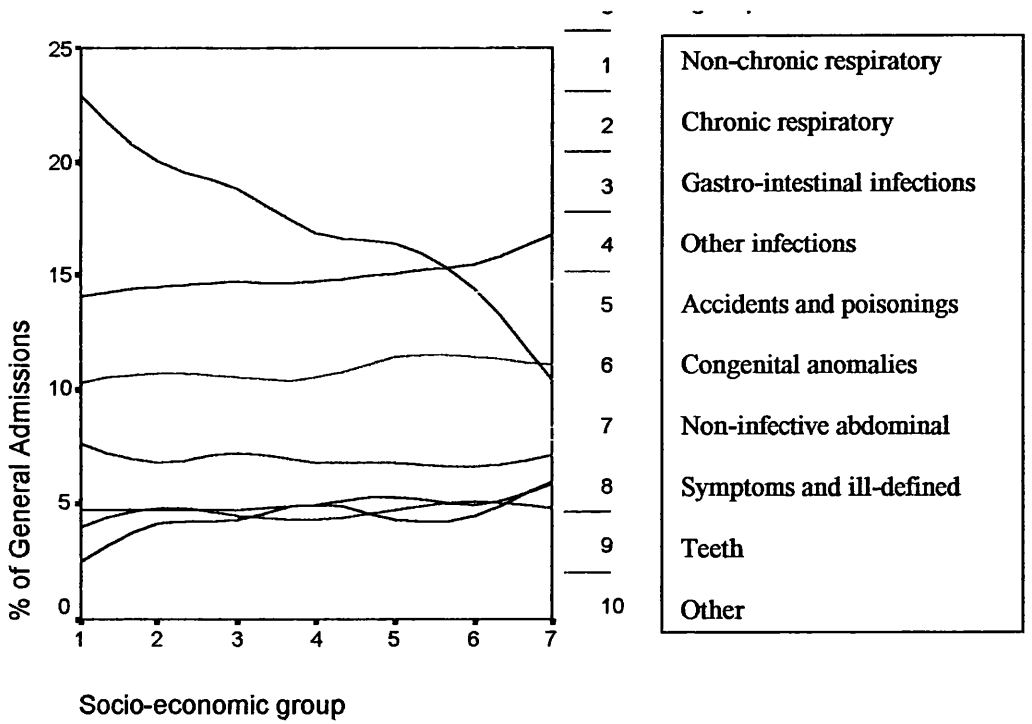
Table 6c: Percentage of admissions composed of specific groups of diagnoses for socio-economic groups in the 1991-3 cohort

Cause of admission	***Most Affluent***		***Socio-Economic Group***			***Most Deprived***	
	1	***2***	***3***	***4***	***5***	***6***	***7***
Non-Chronic Respiratory	*14.1*	*14.5*	*14.7*	*14.7*	*15.1*	*15.5*	*16.8*
Chronic Respiratory	*7.6*	*6.8*	*7.2*	*6.8*	*6.8*	*6.6*	*7.1*
Gastro-Intestinal Infections	*4.7*	*4.7*	*4.7*	*5.0*	*5.3*	*5.0*	*5.9*
Other Infections	*4.0*	*4.8*	*4.5*	*4.3*	*4.7*	*5.1*	*4.8*
Accidents and	*10.3*	*10.7*	*10.5*	*10.5*	*11.4*	*11.4*	*11.1*

[4] For further details of the composition of the categories as concerns specific conditions see Appendix 1.

Poisonings							
Congenital Anomalies	*10.2*	*10.4*	*9.3*	*10.0*	*9.6*	*8.8*	*7.8*
Non-Infective Abdominal	*8.2*	*7.8*	*8.9*	*7.9*	*7.9*	*8.5*	*8.4*
Symptoms and ill defined	*14.5*	*14.2*	*14.1*	*14.9*	*13.5*	*14.2*	*14.7*
Teeth	*2.5*	*4.1*	*4.3*	*5.0*	*4.3*	*4.5*	*6.0*
Other	*22.9*	*20*	*18.8*	*16.9*	*16.4*	*14.4*	*10.4*

Figure 6h: Trends in proportion of different diagnostic groups by socio-economic category



The dominant trend in these results is the large decrease in the proportion of admissions composed of the 'Other' category with increasing deprivation: its percentage share more than halves between socio-economic groups 1 and 7. This category is composed mostly of two types of condition: non-acute conditions

requiring brief spells of inpatient care and serious chronic conditions requiring more extended episodes of inpatient care over a longer period of time. The only other diagnostic group showing a fall in it share is congenital anomalies (-2.4%). It is not replaced by the rise of any one condition: no other diagnostic groups shows anything near such a large change. Instead, slight increases in the proportion of several other conditions account for the extra admissions. The largest of these changes are in tooth conditions, which increase by 3.5%, non-chronic respiratory conditions (2.7%) and gastro-intestinal infections (1.2%). No other condition increases more than 1% overall.

The result of these changes is that more children in deprived group have admissions that are composed of a narrower range of conditions, with a greater share of some of the traditional 'diseases of poverty': dental caries, respiratory infections and gastro-intestinal infections (stomach bugs). This could be viewed as more 'basic' morbidity: conditions probably avoided in affluent areas through better diet and living conditions. Access to or use of primary care may also be a factor, in that many of the 'deprived' conditions may have been noted and treated by a GP in a more affluent area. Children in affluent areas on the other hand can 'afford' to have a wider range of rarer conditions.

6.6. Summary

The main findings of this chapter are as follows:

- A strong relationship exists between general admission rate and deprivation. The more deprived an area the higher its general rates. Given the finding of

previous chapter, it seems likely that this gradient exists within regions and local government districts.

- The character of admissions also changes with decreasing socio-economic status. Deprived admission patterns tend to be more 'severe': longer stays, younger admissions, more individuals with multiple admissions and more emergency cases. They also tend to be for a narrower variety of more 'basic' causes.

- Both of these trends are much more marked in deprived groups. A drop in socio-economic status is much more significant at the lower end of the spectrum. This is perhaps the most significant finding: it indicates that the mechanisms by which deprivation affects health operate largely in socio-economic groups 5, 6 and particularly 7.

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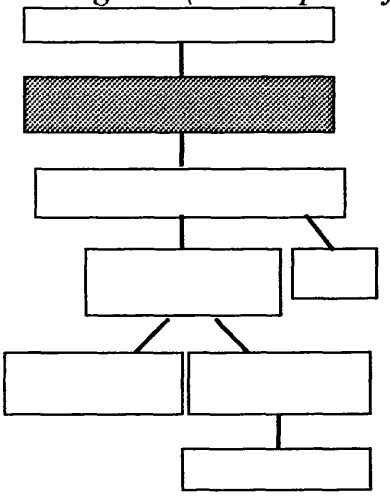
[1] Chaturvedi N, Ben-Schlomo Y. 'From the surgery to the surgeon: does deprivation influence consultation and operation rates'. British Journal of General Practice 1995; 45 :127-131.
[2] Manson-Siddle CJ, Robinson MB. 'Does increased investment in coronary angiography and revascularisation reduce socio-economic inequalities in utilisation?' Journal of Epidemiology and Community Health 1999; 53: 572-577.
[3] Macintyre S. Speaking at a University of Glasgow Seminar. 1999.

CHAPTER 7

Variation in children's hospital admissions across Scotland in relation to urbanicity

Data being used (See Chapter 3 for full size diagram):



All Data
- Sub-divided into deprived and affluent/urban and rural groups for analysis

(1991-93 birth cohort, all regions, all causes of admission)

Relevant null hypotheses:

- Rural admission patterns do not differ from urban admission patterns in level or character.

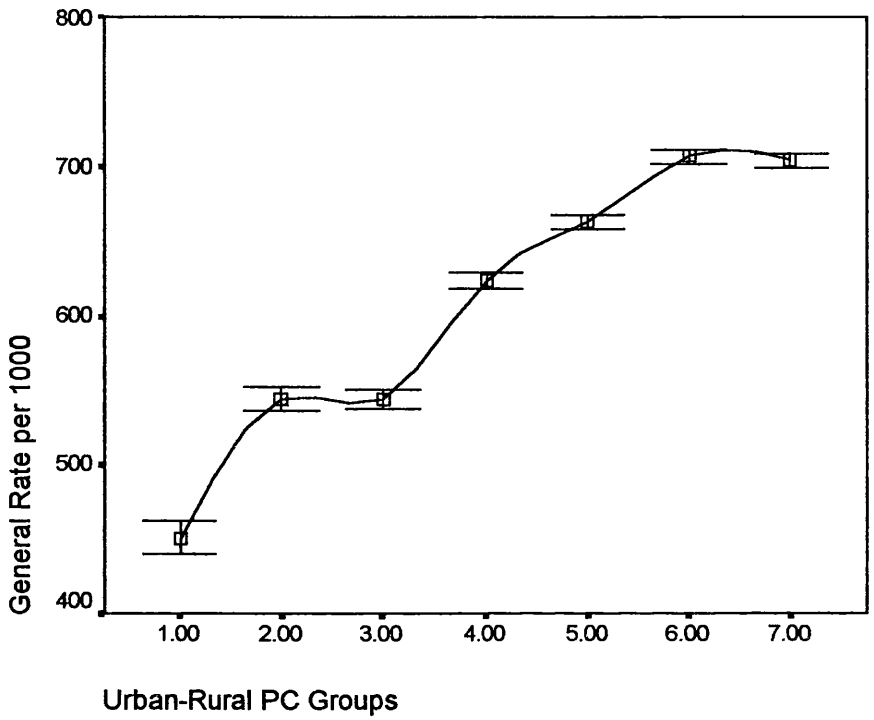
7.1. Introduction

This chapter is essentially a continuation of the analysis begun in the previous one. The aim is to further characterise the relationship between urbanicity and general admissions rates observed at local government district level: the nature of the gradient and the underlying patterns of admission and diagnosis. The process by which the urban-rural categories were created has been described in Chapter 6 inn detail and the form of analysis will be much the same as in that chapter.

7.2. The effect of urbanicity on general admissions rate

General admissions rates and 95% confidence intervals were calculated for each of the urban-rural groups (Group 1 being the most rural and Group 7 the most urban). The results are represented below:

Figure and Graph 7a: Figure and Table 6a: The relationship between general admission rates and urbanicity: General admission rates by urban-rural category, 1991-3 cohort



Urban-Rural PC group	***Most Rural***						***Most Urban***
	1	*2*	*3*	*4*	*5*	*6*	*7*
General discharge rate	*450.68*	*544.18*	*544.59*	*624.15*	*663.12*	*706.93*	*704.35*
95% Confidence Interval	*439.58-461.78*	*536.20-552.17*	*538.37-550.81*	*618.69-629.62*	*658.17-668.06*	*702.61-711.25*	*699.52-709.19*

A steady trend of increasing general admission rates can be seen with increasing urbanicity. Again this could be explained in a number of ways. Access to hospital is more problematic in rural areas, for example, GP services may deputise for emergency hospital care. Medically, the health of children may be better in some

respects due to environmental factors such as air quality or exercise. Social support networks may be more robust: families in a smaller community may be 'bigger fish in a smaller ponds' and as such be able to command more assistance when a child falls ill.

It is difficult to assess the significance of the levelling off of this pattern between groups 1 and 2 and 6 and 7. This may be the result of a threshold effect on admission rates: changes in urbanicity above or below a certain level may have limited impact on factors which might influence admission such as communications or access to services. The significant drop in rates for category one could also be explained in these terms. Scotland has some extremely remote and isolated areas that represent another level of rurality in relation to access to hospitals.

One possible technical issue is the extent to which differing levels of deprivation could confound the trend. Deprived areas tend to be concentrated in the urban end of the spectrum: urban-rural groups 1 and 2 (the most rural) contain 7.3% and 2.8% of areas with DEPCATs 6 and 7 respectively, compared with 33.8% and 31.6% for urban-rural categories 6 and 7. If this is important, then the observed patterns are not entirely the result of urban-rural differences: they are a modified deprivation gradient (and vice versa).

7.3. Differences in the character of admissions between urban-rural categories

Almost exactly the same analysis has been carried out in this section as with its counterpart in the last chapter. The aim too is similar: too find clues in the character of the admissions explaining the patterns in rates and establish whether rural

admissions differ qualitatively from urban ones. The results are presented below in tabular and graphic form:

Table 7b: Key characteristics of admission patterns for groups of differing urbanicity, 1991-3 cohort[1].

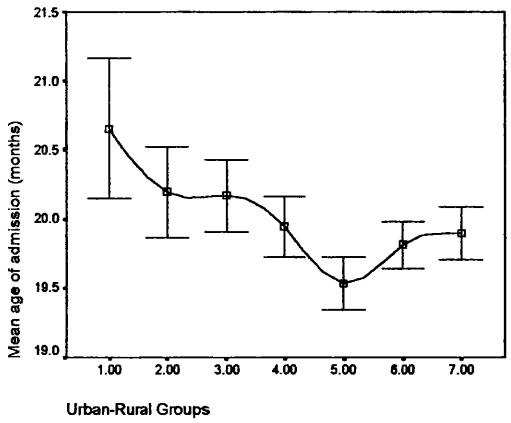
	Urban-rural group						
	1	***2***	***3***	***4***	***5***	***6***	***7***
Mean age of admission (months)	*20.65*	*20.19*	*20.17*	*19.94*	*19.53*	*19.81*	*19.89*
% Males	*60.9*	*58.9*	*60.2*	*59.6*	*60.4*	*59.0*	*59.6*
% Emergency admissions	*62.7*	*64.3*	*65.4*	*67.1*	*68.0*	*69.1*	*67.5*
% 'Acute' admissions[2]	*53.4*	*52.9*	*55.4*	*56.4*	*57.5*	*59.3*	*57.1*
Mean length of stay (days)	*2.64*	*2.66*	*2.72*	*2.77*	*2.80*	*2.92*	*2.98*
% where CIS = 1	*61.1*	*57.1*	*55.8*	*53.5*	*54.5*	*53.8*	*55.0*
% where CIS = 2 to 5	*34.4*	*33.0*	*36.1*	*36.5*	*37.0*	*36.9*	*36.0*
% where CIS > 5	*4.6*	*9.9*	*8.1*	*10.0*	*8.5*	*9.3*	*9.0*

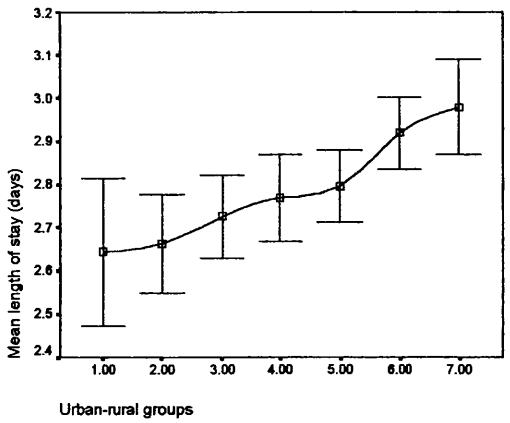
[1] 95% confidence intervals are represented visually in the graphs which follow.

[2] Admissions for groups of conditions deemed to be 'acute' in nature for the purposes of this study: non-chronic respiratory, gastro-intestinal infections, other infections, accidents and poisonings and symptoms and ill-defined conditions.

Below left Figure 7b: Mean age of admission (months) by urban-rural group

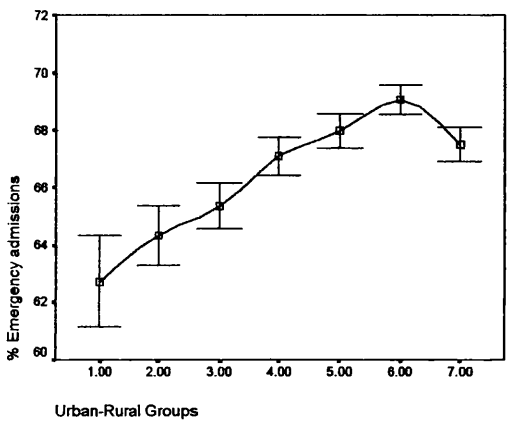
Below right Figure 7c: Mean length of stay (days) by urban-rural group





Below left Figure 7d: % Emergency admissions by urban-rural group

Below right Figure 7e: % Admissions for 'acute' conditions by urban-rural group



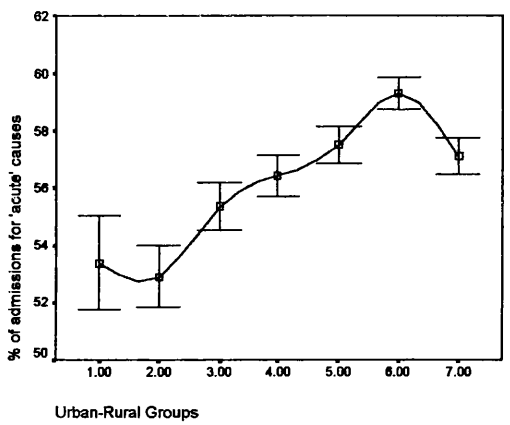


Figure 7f: % Admissions where patient had not been previously admitted

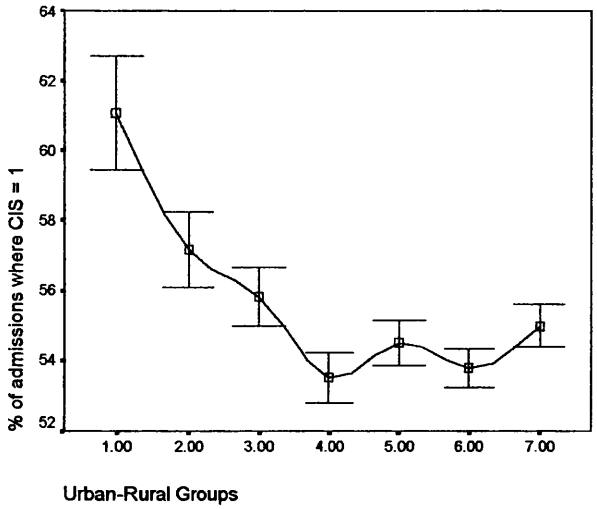


Figure 7g: % Admissions where patient was being admitted for the 2nd to 5th time

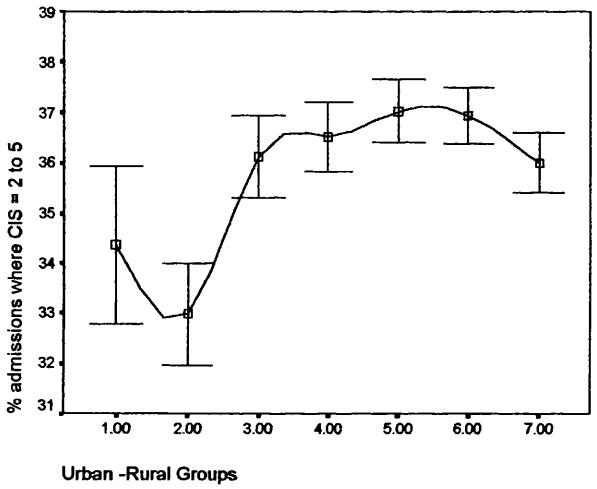
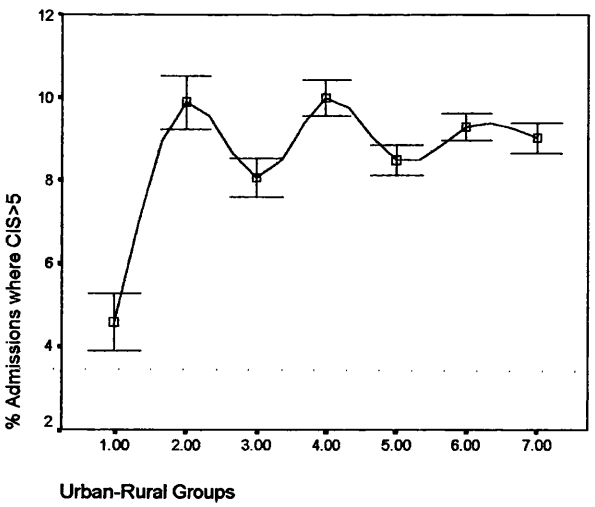


Figure 7h: % Admissions where patient had been admitted more than 5 times



The trends here are broadly similar to those seen in the data on socio-economic variation: urbanicity tends to have a positive effect on rates when deprivation would be expected to, and vice versa. There are however some crucial differences. In several of the graphs, the greatest changes are in the intermediate categories rather than the extremes, suggesting as with the general admission rates for the urban-rural categories that there is a threshold effect of urbanicity above or below which further change makes little difference. Comment on specific trends is given below:

Age of admission: Ages of admission are lower in more urban areas and highest in the most rural. There is little change with increasing urbanicity beyond group 5. It is hard to pinpoint exactly what age of admission tells us: it implies that rural babies more likely to avoid an early admission but whether the reasons for this are social or medical is hard to tell.

Length of stay: Mean length of stay shows a smooth and steady increase with urbanicity, albeit with constantly overlapping confidence intervals. Again this is suggestive of better rural health, but social influences are another possible consideration. Where an inner city child may be kept in hospital a day longer for social reasons, some rural children would probably be sent home as soon as possible regardless of social background. Where access to hospital is difficult for patients, it is also hard for visitors: hence the trend may be partly the result of attempts to minimise disruption on the part of health professionals.

% Emergency Admissions: This is another feature which increases smoothly with urbanicity up to a threshold level at which the trend levels off. The proportion of emergencies even falls away in the most urban category. It seems likely that this trend is the result of easier access to emergency services in urban areas, the efforts of

GPs in rural areas and looking ahead, a more acute diagnostic profile in urban areas. Exactly which conditions are responsible for this remains to be seen: respiratory conditions related to air pollution and accidents seem likely candidates. The slightly lower than expected rate for the most urban areas is intriguing and difficult to explain. One possibility is the presence in very urban (i.e. inner city) areas of a greater number of children with chronic complaints needing elective hospital attention. Another idea is that access to hospital from very urban areas is actually quite problematic, due to fear of crime or similar dystopian factors. It is worth remembering before speculating too wildly that the admissions rate is still high relative to rural areas.

% Admissions for 'acute' causes: As previously mentioned, 'acute' conditions appear to make up a greater proportion of admissions in urban areas. This trend amplifies the pattern shown in the proportion of emergency admissions but with some suggestion of a threshold effect in rural areas.

Variables relating to individual 'admission careers' (Figures f, g and h): Beyond a broad scale disparity between rural and other groups, trends here are not as marked as for the socio-economic gradients. Rural areas in categories 1, 2 and 3 appear to have more individuals being admitted for the first time and fewer children with multiple admissions, a pattern consistent with their lower general rates. In urban and semi urban areas, there is very little difference in the proportions of admissions in each group, suggesting that the higher rates in more urban areas are the result of more individuals in all three categories, rather than a larger subset of children with multiple admissions or a greater risk of first admission.

As with the socio-economic gradient, the higher rate areas, in this case the urban end of the spectrum, appears to have a more 'severe' pattern of admissions. This is however not as clear-cut an effect as with the deprivation gradient. Furthermore, the presence of the 'threshold' effect discussed is ubiquitous, suggesting that differences either in access to hospital services or urban versus rural lifestyles are a likely cause. The potentially confounding effect of deprivation should not be forgotten: this may account for some of the similarity between the urban-rural and socio-economic trends. Some consideration of the interacting effects of the two factors is undertaken in Chapter 8.

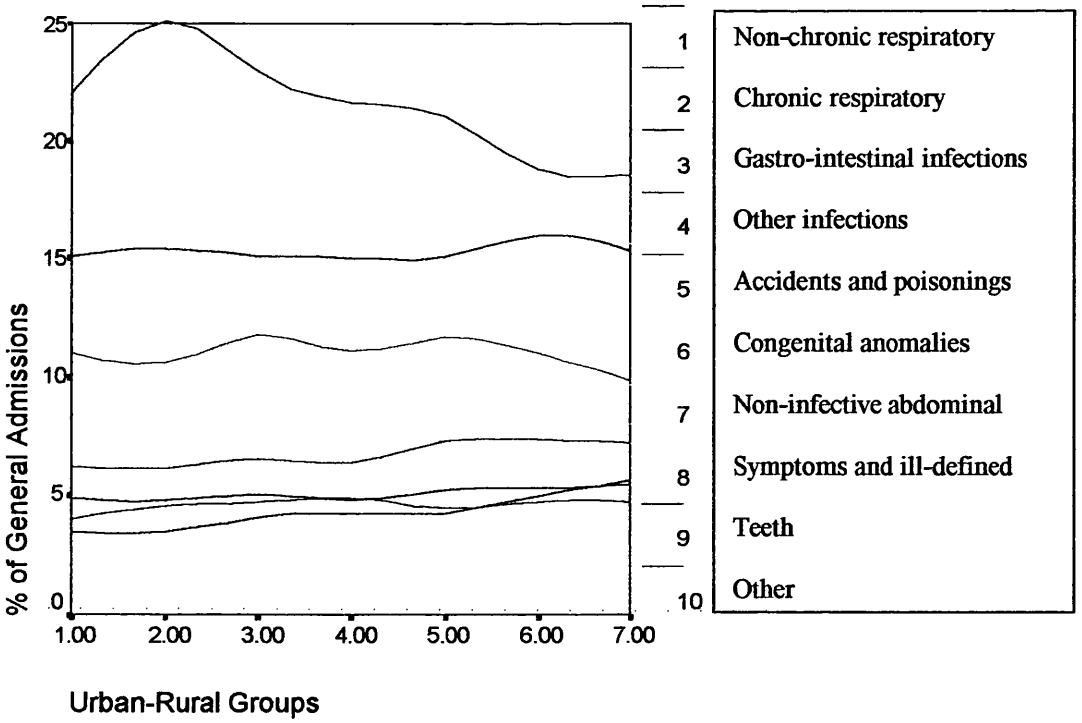
7.4. Differences in the causes of admissions between urban-rural categories

The previous results have established that acute conditions are more prevalent in urban areas. They were not informative as to which specific conditions underlie this trend. The possibility of a higher than normal concentration of chronic conditions in the most urban areas was also speculated. The 'diagnostic profile' of admissions for the urban-rural categories are intended to answer these questions and are reproduced below:

Table 7c: Percentage of admissions composed of specific groups of diagnoses for socio-economic groups in the 1991-3 cohort

Cause of admission	***Urban-Rural Group***						
	1	***2***	***3***	***4***	***5***	***6***	***7***
Non-Chronic Respiratory	*15.0*	*15.4*	*15.1*	*15.0*	*15.0*	*16.0*	*15.4*
Chronic Respiratory	*6.2*	*6.1*	*6.5*	*6.4*	*7.3*	*7.3*	*7.2*
Gastro-Intestinal Infections	*4.8*	*4.8*	*5.1*	*4.8*	*5.2*	*5.3*	*5.4*
Other Infections	*4.0*	*4.5*	*4.7*	*4.9*	*4.5*	*4.8*	*4.7*
Accidents and Poisonings	*11.0*	*10.6*	*11.7*	*11.1*	*11.6*	*11.0*	*9.8*
Congenital Anomalies	*13.4*	*9.2*	*9.3*	*9.1*	*8.8*	*8.5*	*9.6*
Non-Infective Abdominal	*8.6*	*8.0*	*7.0*	*8.7*	*8.5*	*8.5*	*8.0*
Symptoms and ill defined	*11.5*	*12.8*	*13.7*	*14.1*	*13.9*	*14.8*	*15.6*
Teeth	*3.5*	*3.4*	*4.1*	*4.3*	*4.2*	*5.0*	*5.6*
Other	*22.00*	*25.08*	*22.90*	*21.62*	*21.02*	*18.79*	*18.53*

Figure 7h: Trends in proportion of different diagnostic groups by urban-rural category



The most marked trends here are in the 'other' category, which again decreases in prevalence with increasing urbanicity and the symptoms and other ill-defined conditions, which are more prevalent in urban areas. Most of the other conditions display a slight increase, compensating for the loss of 'other' causes. The increases are not in the categories which might have been predicted on the basis of preconceptions about urban versus rural life: accidents and poisoning actually decrease with urbanicity though perhaps there are more opportunities for children to injure themselves in the country.

7.5. Summary

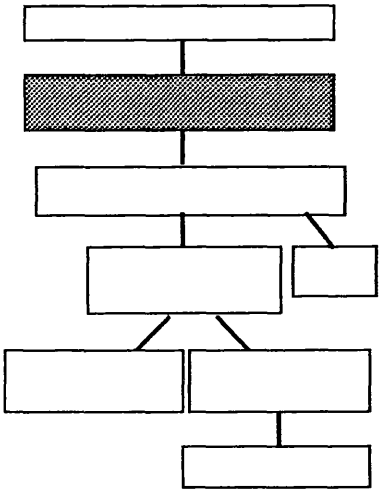
The main findings of this chapter are as follows:

- General admission rates show a positive relationship with urbanicity which appears involve a threshold effect: above and below a certain level changes in area character make little difference.
- Urban areas tend to have a more 'severe' pattern of admissions than rural areas. However, there is some question that this is the result of confounding by deprivation.
- The patterning of admission characteristics and rates hint at underlying factors relating to access to and the organisation of services rather than strictly health related influences. The diagnostic profiles of urban areas differ only slightly from rural ones, adding further credence to the idea of a general social or practical effect of urbanicity on the admissions process.

CHAPTER 8

The interacting effects of socio-economic deprivation and urbanicity on children's hospital admissions

Data being used:



All Data
- Sub-divided into deprived and affluent/urban and rural groups for analysis

(1991-93 birth cohort, all regions, all causes of admission)

Relevant null hypotheses

- Rural admission patterns do not differ from urban admission patterns in level or character.
- Deprived admission patterns do not differ from affluent admission patterns in level or character.

8.1. Introduction

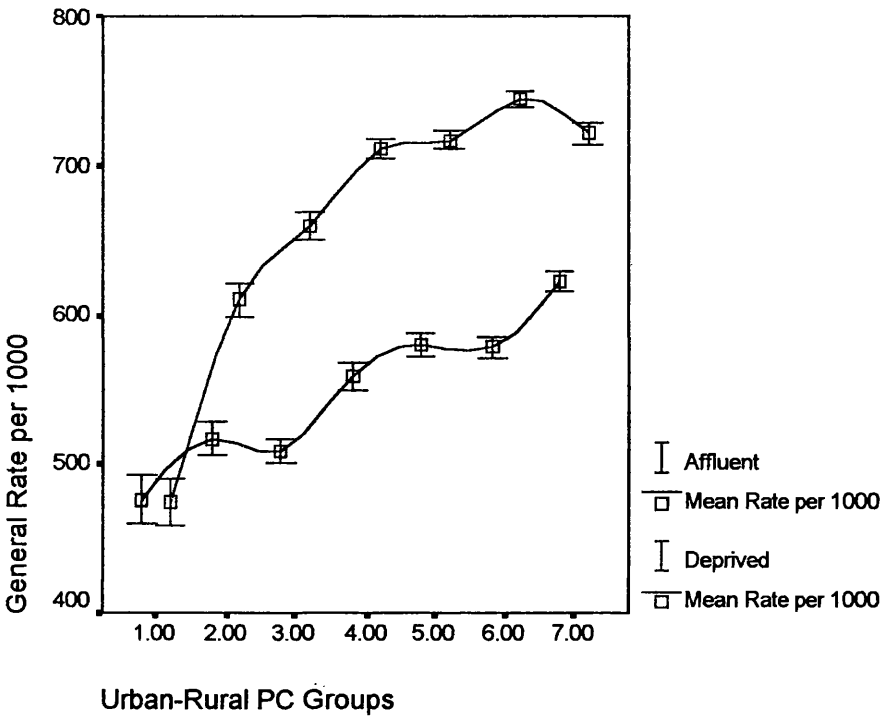
The previous chapters uncovered the various differences in admissions between areas of different socio-economic status and urban and rural character. The main questions addressed in this section relate to the interaction between these two factors: are urban and rural groups affected in the same way by deprivation and vice versa? This is an important point to consider when designing services: all deprived areas, or urban areas or rural areas may not be the same.

In the following set of analyses, broad groupings have been made using the socio-economic and urban-rural categories to represent affluent/deprived and urban/rural areas. It should be emphasised that there is a continuum of character present in both: the divisions made are to a certain extent arbitrary and the groups heterogeneous. There is however some justification for the divisions chosen in that the stratification seen in the previous results came at the relevant points.

8.2. The effect of the urban-rural gradient on general admission rate in affluent and deprived areas

This section compares the urban-rural gradients of general admission rate in affluent (socio-economic categories 1 to 4) and deprived groups (socio-economic categories 5 to 7). General rates and 95% confidence intervals were calculated for both groups in each urban-rural category. The results are given below:

Figure and Table 8a: Differences between general admissions rates in 'affluent' and 'deprived' groups across the urban-rural categories, 1991-3 cohort.



	Most Rural						***Most Urban***
Urban-rural PC groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Rate per 1000 for 'affluent' groups'	*476.06*	*517.02*	*508.76*	*559.06*	*579.66*	*578.54*	*622.96*
95% Confidence Interval	*459.22-492.91*	*505.34-528.70*	*500.51-517.00*	*550.13-568.00*	*571.60-587.71*	*571.18-585.90*	*616.36-629.56*
Rate per 1000 for 'deprived' groups	*473.91*	*610.44*	*659.79*	*711.05*	*716.77*	*744.31*	*721.29*
95% Confidence Interval	*458.34-489.49*	*599.31-621.58*	*650.24-669.34*	*704.27-717.84*	*710.64-722.89*	*739.12-749.51*	*714.23-728.34*

This set of results shows an interesting contrast in the way deprived and affluent groups' admission rates differ between urban and rural areas. The deprived groups initially appear more affected by the urban or rural nature of their environment than the affluent. The ratio of rates between the two extremes of urbanicity for the deprived subset is 1.52, compared to 1.30 for the affluent equivalent. In very rural areas, admission rates for both groups are almost indistinguishable. Rates for the deprived groups then rise very steeply with increasing urbanicity until a high 'plateau' in groups 4 to 7. The affluent admissions rise steadily and also show a suggestion of levelling out in urban areas.

The differences between the two groups after the initial changes throughout the more rural end of the spectrum actually remain relatively constant, with the ratio fluctuating between 1.24 and 1.29 between urban-rural groups 3 to 6. During this time the rates are rising in parallel, indicating that the effect of urbanicity in the semi-urban to urban areas is similar in magnitude for both groups, albeit operating different starting levels of general rates. In the most urban group however, the deprived rates drop and the affluent rates rise, closing the gap between the two. While these changes could be viewed as fluctuations, both are statistically significant: implying that conditions in the most urban areas have more of an effect on the affluent groups' hospital admissions than the deprived.

There is an issue about the size and character of the populations in these figures that may explain the two interesting phenomena observed. Very rural areas contain only a handful of postcodes in the most deprived categories: the majority being in urban

areas. The rate in the very rural area therefore more reliably reflects the behaviour of individuals in DEPCAT 5 than 7. This does not however explain the initially higher rate of change in the deprived groups: the composition of the groups actually becomes more affluent on average between urban-rural categories 1 and 3, with the proportion of postcodes in group 5 rising from 44%, through 75% to 78%. The table below shows these results in full:

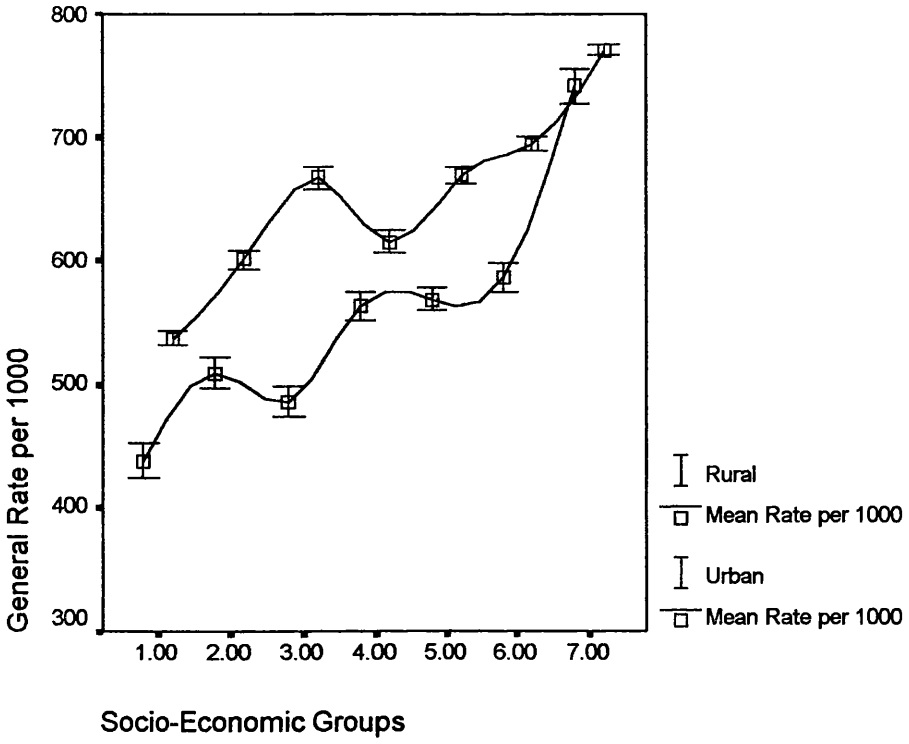
Table 8a(i): The socio-economic composition of the various urban-rural categories.

	1991 DEPCATS						
Urban-Rural PC Groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1 (Most rural)	*11.7%*	*22.6%*	*31.4%*	*21.2%*	*5.8%*	*5.8%*	*1.5%*
2	*8.5%*	*20.6%*	*36.2%*	*23.4%*	*8.5%*	*2.8%*	
3	*13.3%*	*26.7%*	*29.6%*	*17.0%*	*10.4%*	*2.2%*	*0.7%*
4	*6.5%*	*18.0%*	*19.4%*	*28.1%*	*15.8%*	*10.1%*	*2.2%*
5	*12.1%*	*12.1%*	*14.3%*	*24.3%*	*20.0%*	*12.9%*	*4.3%*
6	*7.6%*	*11.7%*	*12.4%*	*21.4%*	*13.1%*	*14.5%*	*19.3%*
7 (Most urban)	*2.9%*	*6.5%*	*16.5%*	*26.6%*	*15.8%*	*20.1%*	*11.5%*

8.3. The effect of the socio-economic gradient on general admission rate in urban and rural areas

The following set of results is similar in format to the preceding section, but the 'other way around'. The effect of the socio-economic gradient in groups of areas defined as 'rural' (urban-rural groups 1 to 3) and 'urban' (urban-rural groups 4 to 7) is being compared. In other words, the rural and urban categories of comparable socio-economic status are being measure against each other. General admission rates and 95% confidence intervals were calculated as appropriate and the results are presented below:

Figure and Table 8b: Differences between general admissions rates in 'affluent' and 'deprived' groups across the urban-rural categories, 1991-3 cohort.



Socio-economic PC groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Rate per 1000 for 'rural' groups'	*437.51*	*509.40*	*486.22*	*563.62*	*568.89*	*585.91*	*741.48*
95% Confidence Interval	*423.43-451.58*	*496.99-521.81*	*473.48-498.96*	*552.47-574.77*	*559.15-578.64*	*574.33-597.49*	*727.73-755.24*
Rate per 1000 for 'urban' groups	*537.32*	*600.85*	*666.98*	*614.82*	*669.39*	*694.42*	*770.28*
95% Confidence Interval	*531.15-543.48*	*593.54-608.16*	*658.07-675.90*	*605.80-623.84*	*662.31-676.47*	*688.69-700.15*	*766.10-774.47*

The distinction between the urban and rural groups' patterns here is less marked than that between affluent and deprived groups. The general trend is one of parallel increase in rates with increasing deprivation: the ratio of rates between groups 1 and 6 is almost identical for both groups (1.33 for rural, 1.29 for affluent). Rural rates are without exception lower, reflecting the positive effect of urbanicity on rates shown in the previous analyses.

The data display two unusual features. Firstly, in the most deprived group, rates in rural areas rise sharply to the same level as in urban areas. This could be accounted for as an artefact of the small size of this category in rural areas. However, there is also the possibility that the effect is genuine (the confidence intervals are, after all, relatively narrow) and may relate to the 'big fish, small pond' phenomenon hinted at in previous chapters. A small subset of very deprived families in a rural area surrounded by the more affluent may have a greater command on emergency services than less deprived or more urban counterparts: if they present, they might be admitted more frequently due to the perceptions of health professionals to them in contrast to their other patients. Conversely, the very deprived in rural areas may find access to primary health care and related services more problematic, resulting in worse health.

The second feature is the unusually large difference between urban and rural rates in socio-economic category 3, coupled with the small equivalent difference in socio-economic category 4. It seems likely that this is a statistical artefact that would be eliminated by an alternative division of the two groups, but is worth bearing in mind.

The data on rates indicate that urban and rural deprivation and deprived and affluent urbanicity exert slightly different effects on rates: essentially the effects of the two multiply together. Urban deprived areas have higher rates than urban rural (7770 per 1000 as opposed to 741 per 1000) and so on (Figure 8b). There are also some 'quirks' in this relationship: deprived groups are more affected by the urban rural gradient: the 'affluent' categories admission rates increase by a factor of 1.3 between the most rural and the most urban categories, compared with 1.5 for the 'deprived' group (figure 8a). The very deprived in rural areas display high general admission rates and the affluent in urban areas also have higher admissions than might be expected (Figure 8b).

8.4. The interacting effect of urbanicity and deprivation on admission characteristics

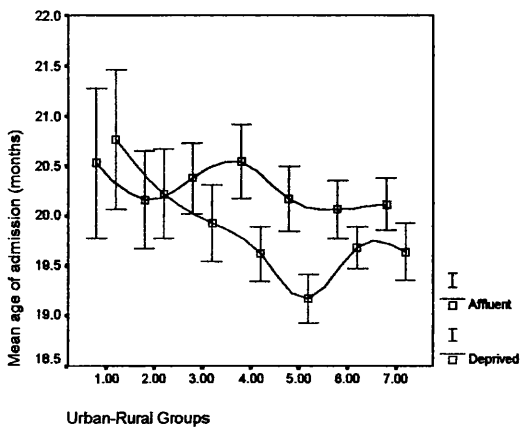
The previous chapters demonstrated that admissions differ systematically between affluent and deprived and urban and rural areas not just in rate, but in character. It would be interesting to discover whether these effects interact: are, for example, the admissions of the rural deprived groups different from the urban deprived? Data on the same set of key characteristics of admissions as previous have therefore been generated. The same groupings of 'urban' (groups 4 to 7) 'rural' (groups 1 to 3), 'deprived' (socio-economic groups 5 to 7) and affluent (socio-economic groups 1 to 4) have been used throughout. Dissecting the character of the admissions in this context is quite a complex operation and the results are perhaps best interpreted visually. The series of graphs below displays the relevant findings[1]:

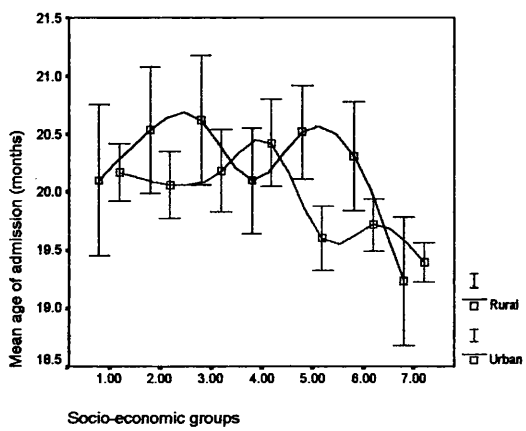
[1] Full sets of numerical results can be found in Appendix 3

8.4.1. Trends in mean age of admission

Below left Figure 8c: Urban-rural gradients in mean age of admission (months) for affluent and deprived groups, 1991-3 cohort

Below right Figure 8d Socio-economic gradients in mean age of admission(months) for urban and rural groups, 1991-3 cohort





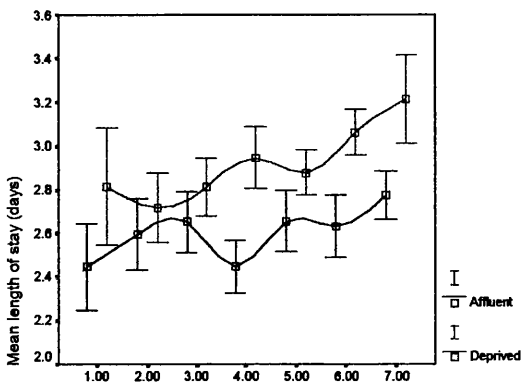
The differences in age of admission between the urban and rural groupings revealed here are not especially great and the differences in pattern between the various groups not especially significant. Arguably age of admission decreases with increasing deprivation in rural and urban areas in a similar way, but the trend is inconsistent and unpredictable.

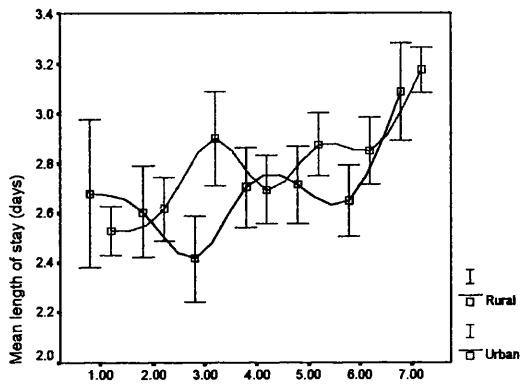
The contrast between the urban-rural gradients in 'affluent' and 'deprived' groups (above left) is more marked: urbanicity seems to have very little effect on the age at which affluent groups are admitted, but in the deprived category younger children are admitted in more urban areas. This supports the conclusion that the deprived groups admissions are more influenced by the urban-rural gradient.

8.4.2. Trends in mean length of stay

Below left Figure 8e: Urban-rural gradients in length of stay (days) for affluent and deprived groups, 1991-3 cohort

Below right Figure 8f Socio-economic gradients in mean length of stay (days) for urban and rural groups, 1991-3 cohort





The pattern in both these graphs is one of parallel increases in mean length of stay with both deprivation and urbanicity, indicating that both have an influence. Deprivation appears to have the greater of the two effects (above right): the 'deprived' group in the left hand graph has stays consistently higher than the affluent group. The rural and urban groups (above right) are not similarly separated.

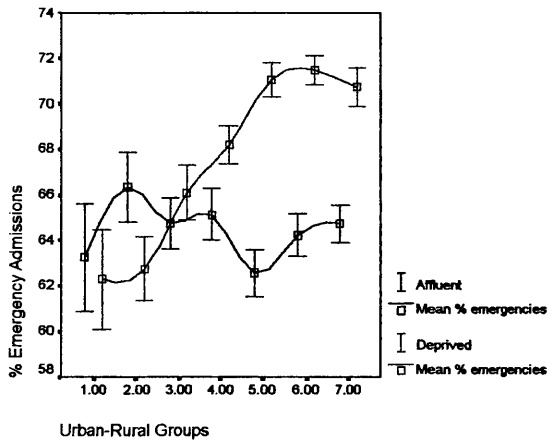
As with age of admission, the magnitude of difference in real terms in length of stay is quite small: the longest mean stay is less than a day more than the shortest. However the trends observed are fairly robust: an extra day in hospital may well be quite an important outcome. Given that the average length of stay is only 2.83 days one more day represents a 35% increase.[2]

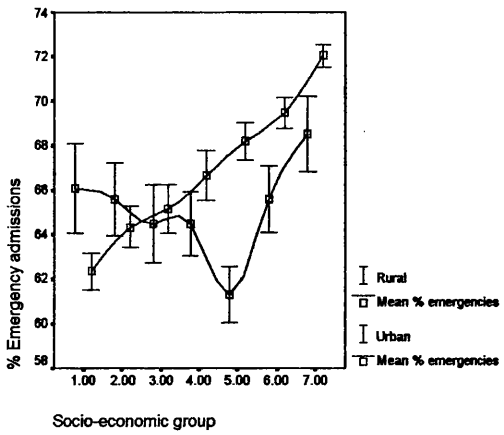
[2] One potential confounding factor is the presence of individuals diagnosed with congenital anomalies who have extremely long stays in hospital: the maximum length of stay in the sample is 850 days!

8.4.3. Trends in the proportion of emergency admissions

Below left Figure 8c: Urban-rural gradients in the % of emergency admissions for affluent and deprived groups, 1991-3 cohort

Below right Figure 8d Socio-economic gradients in % of emergency admissions for urban and rural groups, 1991-3 cohort





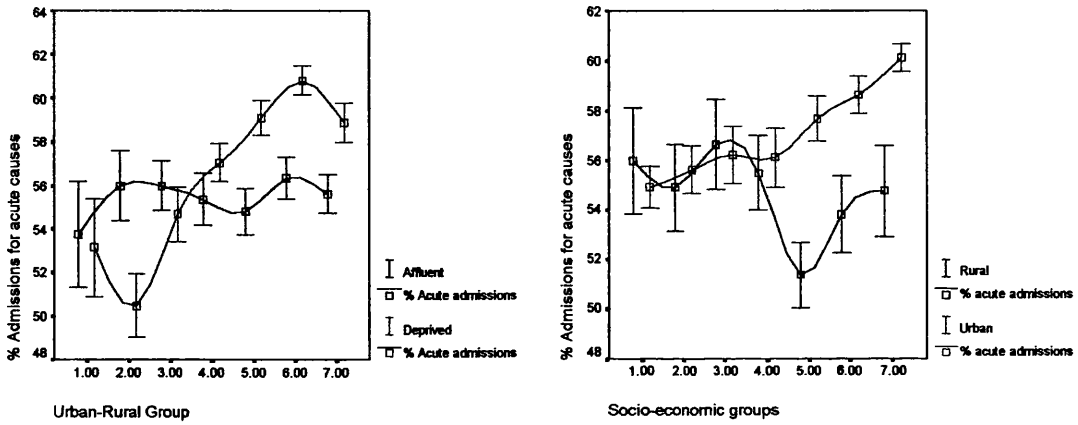
The proportion of emergencies is one of the most revealing features of the character of an areas' admissions and some significant patterns are revealed in the results. Firstly a marked and regular deprivation gradient is evident in urban but not rural groups (above right). The proportion rises 10%, from 62% in the most affluent to 72% in the most deprived. The rural pattern, despite some fluctuation, incorporates only a modest rise.

Deprived groups again appear more affected by the urban rural gradient (above left), showing a 10% difference in proportion between the most rural and most urban areas, while the affluent groups remain at a similar level. The threshold effect of urbanicity is again in evidence, with little change in the proportions beyond category 5.

8.4.4. Trends in the proportion of admissions for 'acute' causes

Below left Figure 8e: Urban-rural gradients in the % of admissions for 'acute' causes in affluent and deprived groups, 1991-3 cohort

Below right Figure 8f Socio-economic gradients in the % of admissions for 'acute' causes in urban and rural groups, 1991-3 cohort



The pattern for 'acute' causes is strikingly similar to that for emergency admissions. The same steady rise with deprivation can be observed in urban groups in comparison to an inconsistent relationship for rural groups (above right), while a similar threshold effect is evident with the urban-rural gradient in deprived areas (above left). This is in contrast to the absence of any trend in affluent areas.

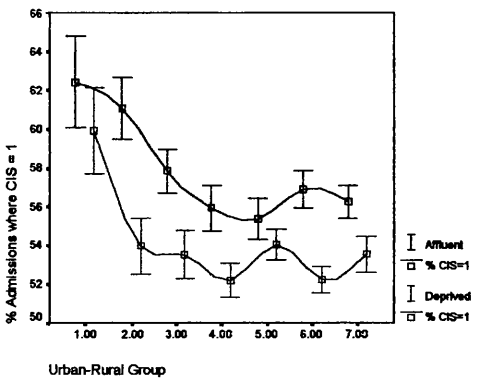
The match of the patterns with emergency admissions suggests that differences in the character of admission between areas result from a different prevalence of acute conditions rather than an unrelated tendency towards accessing hospital services through Accident and Emergency. The disparity in trends implies that urban and

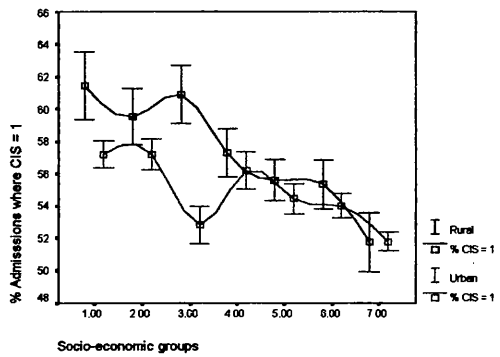
deprived groups' admissions are more strongly influenced by their immediate environs than rural and affluent groups.

8.4.6. Trends in 'admission careers'

Below left Figure 8g: Urban-rural gradients in the % of admissions where patients are being admitted for the first time for affluent and deprived groups.

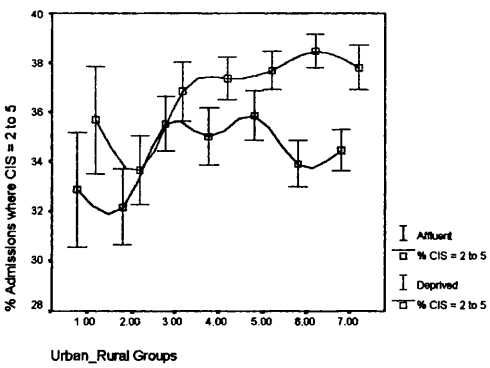
Below right Figure 8h Socio-economic gradients in the % of admissions where patients are being admitted for the first time for urban and rural groups.

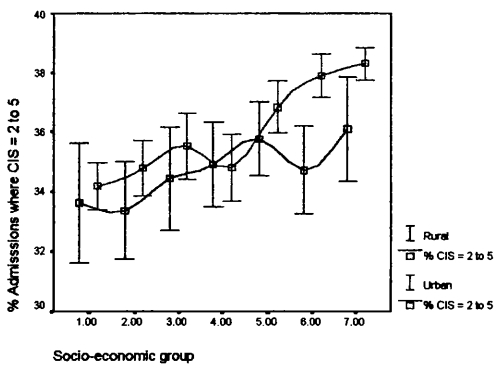




Below left Fig. 8i: Urban-rural gradients in the % of admissions where patients are being admitted for the second to fifth time, affluent and deprived groups.

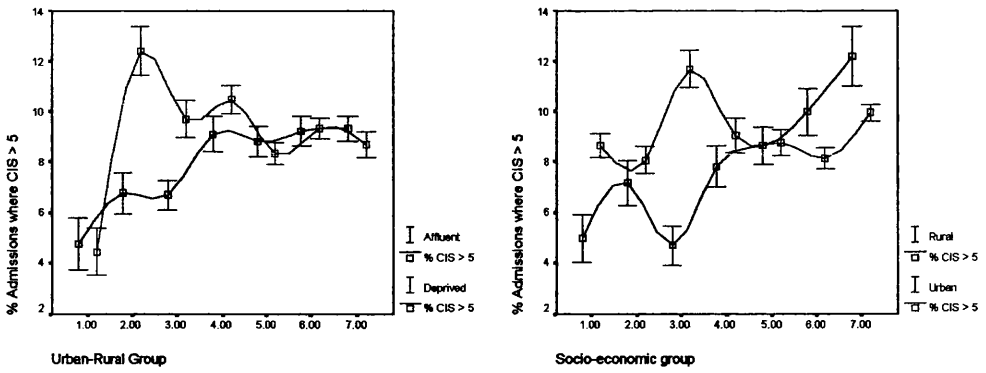
Below right Fig. 8j: Socio-economic gradients in the % of admissions where patients are being admitted for the second to fifth time, urban and rural groups.





Below left Figure 8g: Urban-rural gradients in the % of admissions where patients have been admitted over 5 times for affluent and deprived groups.

Below right Figure 8h Socio-economic gradients in the % of admissions where patients have been admitted over 5 times for urban and rural groups.



The patterns shown in all these graphs correspond fairly closely to the socio-economic and urban-rural gradients observed in previous chapters. Essentially, as areas become more urban and deprived, more individuals with multiple admissions are present: the proportion of first admissions decreases while admissions where the CIS code is between 2 and 5 or more than 5 increase. The urban-rural trends contain a threshold of urbanicity above which further change is limited, while a more consistent rate of change is seen with deprivation.

The only notable differences in pattern between groups are in the proportion of admissions where CIS is greater than 5: patients who have been admitted on numerous occasions. Affluent groups show more of a consistent relationship with urbanicity than deprived: a reversal of the usual situation. More significantly, the proportion of multiple admission type patients increased with deprivation in rural groups, but not in urban. The proportion of 'multiple admittees' in urban areas is moderately high across the socio-economic spectrum, fluctuating around approximately 9%. In rural areas the figure changes steadily from a low of about 5 in the most affluent areas to a high of about 12: a factor of 2.4. This feature of the data is very hard to explain.

8.5. Interpretation of general trends in characteristics

- Differences in the nature of the urbanicity and socio-economic gradients can be seen for some of the admission characteristics, but not for others. Where the trends are not distinct, the data for both urban and rural tend to follow the underlying patterns established in previous chapters, at a similar or different level of magnitude.

- Characteristics where two distinct urban-rural gradients can be seen for deprived and affluent groups include mean age of admission, the proportion of emergencies and 'acute' admissions. The proportion of children being admitted for the first time and the proportion being admitted for the second to fifth time display parallel trends which run at different levels.

- Characteristics where two distinct socio-economic gradients can be seen for urban and rural groups include the proportion of emergencies, the proportion of admissions for 'acute' causes and the proportion of admissions where the children had been admitted more than 5 times previously (CIS > 5).

- Usually, it is the deprived or urban group that displays a trend if none is evident in the other group. This fits with the general pattern of deprived groups being more 'vulnerable' to area based differences. The exception to this is the proportion of 'multiple admittees', where rural groups display a marked deprivation gradient not present in urban areas.

- Urban deprived areas tend to display a more 'severe' pattern of admissions than rural deprived or urban affluent areas.

8.6. Summary

- The interaction of the influences of urbanicity and deprivation on general admission rates is such that deprived urban areas tend to have the highest rates. Apart from the extremes, deprived rural areas have higher rates than affluent rural areas. Greater 'severity' of admission characteristics tends to be associated these higher rate areas.
- The rate and character of admissions in deprived groups are more influenced by the urban-rural gradient than their equivalent in affluent groups. Urban groups are more affected by socio-economic gradients that rural, but this effect is less marked.
- Deprived and affluent groups display more distinct urban-rural patterns of admission characteristics than vice versa, suggesting that deprivation is a more important influence than urbanicity at this level of analysis.

The picture emerging from all of these trends is that levels urbanicity and deprivation interact to produce admission patterns, but that deprivation is marginally the more important of the two: it creates more differences between groups. Both rate and character of admissions are affected. The reasons for this possibly relate to ideas such control or choice: both urbanicity and socio-economic status affect these concepts in different ways in relation to hospital admissions. Social exclusion, a frequently discussed topic in relation to deprivation in recent times relates to people's ability to access society and the services, including medical care, which it provides.

Affluence increases a families control over their involvement in society, their health and their access to medical services. Living in a rural or urban area can constrain choice in different ways, but the impact of this may often depend on the affluence of

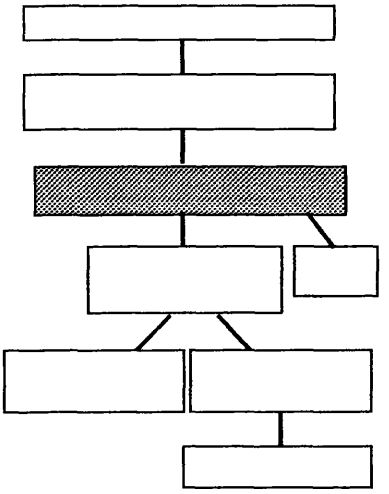
the family. An affluent family for example are more likely to have private transport than one living in a deprived area. When a child is ill in an urban area, with hospitals geographically close and accessible by public transport, this makes little difference. In a more remote rural area, the deprived family encounter an obstacle to emergency care their better off counterparts do not: hence the greater influence of urban-rural differences on deprived groups.

This is just one example of a mechanism: there may be many more. It does not for instance explain why the proportion of 'acute' admissions displays an urbanicity gradient in deprived but not affluent areas. The next chapter will consider more specific groups of conditions and may throw some light on this mystery.

CHAPTER 9

The rates of different diagnostic categories in relation to socio-economic deprivation and urbanicity

Data being used:



All data
- Sub-divided into deprived and affluent/urban and rural groups
- Sub Divided by cause of admission

Relevant null hypotheses:

- All medical conditions react in a similar way to deprivation and urbanicity.

9.1. Introduction

Previous chapters have included some brief consideration of diagnostic mix as a means of characterising the admission patterns in areas of differing socio-economic and urban rural characteristics. This chapter will examine patterns in the rates of the various diagnostic groups created earlier in the thesis[1] more closely, in relation to deprivation and urbanicity. The behaviour of particular groups of conditions may hint at the nature of the mechanisms underlying the patterns of general admissions.

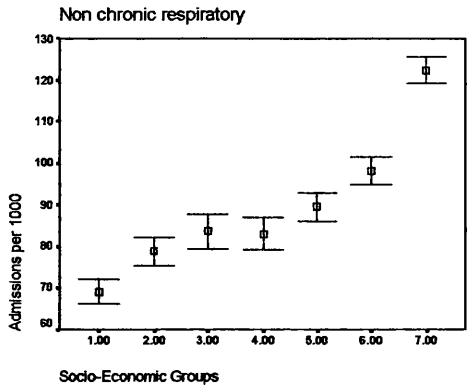
9.2.Deprivation gradients for the diagnostic groups

[1] See Appendix 1

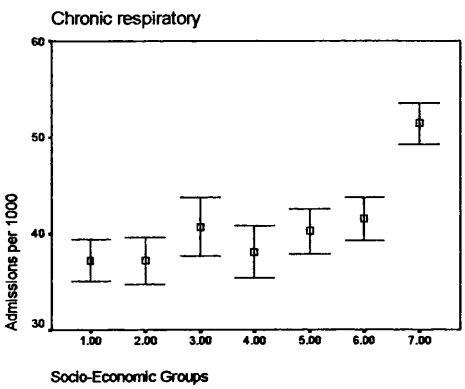
Cause specific admission rates per 1000 were calculated for each of the seven socio-economic categories (1 being the most affluent, 7 the most deprived) defined in Chapter 6. Results for the 10 diagnostic groups are plotted below[2]:

Figure 9a: Deprivation gradients in admission rates for the ten diagnostic groups

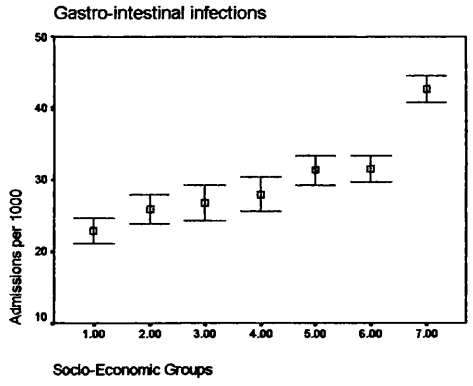
Non-chronic respiratory



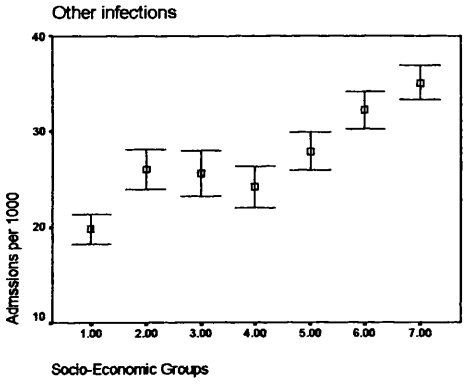
Chronic respiratory



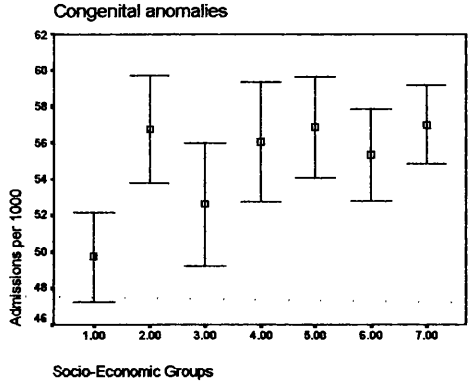
Gastro-intestinal infections



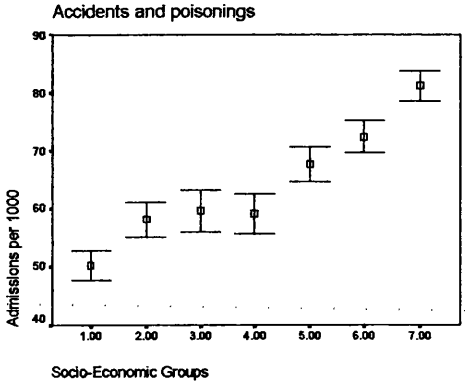
Other infections



Congenital anomalies

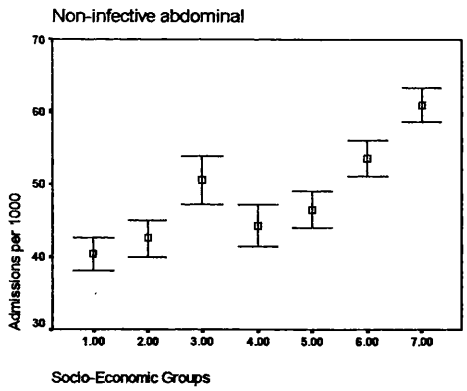


Accidents and poisonings

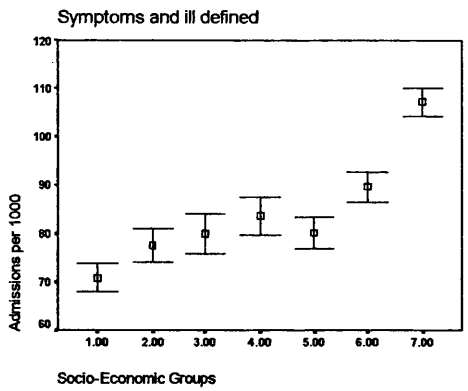


[2] For numerical rates see Appendix 4

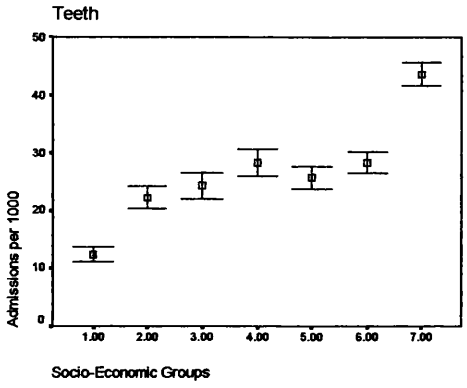
Non-infective abdominal



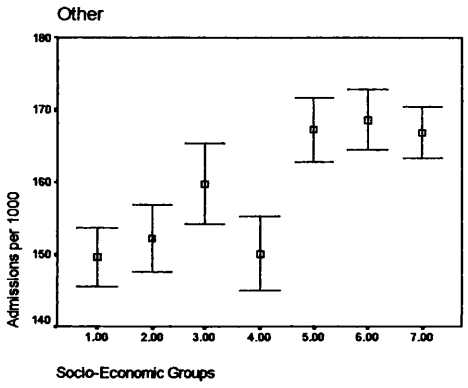
Symptoms and ill-defined conditions



Teeth



Other



The rates of all of these listed conditions show a positive relationship with socio-economic deprivation, albeit to different degrees and at varying levels. The highest rates are for the 'other' category, (168.58 per 1000 in socio-economic category 6) non-chronic respiratory conditions (122.21 per 1000 in category 7) and symptoms and ill-defined conditions (107.17 per 1000 again in category 7). Less common are dental conditions (12.31 per 1000 in category 1), other infections (19.76 per 1000 in category 1) and gastro-intestinal infections (22.77 per 100 in category 1). The level at which the other conditions are located vary fairly widely between these extremes. The rate of one diagnostic group compared to another is a reflection of its epidemiological importance to hospital admissions in young children, but also of the number of conditions included in that category: the 'other' category for example

contains 315 disparate diagnosed conditions, compared with 14 for non-chronic respiratory.

The magnitude of change across the socio-economic spectrum also varies widely: the average factor of increase between groups 1 and 7 is 1.72. Dental conditions (3.53) and gastro-intestinal conditions (1.87) display the greatest proportional change (probably the result of having the lowest starting rates) while the 'other' category (1.12) and congenital anomalies (1.15) rise least. Of the other most prevalent causes of admission, non-chronic respiratory conditions increase by a factor of 1.78 and symptoms and ill-defined conditions by 1.51.

The fact that rates of all conditions rise to reasonable extent and not just those traditionally associated with poverty is significant and suggests that a general mechanism rather than one specific to any condition (or type of condition) is at work. Whether this is Watt and Ecob's (1995)[i] 'general vulnerability which transcends specific aetiology' or a tendency to seek hospital care for conditions rather than visit a GP remains to be seen: the former seems more likely, but the two are not mutually exclusive. This general vulnerability may be biological, environmental or social in origin and further research is no doubt needed to find out more.

While all the diagnostic groups display increasing rates with increasing deprivation, there is a certain amount of variety in the nature of this response[3]. The general pattern is one of increasing rates at either end of the spectrum and fairly similar rates in the middle groups, giving an S-shaped curve. Quite why the pattern is not a

[3] Although not as much as with the urban-rural gradient: see section 9.3.

straightforward rise is open to speculation: the most likely and least interesting possibility is that the middle groups contain a mixture of affluent and deprived individuals which will tend to equalise rates. Several variations on this 'theme' can be seen in the data:

a. *S-shaped curve similar to that described above with some slowing down of the rate of change in groups 2 to 4, but otherwise a steady increase in rates throughout.*

e.g. Other infections, accidents and poisonings and non-infective abdominal conditions.

With this pattern, risk increases steadily with deprivation. More than one influence may be at work.

b. *A limited rise in rates or almost level trend up to socio-economic category followed by a markedly higher rate in the most deprived group.*

e.g. Non-chronic respiratory conditions, chronic respiratory conditions, gastro-intestinal infections, symptoms and ill-defined conditions and dental conditions.

This is the most common pattern and includes most of the dominant groups in the diagnostic profile. Under this set of circumstances, the very deprived seem to be affected disproportionately: the same kind of effect was observed in the chapter on rates. The conditions are largely what would be regarded as the classic diseases of poverty, which is an interesting co-incidence: why are they associated with poverty? One possible answer is because more affluent groups and in more recent times most

deprived families are able to avoid suffering from them. Again, speculatively, perhaps the threshold between groups 6 and 7 is the point at which the coping strategies used by families to prevent their children becoming ill enough to require hospital attention cease to be effective.

c. *Constant rates in socio-economic groups 1 to 4, with higher rates above this threshold showing no increase with deprivation.*

e.g. The 'other' category.

The trend in this category is quite distinctive from any of the others and is suggestive of a threshold effect. Below a certain level of affluence the risk of admission is much greater, but the degree of deprivation does not make a difference beyond this. The mechanism may therefore be something socio-economic groups 5 and 7 have in common.

The other category is composed of a large number of conditions which vary in character, but are largely chronic. The most frequently occurring three causes are ear complaints (14.3%), perinatal conditions (12%) and male genital conditions (10.3%). The rest include neoplasms, osteopathies, eye complaints and even mental disorders. 32.1% of the group is composed of a variety of conditions which account for less than 1% each. The category is therefore a combination of routine, non-serious complaints such as ear and eye problems that affect a moderately large number of children and life threatening conditions affecting an unlucky minority.

So, summarising the main trends in this data:

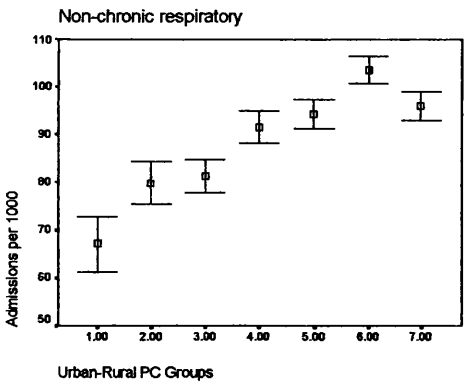
- All the diagnostic groups show an increase in admission rates with increasing socio-economic deprivation, including conditions not traditionally associated with poverty.
- There is some variety in the way this increase manifests itself between conditions. This variety can be used to speculate as to the underlying influences.

9.3. Urban-rural gradients for the diagnostic groups

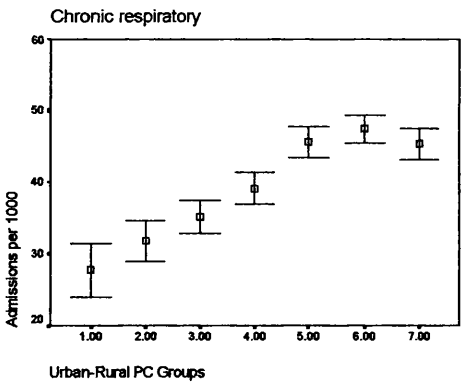
Diagnosis group specific rates and 95% confidence intervals[4] were calculated as previously for the seven urban rural groups used in chapters 7 and 8. These results are plotted below:

Figure 9b: Urban-rural gradients in admission rates for the ten diagnostic groups

Non-chronic respiratory



Chronic respiratory

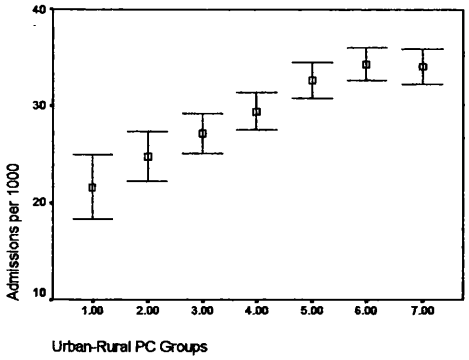


Gastro-intestinal infections

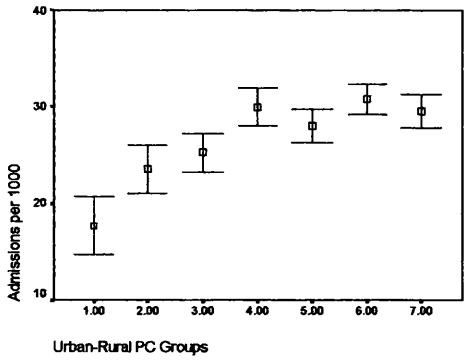
Other infections

[4] For numerical rates see Appendix 4

Gastro-intestinal infection

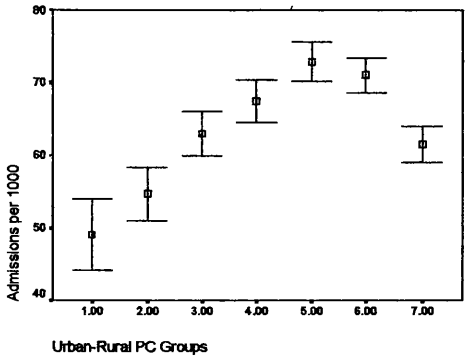


Other infection



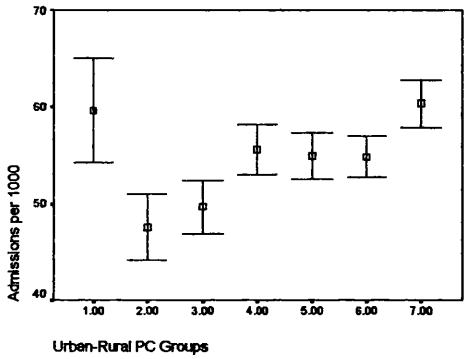
Accidents and poisonings

Accidents and poisonings



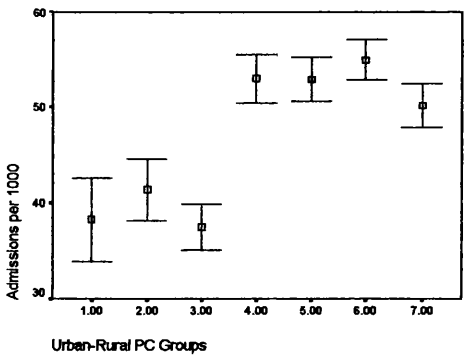
Congenital anomalies

Congenital anomalies



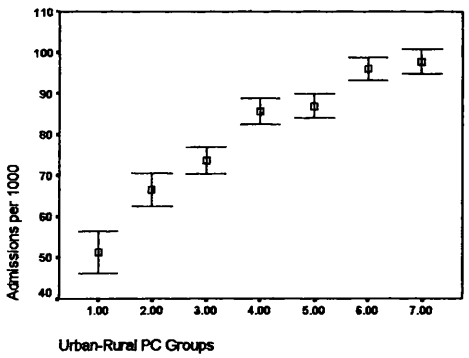
Non-infective abdominal

Non-infective abdominal



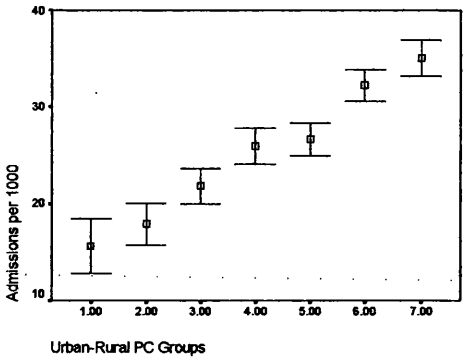
Symptoms and ill-defined conditions

Symptoms and ill-defined



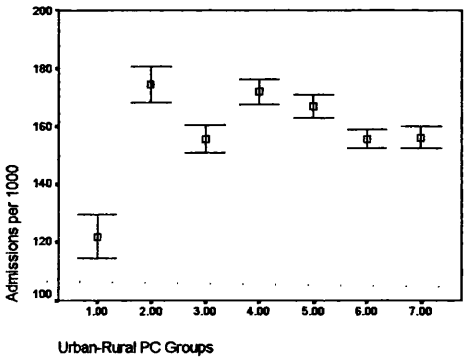
Teeth

Teeth



Other

Other



As with the results in the previous section, all the diagnostic group rates display the same basic trend of increase with urbanicity, to different degrees and at different levels. The diagnostic groups producing the highest and lowest rates are almost identical to those in the previous results, for obvious reasons: the 'Other' category peaks at 155.93 per 1000, non-chronic respiratory conditions are is second at 103.41 per 1000 and symptoms and ill-defined conditions third at 97.67 per 1000. Dental conditions (15.5 per 1000) and gastro-intestinal (21.57 per 1000) and other infections (17.60 per 1000) are again the smallest groups.

The average factor of increase, this time calculated from the lowest to the highest rate regardless of category, is slightly lower than for the socio-economic gradients at 1.6 (compared to 1.72) but there is less variability. Dental conditions increase by a factor of 2.26, symptoms and ill-defined conditions by the notably large factor of 1.91 (0.40 more than its factor of increase between socio-economic groups 1 and 7) while non-chronic respiratory conditions increase less spectacularly than with deprivation by 1.55. Chronic respiratory conditions, one of the groups less affected by deprivation (factor = 1.38) increase by the larger factor of 1.64. The smallest changes are in congenital anomalies (1.27) and non-infective abdominal conditions (1.31).

The patterns of increase in rate with urbanicity are more varied and complex than those observed with deprivation. Several distinct patterns can be identified:

a. *The 'threshold' effect: rates increase with urbanicity up to category 4 or 5, but remain at a similar high level in the more urban areas*

e.g. Chronic respiratory conditions, gastro-intestinal infections, other infections, congenital anomalies.

This pattern is indicative of a mechanism that is increasingly effective in mixed areas of increasing urbanicity, but remains constant in its influence above a certain level. With the exception of congenital anomalies, which only tenuously belongs in this category anyway, all of the diagnostic groups displaying this pattern of change are environmentally influenced. Chronic respiratory conditions such as asthma (which comprises 76.8% of the group) are influenced by factors including outdoor and indoor air quality and time spent by small children in these respective environments. These influences do not vary much in degree between the city centre and, say, a moderately large town. Children's infections have their own specific epidemiologies, which may depend on the extent of contact with other children: again a factor which will vary quite a lot between rural and semi-urban areas, but will be quite constant in different degrees of urban area.

b. A rise in rate to a peak in moderately urbanised areas (category 5 or 6), with a fall in rates in the most urban areas.

e.g. Non-chronic respiratory, accidents and poisonings.

This puzzling pattern indicates a mechanism that increases admissions up to a certain degree of urbanicity and then hinders them beyond this. The two diagnostic groups which display this trend are the two most likely causes of an emergency admission in small children: a child with acute breathing difficulties or one which has just been injured are likely to be taken quickly to accident and emergency. It is possible then,

than the trend reflects some feature of the emergency admissions process, perhaps relating to modes of accessing such services.

b. A relatively constant rate of change across the urbanicity gradient.

e.g. Dental conditions, symptoms and ill-defined conditions

The underlying mechanism here must be something that changes steadily with urbanicity and is at its most effective in the most urban areas. One possibility is physical access to services. The diagnostic groups do not offer any clues, being quite different in the character of admissions they generate: dental admissions will tend to be planned, ill-defined conditions are more likely to be emergencies. On the basis of this, one could imply that the relevant mechanism must be able to affect both elective and emergency admissions. There is no reason to suppose, however, that the same factors underlie both trends.

c. A stepped trend with constant low or high rates either side of the threshold

e.g. Non-infective abdominal.

This trend is unique to one condition and hard to explain. Rates are low (they fluctuate around 38 per 1000) in the three most rural groups and then consistently higher (around 53 per 1000) in the remainder of the spectrum. The most likely explanation seems to be that this is a modified version of trend a.

d. No consistent pattern.

e.g. Congenital anomalies, the 'other' category.

Trends can be imagined in these data: read in particular ways both show an urban-rural gradient. The most realistic assessment however is that urbanicity has limited effect on admissions for these diagnostic groups. This makes speculative sense for both sets of conditions, which will either generate short planned elective admissions or longer stays in hospital for operations and treatment. With the more serious conditions that compose a fair proportion of admissions in the other category, there is little choice about seeking medical attention in most cases, so factors such as ease of access that might vary with urbanicity play a limited role.

So, to summarise:

- Most of the conditions show a positive relationship between urbanicity and rates to varying degrees.
- There is a great deal of variety in the nature of the relationship with urbanicity. Unlike the relationships observed with deprivation, influences specific to the different diagnostic groups seem to be important.
- This implies that the nature of the mechanisms underlying urban-rural differences in rate is distinct from that of socio-economic gradients: the latter are more general and probably more complex.

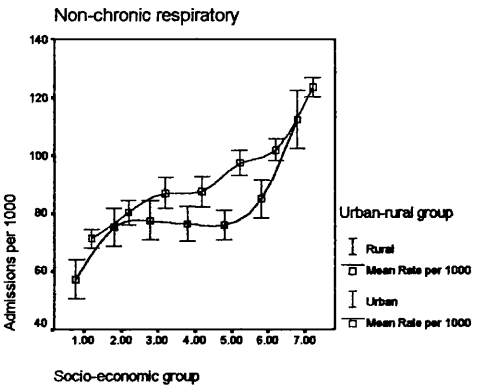
9.4. Interaction of socio-economic deprivation and urbanicity in the different diagnostic groups

Having explored the individual effects of deprivation and urbanicity on diagnostic groups rates, the next two sections will attempt to dissect the way in which these two factors combine to influence cause specific admissions. This aim was achieved by dividing the sample into the urban and rural groups devised for chapters 7 and 8

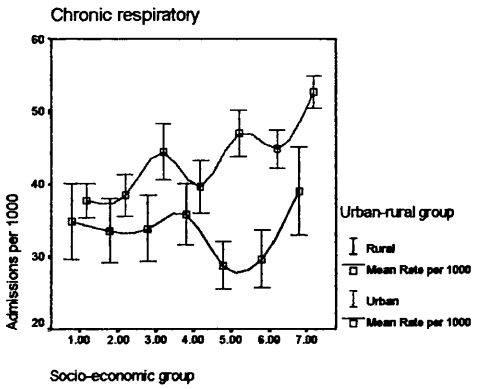
(urban-rural categories 4 to 7 and 1 to 3 respectively) and calculating rates for each of the seven socio-economic categories. This created two trends that could then be compared. The results are plotted below:

Figure 9c: Deprivation gradients in urban and rural admission rates for the ten diagnostic groups

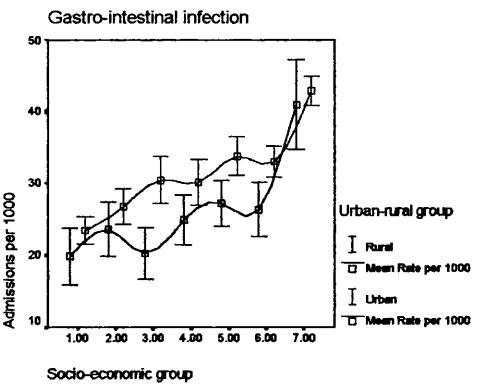
Non-chronic respiratory



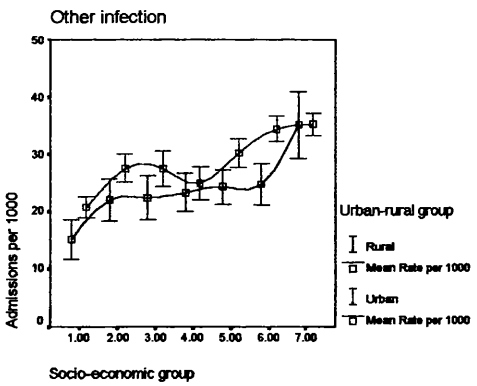
Chronic respiratory



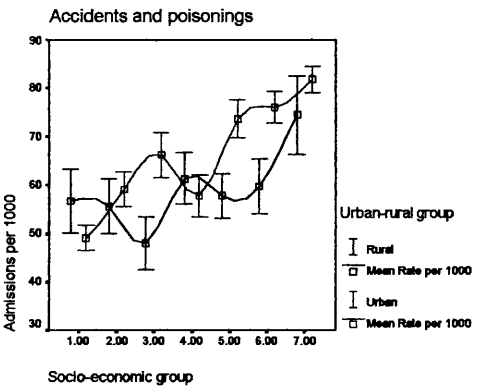
Gastro-intestinal infections



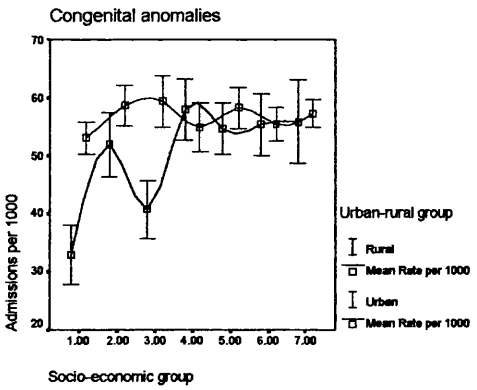
Other infections



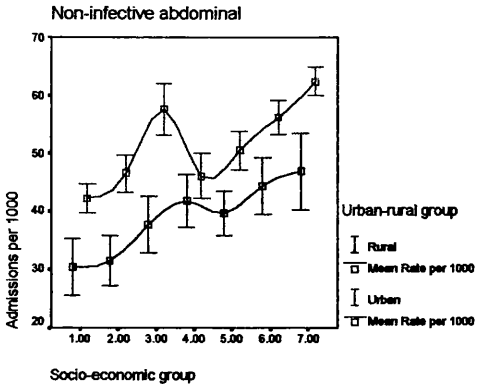
Accidents and poisonings



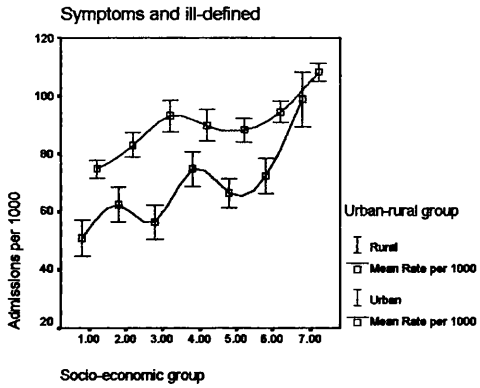
Congenital anomalies



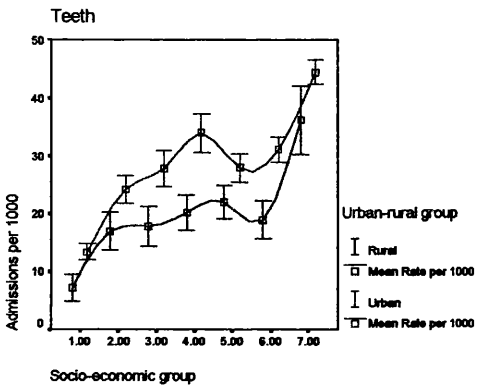
Non-infective abdominal



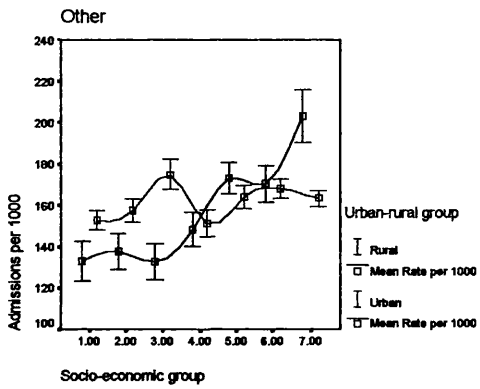
Symptoms and ill-defined conditions



Teeth



Other



The division into urban and rural groups creates two distinct trends for some conditions and not others. Several patterns can be observed:

a. *Parallel increase of rates with deprivation, little difference in level between urban and rural groups.*

e.g. Non-chronic respiratory, gastro-intestinal infections, other infections, accidents and poisonings, dental conditions.

It is puzzling that some of these conditions do not show more of a difference between urban and rural rates, having displayed marked urban-rural gradients when this was considered independently. The results imply that deprivation is the dominant influence for these conditions.

There are some recurring motifs in the patterns of changing rates across the socio-economic spectrum which do separate the two groups, namely: the rural groups' gradient is often more 'stepped'. While urban groups' rates increase fairly steadily with increasing deprivation, the rural rates are frequently fairly constant in the middle section of the spectrum, with a high rate in the most deprived group. The reasons for this are probably statistical: the middle socio-economic categories in rural areas will be composed of large and socially heterogeneous postcodes, with only the most affluent and the most deprived areas being characteristically different. In urban areas, where postcode sectors are geographically smaller, socio-economic characteristics can be more accurately defined.

b. Parallel increase with higher urban rates across the spectrum

e.g. Non-infective abdominal, symptoms and ill defined conditions.

This trend implies that both socio-economic status and urbanicity are important influences on these conditions: urban and rural groups are affected in a similar way by deprivation, but the rural groups have a 'head-start' as a result of their location. Given that the diagnostic categories do not really form a coherent group it is hard to speculate over what the underlying mechanisms might be.

c. A deprivation gradient in either urban or rural groups, but not both.

e.g. Chronic respiratory, 'other'.

For chronic respiratory conditions, deprivation only appears to influence admissions in urban groups. Given the nature of this diagnostic group and its relation to

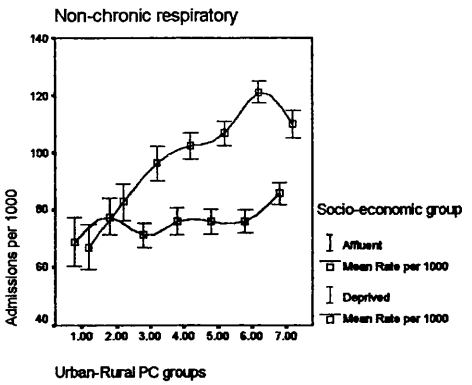
environment it is possible to imagine why: there are a greater range of physical environments within an urban area, from leafy suburbs to inner city areas. In rural areas, affluent and deprived groups will live differently, but under similar ecological circumstances. For the 'other' category the pattern is reversed, with an rural gradient, but no urban one. Ease of access to services seems the most likely factor for this group: given that some of the conditions within it generate either planned, elective admissions, the inconvenience of travel would affect rural but not urban groups decision making. Families in deprived areas may have less choice about whether their children should visit hospital to undergo a given procedure, either because of greater medical severity of the problems or because of being more dependent on health professionals to make such decisions for them.

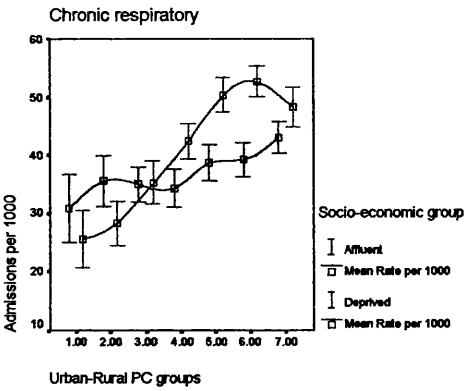
9.5. Urbanicity gradients in affluent and deprived groups

In this section, the urban-rural patterns of rate in affluent (socio-economic categories 1 to 4) and deprived (socio-economic categories 5 to 7) groups are compared. This is a similar kind of analysis to that undertaken in the last section, but the 'other way around'. The aim is to discover the different ways in which groups of different socio-economic status react to environments of varying urbanicity. Again, rates and confidence intervals were generated for the two socio-economic groups, in each of the 7 urban rural categories. The results are presented below:

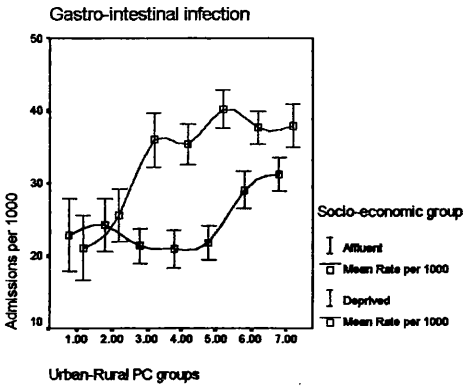
Figure 9d: Urbanicity gradients in deprived and affluent admission rates for the ten diagnostic groups

Non-chronic respiratory *Chronic respiratory*

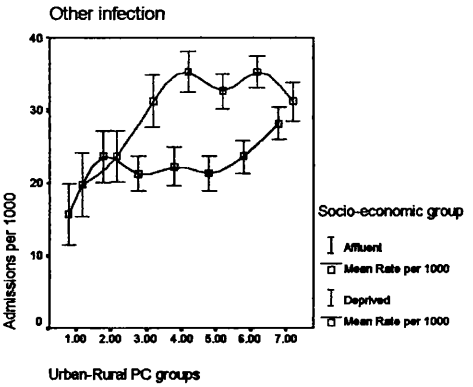




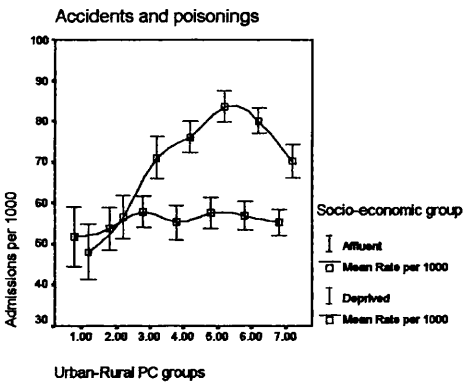
Gastro-intestinal infections



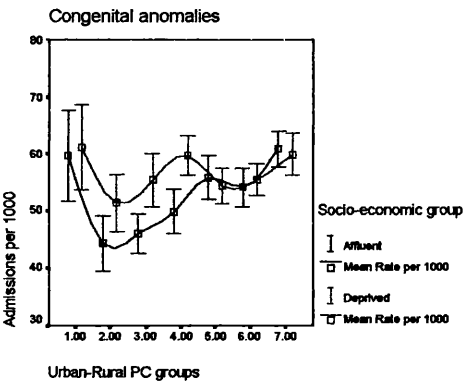
Other infections



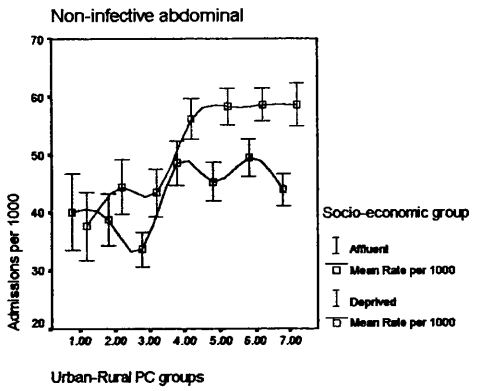
Accidents and poisonings



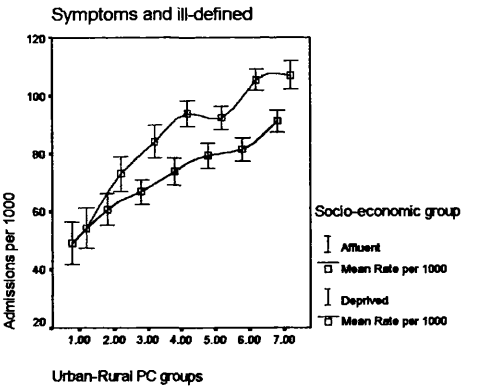
Congenital anomalies



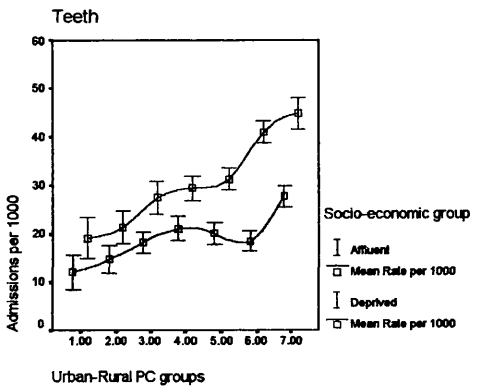
Non-infective abdominal



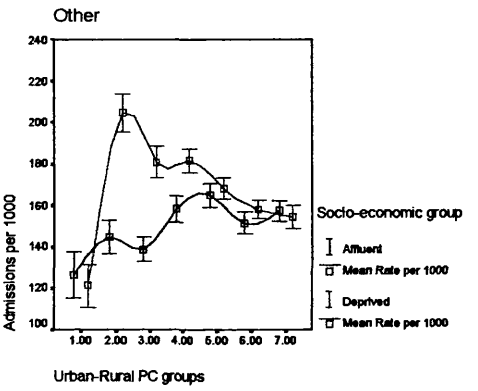
Symptoms and ill-defined conditions



Teeth



Other



These results display a much greater disparity between the affluent and deprived patterns than was evident between urban and rural groups in the previous section. This suggests again that deprivation is the more dominant influence of the two on admissions.

Deprived groups seem most 'affected' by the urban-rural gradient, often showing a characteristic a pattern of increase while rates in the affluent group remain relatively constant. The changes generally mirror the urbanicity gradients observed with rates of all socio-economic backgrounds together, suggesting that these trends arise from the actions of the deprived group alone. Affluent families are 'spectator ions' in this process (though their role as a catalyst is a possibility!). A similar phenomenon was

noted in the data on admission characteristics such as length of stay presented in Chapter 8.

Several main patterns can be distinguished among the diagnostic groups:

a. *Deprived rates rise rapidly to a plateau in urban areas, while affluent admissions display either a more modest increase or remain constant.*

e.g. Gastro intestinal infections, other infections, non-infective abdominal conditions.

As already observed, the trends in the deprived groups in these sets of conditions mirror those seen in the previous section. Speculating further as to the underlying mechanisms would therefore be superfluous, except to state that they evidently operate predominantly on families in the lower end of the socio-economic spectrum.

b. *Deprived rates rise rapidly to a peak in moderately urban areas, but display lower rates in the most urban. Affluent groups rates rise less markedly or remain constant.*

e.g. Non-chronic respiratory, accidents and poisonings.

As with category a, the patterns for these conditions mirror those observed before the data was separated into deprived and affluent groups.

c. *Both affluent and deprived groups rates rise steadily from a similar level in the most rural areas with urbanicity, but with a greater degree of change in deprived groups.*

e.g. Dental conditions, symptoms and ill-defined.

For these conditions, the mechanisms underlying the gradients evidently affect affluent as well as deprived groups, albeit to a slightly lesser extent. The two diagnostic groups are not obviously similar in nature, so it is difficult to speculate further as to what these mechanisms might be.

d. Decreasing rates with urbanicity in the deprived group with a slight increase in the affluent group.

e.g. 'Other conditions'.

This trend is only evident if the result for the most rural group is discounted, but nevertheless is noteworthy. In this case, whatever mechanisms underlie the patterns have opposite effects on affluent and deprived groups. The 'other' category consistently behaves differently to the other diagnostic groups, suggesting that factors specific to the kind of conditions it comprises (either serious chronic conditions requiring long-term care, or planned admissions for procedures related to chronic conditions) are at work.

9.6. Summary

The main findings of this chapter are as follows:

- Deprivation exerts a positive effect on rates of admissions. This influence appears to be general: it applies to all conditions with a limited amount of variety in the resulting patterns.
- The influence of urbanicity varies more according to the specific diagnostic group. Often a threshold effect is observed in urban-rural gradients in admission rates, whereby rates in areas above a certain level of urbanisation are similar.

- Rural and urban groups do not display markedly different socio-economic gradients, though rates are usually higher overall in urban areas.
- Deprived groups' admissions are markedly more affected by differences in urbanicity than affluent groups, to the extent where they account for most of the general trends on their own. Affluent groups dilute, rather than add to the observed trends.

A picture is emerging of the kind of influence exerted by urbanicity and deprivation on children's hospital admissions. The effect of deprivation appears to be more general, affecting most conditions in a similar (but not identical) way regardless of their nature. This suggests it is based on a multitude of mechanisms, each of which increase the risk of admission rather than the risk of developing a particular complaint. Deprivation may make conditions more severe, or raise the likelihood that a child will be admitted for a given complaint, but it does not affect specific illnesses. Watt and Ecob (1992) [1], drew a similar conclusion when they noted that in explaining differences in mortality within Scotland that it was the age rather than the cause of death which varied.

The mechanisms underlying urban-rural effects appear to affect different conditions in different ways, suggesting that they are related to the epidemiology of these complaints rather than severity of symptoms or admissions behaviour. The presence of a threshold effect is also significant: it suggests that in child health at least there is a discrete (in the statistical sense) difference between urban and rural environments and lifestyle. Living in a small town has the same effect on admission risk as living in the inner city.

Of the two influences, deprivation appears to be the more important. Not only does it have an effect in its own right, but it also affects the way families react to other aspects of their environment as evidenced by the differences in the urban-rural gradients of affluent and deprived groups in Section 9.5. Deprivation makes families more 'vulnerable' or less 'resilient' to outside influences: exactly how is open to debate. One possibility is that deprivation represents a reduction in families' control over certain aspects of their lives, through the loss of certain coping strategies. This is an interesting possibility and more evidence could be uncovered in relation to it through more detailed examination of admission patterns in deprived groups.

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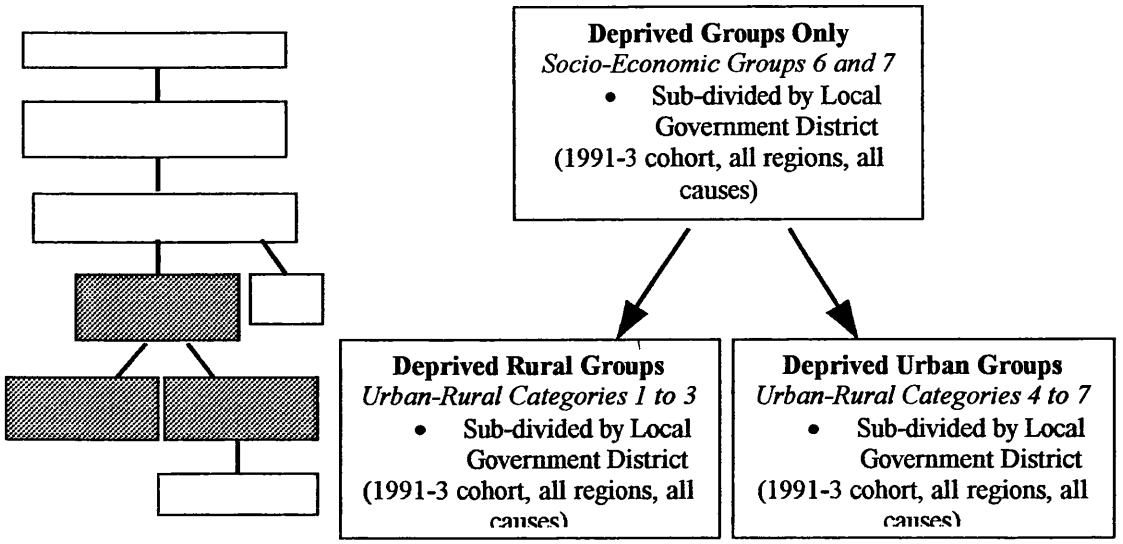
[i] Watt GCM and Ecob R 'Mortality in Glasgow and Edinburgh: A paradigm of inequality in health' Journal of Epidemiology and Community Health 1992;46:498-505.

CHAPTER 10

Variation in children's hospital admissions between deprived areas throughout Scotland

Data being used:



Relevant null hypotheses:

- Deprived rural admission patterns do not differ from deprived urban admission rates.
- Hospital admissions are affected in the same ways by deprivation and urbanicity regardless of location.

10.1. Introduction

This thesis has so far explored two main themes: the effect of location within Scotland and area characteristics, namely deprivation and urbanicity, on the level and character of hospital admissions. This section aims to examine more closely how these themes operate in combination: do deprived urban areas in different areas of Scotland have differing admission patterns? Furthermore, does the arrangement of such variation give any clues as to why it might have arisen? Consideration will be given to the same three aspects of admissions as previously (rates, average characteristics and diagnostic profile), but cases drawn only from

socio-economic groups 6 and 7. This subset is taken to represent the 'deprived' population within the sample: the division was chosen to ensure a relatively homogenous group, which still contained enough individuals to make rates and other statistics reliable. This population was further subdivided into urban and rural postcodes using the same groups as in previous chapters (urban-rural groups 1 to 3 are rural, groups 4 to 7 are urban). With this arrangement, it became possible to compare like postcodes in one region with like in another local government district.

10.2. Variation in general admission rates throughout deprived urban and rural Scotland

General admission rates and 95% confidence intervals were calculated for postcodes as defined above along with mean scores from the socio-economic (PC 1) and urban-rural (PC 2) principal components. The results for deprived rural and urban postcodes are presented separately below in descending order:

Table 10a: General admission rates for deprived rural postcodes in different local government districts

LGD	General Rate	95% Confidence Interval		Socio-economic PC	Urban-rural PC	Number of postcodes
Nithsdale	940.97	956.69	925.26	1.47	-.81	3
Kirkcaldy	895.35	932.70	858.00	1.54	-.26	1
Annandale and Eskdale	881.50	925.47	837.54	.63	-.75	1
Perth and Kinross	842.36	897.76	786.96	.79	-1.09	1
Clydesdale	825.69	856.34	795.04	.90	-.67	2
Cumnock and Doon Valley	806.68	827.46	785.91	1.40	-.42	6
Roxburgh	736.26	788.54	683.99	1.25	-1.04	1
Argyll and Bute	666.06	701.95	630.18	.67	-1.14	8
Falkirk	634.37	706.06	562.69	1.12	-.33	2
Renfrew	614.04	896.64	331.43	.63	-.30	1
Ross and Cromarty	599.53	636.30	562.76	.88	-.81	4
Kyle and Carrick	595.35	633.99	556.71	.92	-.78	4
Angus	584.14	615.76	552.51	.71	-.67	4
Wigtown	571.55	635.62	507.49	.99	-1.72	3
Midlothian	568.63	704.56	432.70	.88	-.21	1
Berwickshire	555.56	774.43	336.68	.62	-1.47	1
Moray	549.53	587.37	511.69	.81	-.98	3
Banff and Buchan	522.75	555.12	490.37	.71	-.80	2
Nairn	481.59	548.88	414.29	.62	-1.00	1
Caithness	453.82	497.27	410.38	.66	-.80	3
Skye and Lochalsh	421.05	511.69	330.42	.61	-1.41	2
Sutherland	417.45	471.39	363.50	.77	-1.36	5
Western Isles	394.59	444.91	344.27	.86	-1.30	5
Lochaber	374.48	412.51	336.45	.65	-1.25	7
Mean	622.22			.88	-.89	

Table 10c: General admission rates for deprived urban postcodes in different local government districts

LGD	General Rate per 1000	95% Confidence Interval		Socio-economic PC	Urban-rural PC	Number of postcodes
Perth and Kinross	1046.42	.	.	.95	.93	1
Edinburgh City	1038.36	.	.	1.19	.89	9
Aberdeen City	970.04	976.91	963.16	.97	.74	5
East Lothian	867.09	891.30	842.88	1.10	.29	3
Wigtown	852.16	892.85	811.46	1.21	.58	1
Dunfermline	829.11	849.55	808.68	1.21	.22	5
Cumnock and Doon Valley	804.72	851.19	758.25	.84	.65	1
Midlothian	803.53	828.94	778.13	.83	.41	3
Dundee City	799.46	812.64	786.27	1.57	.66	8
Cunninghame	759.12	775.60	742.64	1.09	.48	12
Kyle and Carrick	755.10	786.19	724.01	1.11	.83	2
Stirling	745.12	773.40	716.85	.80	.59	3
Glasgow City	743.27	749.87	736.67	1.70	1.08	61
Renfrew	739.23	755.08	723.39	1.13	.95	10
Angus	732.65	789.43	675.87	.97	.60	1
Hamilton	727.04	750.55	703.52	1.07	.95	4
West Lothian	724.45	744.71	704.20	.94	.45	8
Motherwell	713.41	726.32	700.49	1.09	.77	14
Strathkelvin	683.49	716.54	650.44	1.15	.61	4
Inverclyde	668.44	686.56	650.32	1.23	.88	9
Monklands	665.23	681.59	648.87	1.34	.62	9
Falkirk	650.95	668.73	633.16	.98	.52	10
Kirkcaldy	639.81	661.07	618.55	.91	.40	9
Clackmannan	634.12	660.85	607.39	.76	.54	4
Banff and Buchan	631.97	662.35	601.60	.90	-.14	2
Kilmarnock and Loudoun	624.33	648.90	599.76	.96	.62	5
Clydebank	590.52	616.63	564.42	1.22	1.13	5
Dumbarton	371.23	396.42	346.05	.70	.58	4
Cumbernauld and Kilsyth	350.14	414.02	286.26	.69	.12	1
Lochaber	333.33	487.33	179.34	.69	.14	1
Mean	716.46			1.04	.60	

Figure 10a: Distribution of general admission rates per 1000 in rural deprived areas of local government districts

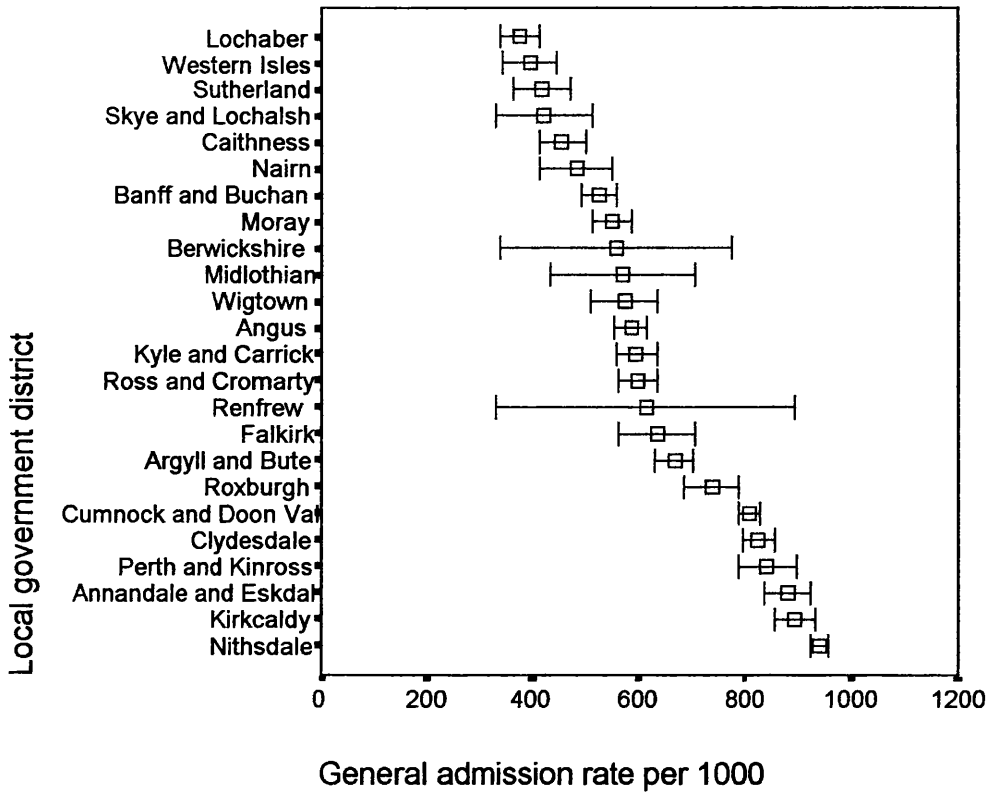
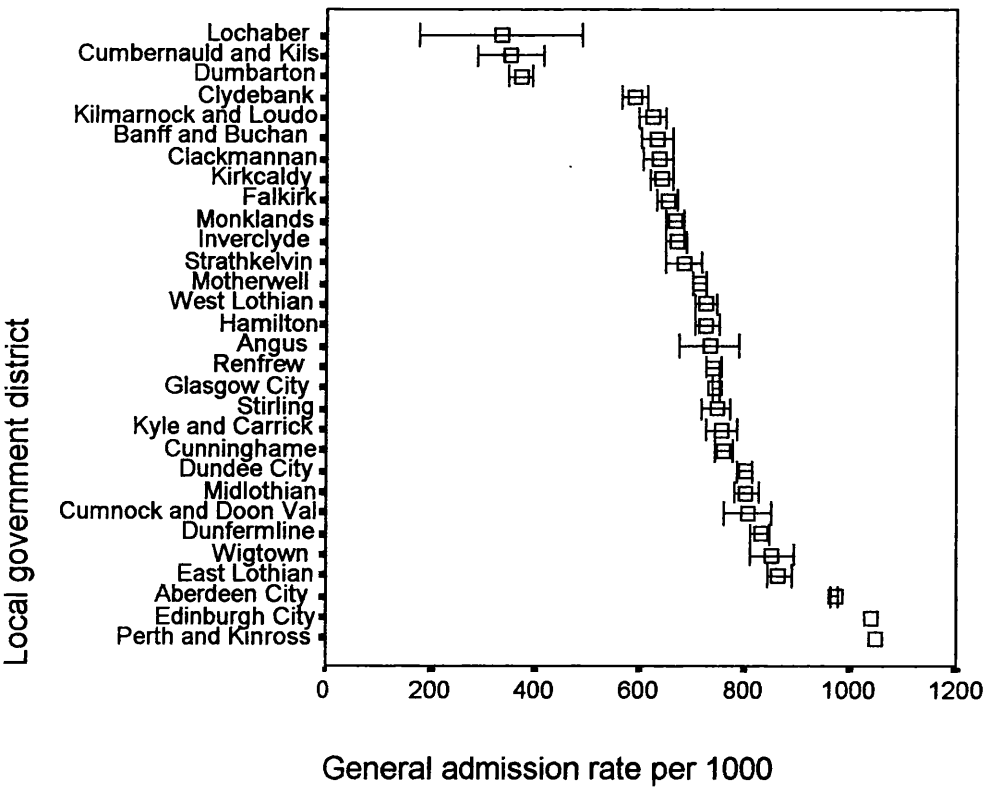


Figure 10b: Distribution of general admission rates per 1000 in urban deprived areas of local government districts



10.3. Patterns and trends in general admission rates across deprived Scotland

The mean rate of admission in deprived urban areas is slightly higher at 716 per 1000 but this is well within one standard deviation of the rural mean of 622 per 1000. The higher rates in the rural table are comparable with those in the urban table: indeed, some rural areas have higher rates than Glasgow City (743 per 1000) and even the urban areas in the same LGD (e.g. Lochaber, Cumnock and Doon Valley). The urban rates are nevertheless mostly located in what would be the upper end of the rural spectrum.

A significant amount of variation is present in both sets with the rural rates showing a greater degree of spread: despite a similar standard deviations of 168.6 and 167.5 for rural and urban rates respectively, the graphical plots above show that there us a much more even distribution in the former. Deprived urban areas, it seems, have more in common than rural deprived areas, at least as far as general admission rates are concerned. Nevertheless, there is some evidence that the local government district of residence has an influence on risk of admission.

10.3. What underlies the observed variation? Correlation of general rates with deprivation and urbanicity within deprived urban and rural populations.

Rates evidently vary between deprived areas of urban and rural character, but it is not yet clear how much of this variation is independent of deprivation and urbanicity differences within the subsets. Possible sources of such variation could include alternative arrangements of health services, or local norms of behaviour regarding hospital admissions. Correlations between the mean socio-

economic and urban rural principal components and general rates for both groups were generated to answer this question and are presented below:

Table 10 c: Pearson correlations between general admission rates for deprived areas of local government districts and the socio-economic and urban rural principal components

	Socio-economic principal component score	***Urban-rural principal component score***
General admission rate for rural deprived areas of local government districts	*.616** .001*	*.448* .028*
General admission rate for urban deprived areas of local government districts	*.397* .030*	*.373* .042*

*** = correlation is significant at the 0.01 level (two tailed)*
** = correlation is significant at the 0.05 level (two tailed)*

These results demonstrate that at least some of the observed differences between local government districts can be accounted for by differences in the degree of deprivation and urbanicity rather than factors independent of these. This fits in with previous finding regarding the nature of the deprivation gradient in general admissions: the greatest differences in rates were to be found at the 'bottom end' of the socio-economic spectrum. Therefore, a sample containing areas in socio-economic groups 6 and 7 might be expected to show deprivation-linked variation in rates. The fact that there was no significant relationship with deprivation at local government district level when all groups were involved[1] is interesting: it reinforces the conclusion that deprived groups vary more than affluent groups and also that a relationship was indeed present but concealed by the heterogeneity of the populations.

[1] See Chapter 5

The existence of an urbanicity gradient at local government district level was established for groups of all socio-economic backgrounds in chapter 5. This still applies to deprived groups considered alone, suggesting that the effect is to a certain extent independent of related differences in deprivation. The two sets of principal component scores are very significantly correlated at the 0.01 level (r = .499) in urban areas, but not rural ones: urbanicity therefore appears to have more of an effect in its own right in the latter. The degree of the effect is not entirely surprising, given that the urban and rural groupings contained the entire spectrum of difference between them. They were not a limited cross-section, like the sample was with relation to deprivation.

The actual values or the correlation co-efficients and their significances indicate that the amount of variation explained by urbanicity and deprivation is greater in rural areas. In urban areas, while a relationship does exist, there is 'more room' for differences in arrangement of services or the 'residual factors' referred to earlier in the thesis[2]. The location of this kind of variation can really only be established by examining the raw data more closely for 'outliers': areas which do not seem to fit in with the overall pattern.

10.4. Locating variation independent of deprivation and urbanicity in general admission rates

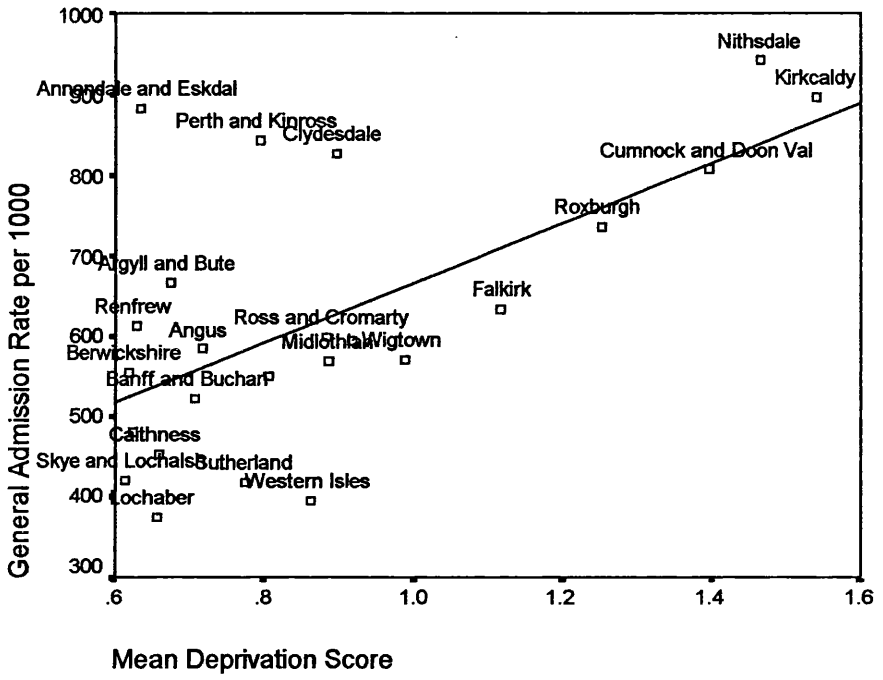
Examining exactly which local government districts do not fit the trends indicated by the correlations may shed some light on the patterning of any

[2] See Chapter 1

independent variation. The scatter-plots below show the location of the individual local government districts in relation to the regression trend for each relationship. Not all districts are labelled for reasons of space.

Rural rates:

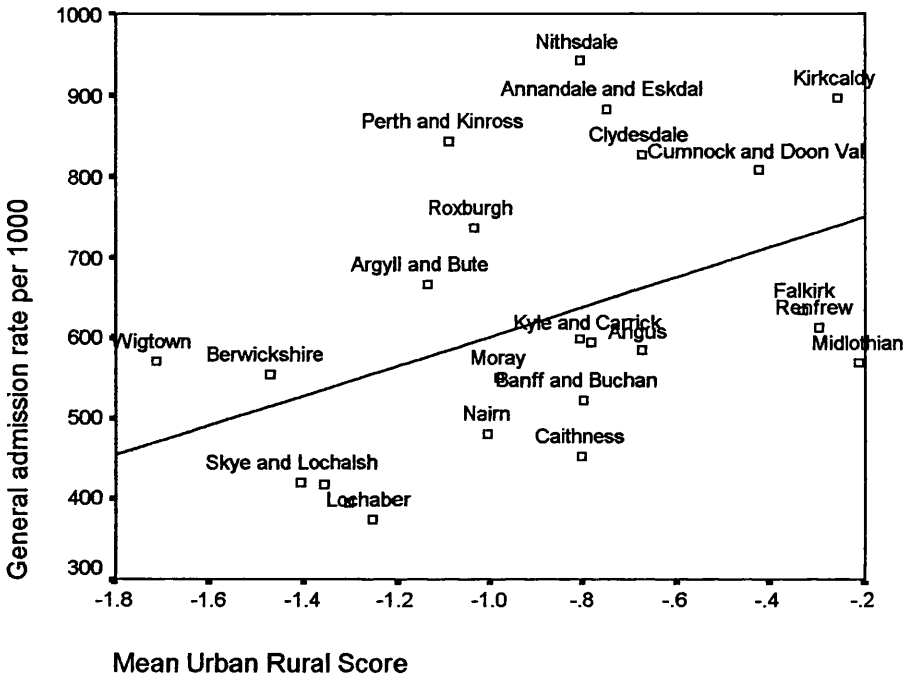
Figure 10c: Distribution of general admission rates per 1000 in relation to deprivation



Some interesting patterning can be seen in these data, notably the bias towards the more affluent end of the socio-economic spectrum in rural areas. The spread of data outside the regression trend could be perceived as relating to the remoteness of the area: Northern regions at some distance from the main centres of population, for example the Western Isles, Lochaber and Caithness have rates below what might be predicted on the basis of their deprivation scores. Conversely, the rural regions on the fringes of urban Scotland, for example Perth and Kinross and Clydesdale rate higher than expected. The urban-rural gradient is obviously a confounding factor here but 'remoteness' as a geographical concept independent of this goes some way towards explaining the observed

variation: it is harder to get patients to a hospital in Skye where services are relatively sparse than it is in Clydesdale. Another possibility is the migration of groups from urban areas with worse health in regions near to the large population centres, but not the far North. Either way, the trend seems to be that proximity to concentrations of population increases the likelihood of admission.

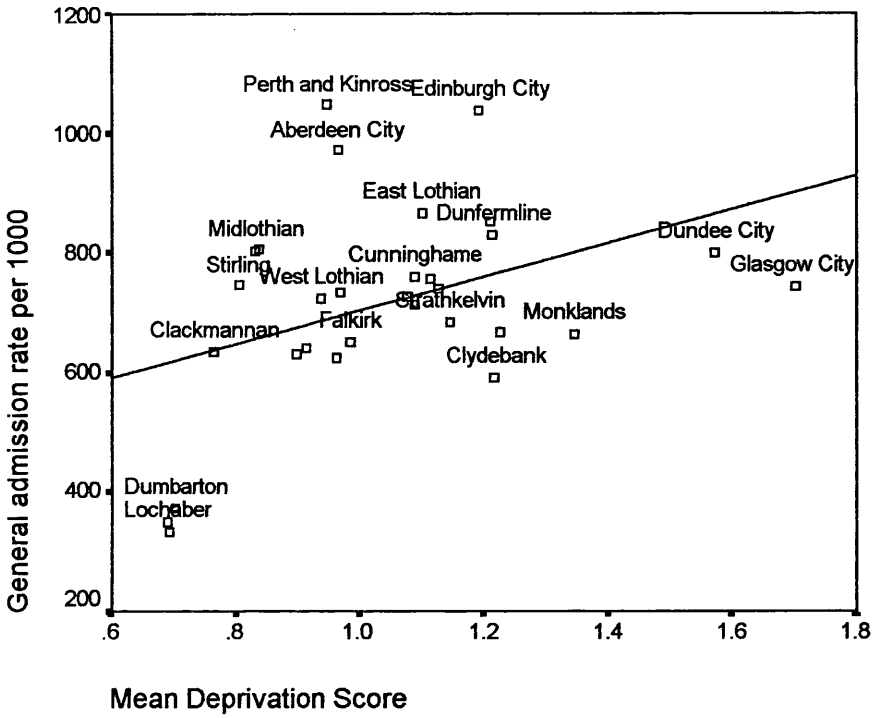
Figure 10d: Distribution of general admission rates per 1000 in relation to urbanicity



No statistically significant relationship with urbanicity for this set of results was found but examining the raw data in relation to the (statistically insignificant) regression line, the only real patterning of the data is a tenuous north-south divide similar to that observed for the deprivation gradient. Remote, northern districts such as Skye, Lochaber and Caithness tend to have rates below the predicted level, whereas geographically more central, southern regions such as Nithsdale and Perth and Kinross rate higher than expected. This suggests factors relating to the organisation of services in sparsely populated areas might be at work.

Urban Rates:

Figure 10e: Distribution of general admission rates per 1000 in relation to deprivation

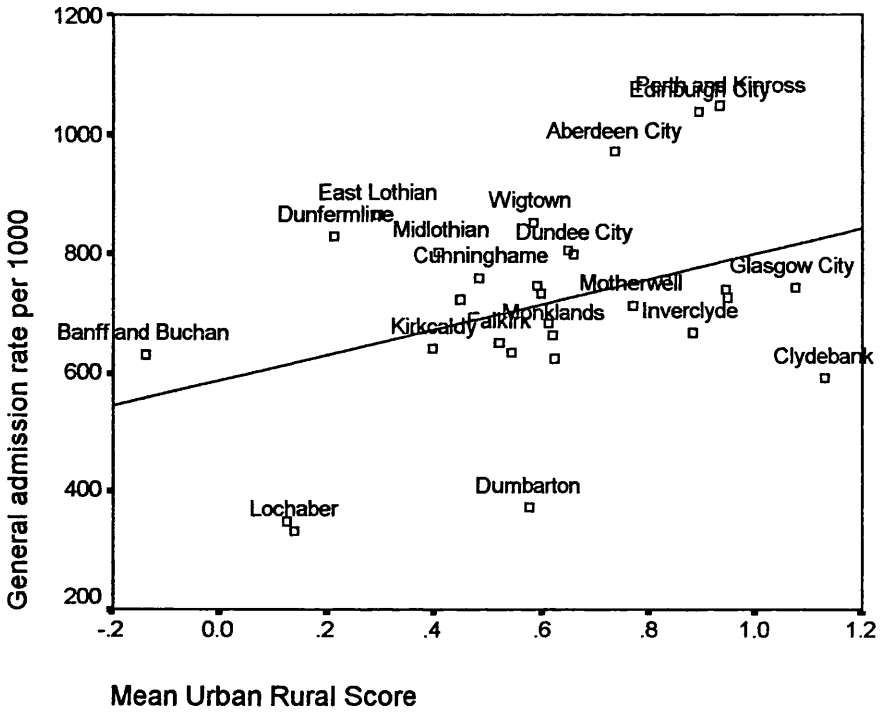


Two patterns can be observed here. Firstly, rather than the north-south divide present in the rural data, an east-west divide can be seen. East coast districts, such as Edinburgh, Perth and Kinross, Aberdeen and the areas surrounding them, display general rates above the regression line. Strathclyde districts such as Monklands, Clydebank and Glasgow City appear below the line, as does Dundee: a West coast city with an East coast industrial history. Secondly, a suggestion of the inverse care law is apparent even at this level of deprivation: the areas with rates above the predicted level are mostly towards the centre or affluent end of the socio-economic scale, while all the areas with a deprivation score of 1.3 or above rate below average.

These two effects are probably related to each other: the more affluent eastern conurbation may well have quite different patterns of admission to the more

deprived Strathclyde region. This applies equally to deprived groups as a subset of the sample: the eastern cities have a smaller of deprived individuals; therefore they can invest more time and money in treating them. Admissions may therefore be higher.

Figure 10f: Distribution of general admission rates per 1000 in relation to urbanicity



The same east-west divide in rates between urban areas can be seen in these data as in the deprivation scatter-graph. Eastern areas of equivalent levels of urbanicity tend to rate above their counterparts in the west. There are some major 'quirks' here also. For example, Clydebank, the most urban local government district on average, has the fourth lowest rate. It seems likely that the same reasons underly the east-west divide observed here as in the previous data.

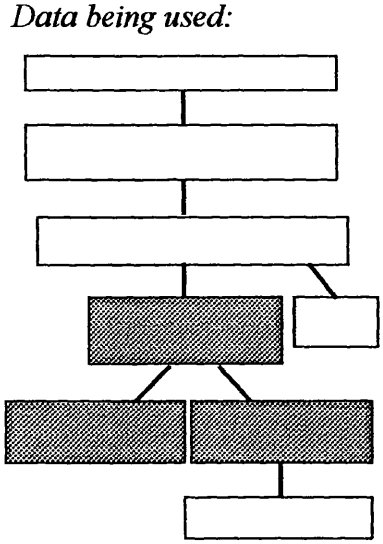
10.5. Summary

- A significant amount of variation does exist in general admission rates between deprived populations in different local government districts of Scotland.
- Much of this variation is accounted for by differences in the degree of deprivation and urbanicity. Extremely deprived areas have higher rates than very deprived areas, while urban deprived areas have higher rates than deprived rural areas.
- The effect of the degree of deprivation and urbanicity is more marked in the more rural deprived areas.
- Patterned variation can be seen in the data over and above the deprivation and urbanicity gradients.
- In rural areas, this takes the form of a North-South divide, with more remote northern areas having rates below what would be predicted form their deprivation scores. Ease of access to hospital care seems to be the most likely factor here
- In urban areas, an East-West divide can be seen. Strathclyde has lower rates than predicted. This may well be an amplification of the effects of deprivation: an example of the inverse care law at work. The eastern cities are less deprived overall and therefore have more resources to devote to their deprived populations, resulting in higher admissions. Alternatively, they may provide a general service in which deprived individuals are served more equally with affluent groups.

CHAPTER 11

Variation in children's hospital admissions between deprived areas throughout Scotland: characteristics and diagnostic profile

Data being used:



Deprived Groups Only
Socio-Economic Groups 6 and 7
- Sub-divided by Local Government District

(1991-3 cohort, all regions, all causes)

Deprived Rural Groups
Urban-Rural Categories 1 to 3
- Sub-divided by Local Government District

(1991-3 cohort, all regions, all causes)

Deprived Urban Groups
Urban-Rural Categories 4 to 7
- Sub-divided by Local Government District

(1991-3 cohort, all regions, all causes)

Relevant null hypotheses:

- Deprived rural admission patterns do not differ from deprived urban admission patterns in character.
- There is only one characteristic pattern of admission in deprived areas.
- Hospital admissions are affected in the same ways by deprivation and urbanicity regardless of location.

11.1. Introduction

Examination of patterns in general admission rate throughout deprived Scotland revealed three main trends: a relationship with urbanicity and deprivation, a residual difference between North and South in rural areas and an East-West divide in urban areas. This chapter will examine the actual nature of these admissions, including factors such as the average lengths of stay, age of admission and the proportion of admissions for specific diagnoses. It may be possible to identify groups of local

government districts where admissions in deprived postcodes (socio-economic categories 6 and 7) are similar in character and diagnostic profile. Qualitative examination of which local government districts fall into similar groups may then reveal clues as to what underlies the similarities and differences. For example, do particular geographical areas display a distinctive 'complex' of admission characteristics: low ages of admission coupled with other characteristic features such as long lengths of stay and so on. Such patterns may relate to particular conventions of practice or factors relating to the organisation of the admissions procedure operating at city, hospital or health board level.

11.2. Creating groups of similar areas: K-means cluster analysis

The statistical procedure best suited to the goal outlined above is probably cluster analysis. This is a multivariate procedure closely related to principal components analysis that groups individual's data on the basis of a number of variables describing them. In this case, the 'individuals' are groups of deprived postcodes within Scottish local government districts and the variables are features of the average admission in these districts: mean age of admission, mean length of stay, the proportion of emergency admissions, the proportion of acute admissions and the distribution of admission careers (the proportion of individuals with various numbers of continuous inpatient stays).

Groups of areas with a similar complex of admission characteristics were created in SPSS using a variant of the clustering process called k-means cluster analysis. This uses an algorithm to identify a number of homogenous groups on the basis of a given number of variables: in this case either the key admission characteristics or the

various aspects of the diagnostic profile. The algorithm requires that the number of groups identified is prescribed: it was therefore necessary to experiment with different numbers of groups to strike a balance between identifying enough categories to reveal any interesting patterns and avoiding the creation of groups which were not sufficiently distinct. To put this in more basic terms, being too greedy and demanding too many groups would have created a contrived set of results, while not being greedy enough might have created two or three groups which were markedly different from each other but two large to identify any geographical or social patterns. The technique is not without its flaws or critics, but is ideal for the purposes of this study. The composition of the groups of local government districts can then be examined qualitatively and comparisons made regarding geography, levels of deprivation and so on.

11.3. Admission characteristics: grouping the local government districts

Perhaps the greatest interest lies in comparing the patterns of admission in deprived urban areas of Scotland with one another, and undertaking a similar process with rural areas. Clusters were therefore generated for the deprived urban and rural postcode groupings within the local government districts separately.

The variables included in the analysis were mean age of admission, mean length of stay, percentage of emergency admissions, percentage of acute admissions and the proportion of admissions in the various continuous inpatient stay categories (1, 2 to 5 and >5). General rates were excluded on the basis that they dominated the final categorisation too much and had already been considered in their own right in the previous chapter.

Five categories were created in order to strike a balance between a limited number of overly broad groups and too many contrived divisions as previously discussed. In fact, experimentation with various other numbers of categories revealed that more or less the same divisions were arising regardless of the number of groups specified[1].

11.4.1. Creating groupings on the basis of admissions characteristics for deprived, rural areas of Local Government Districts across Scotland

Five clusters of local government districts were created on the basis of their average admission characteristics. These groupings are based on the data for the deprived, rural postcodes of each local government district. Of the five groups, only four were based on sufficient numbers of admissions to be considered reliable. The fifth category (cluster 5) was based on only 7 admissions from one local government district (Renfrew) and hence is disregarded in subsequent analyses. One-way analysis of variance suggests that the groups differ significantly at the 0.05 level with the exception on mean length of stay and mean age of admission, which are significant at the 0.10 level[2].

Some groups will obviously be closer in character than others: the table below is a matrix of standardised 'distances' between the groups giving some indication of which if the clusters are most distinct from each other. It should be noted that these are relative figures, which hold no intrinsic reality. The higher the 'distance', the more distinct the two groups:

[1] Full sets of data for both admission characteristics and diagnostic profiles are included in Appendix 5.
[2] See Appendix 6 for full results for the ANOVA.

Table 11a: Standardised 'distances' between the rural clusters

Cluster	*1*	*2*	*3*	*4*
2	*17.7*			
3	*18.6*	*22.2*		
4	*18.0*	*13.9*	*29.0*	
5	*66.3*	*56.6*	*77.3*	*57.5*

There is a certain amount of variation in the distances between the various clusters. The most similar overall are cluster 2 and 4 and the most distinct (excluding cluster 5) are clusters 3 and 4. The standardised distances between the remainder of the groups are neither remarkably large nor remarkably small, fluctuating around 20 units.

The average characteristics, or 'cluster-centres' of the groups generated in the cluster analysis of rural postcodes are reproduced below. Mean values for the socio-economic and urban rural principal components are also given for reference.

Table 11a: Average admission characteristics of the rural clusters

Characteristic	***Cluster***				
	1	*2*	*3*	*4*	*5*
Mean age of admission (months)	*20.8*	*20.0*	*20.4*	*18.3*	*10.9*
Mean length of stay (days)	*3.0*	*2.8*	*2.1*	*2.5*	*1.9*
% Emergency admissions	*65.1*	*65.7*	*51.1*	*73.5*	*100.0*
% Acute admissions	*50.9*	*54.7*	*41.5*	*58.1*	*85.7*
CIS = 1	*50.4*	*61.5*	*54.1*	*53.0*	*85.7*
CIS = 2 to 5	*31.5*	*33.6*	*34.1*	*39.9*	*14.3*
CIS > 5	*18.0*	*4.9*	*11.8*	*7.2*	*0.0*
Socio-economic PC	*.997*	*.795*	*.657*	*.910*	*.628*
Urban-rural PC	*-1.09*	*-.881*	*-.803*	*-.805*	*-.299*
Number of cases	*2270*	*2020*	*229*	*2433*	*7*

Most of the variables considered differ quite markedly between the clusters, with mean age of admission and CIS = 2 to 5 being exceptions. There is also some variation in socio-economic and urban rural character. However the clusters are

perhaps better considered as a whole. The groups can therefore be characterised qualitatively categorised in a broad sense as follows:

Cluster 1: Local government districts with high average age of admission, a moderate to low proportion of admissions for emergencies and acute causes, long stays and a pattern of admission careers biased towards multiple episodes.

e.g. *Nithsdale, Clydesdale, Perth and Kinross, Roxburgh, Sutherland, Wigtown, Moray*

The socio-economic and urban-rural data suggest that this subset of postcodes is on average relatively deprived and rural.

Cluster 2: Areas with moderate to high emergency and acute admissions, moderate to low mean age of admission, above average lengths of stay and a pattern of admission careers biased towards single or low numbers of admissions per patient.

e.g. *Western Isles, Lochaber, Nairn, Angus, Ross and Cromarty, Falkirk, Banff and Buchan*

The socio-economic and urban-rural data suggest that this subset of postcodes is moderately deprived and moderately rural.

Cluster 3: Areas with low lengths of stay, emergency and acute admissions. Admission careers biased towards multiple episodes per patient.

e.g. *Caithness*

This subset of postcodes is notably affluent relative to the other groups.

Cluster 4: Areas with a low mean age of admission, high emergency and acute admission and a bias towards moderate numbers of admissions per individual.

e.g. Kirkcaldy, Annandale and Eskdale, Cumnock and Doon Valley, Skye and Lochalsh, Midlothian, Argyll and Bute, Kyle and Carrick, Berwickshire

The subset of postcodes is deprived and moderately rural, statistically speaking.

11.4.2. What do the deprived, rural clusters suggest?

The analysis identified three, possibly four reasonably secure patterns of admission characteristics. Cluster 3 is based on sufficient numbers of cases to be valid in some senses, but it only includes one local government district. The distance matrix indicated that some of the groups are more distinct overall than others: groups 2 and 4 are the most similar, while groups 3 and 4 are the most distinct. The latter relationship is probably the result of the fact that group 3 contains only one district, the former is hard to explain.

Interpreting the patterns in the various clusters, it is possible to speculate as to the kind of 'regime' they reflect, either of morbidity or in hospital services themselves. Cluster 1's pattern, given its low emergency admissions coupled with long stays and higher proportion of individuals with multiple admissions, is suggestive of a large subset of 'sickly' children, with high levels of chronic illness. Characteristics in cluster 2 are fairly well balanced, indicating a mixed pattern of admissions along similar lines. Cluster 3 is the most affluent of the four and looks it, with a relatively 'easy' pattern of admissions: low emergencies, stays and so on. Cluster 4 appears to have the most 'severe' pattern of admissions, with high emergencies and a more universal risk of admission: a greater proportion of individuals have been admitted a

moderate number of times, rather than a subset on many occasions. This group is the most deprived and, given the patterns of admission associated with deprived groups in Chapter 6, this makes sense.

The actual composition of the groups in terms of specific local government districts is harder to interpret. The groups are fairly mixed in terms of geographical 'character' and location with areas bordering on the central belt such as Clydesdale and Nithsdale classified along with remote districts such as Sutherland. Neither does the classification seem to bear any relation to general admission rates: group 2 might be considered 'mid to low range' with most of its members in the middle or bottom third of districts, but the other groups contain a mix of districts from both ends of the spectrum.

Generally speaking, then, there does appear to be a range of characteristic patterns in rural deprived areas. How and why these patterns arise does not appear to be related to location within Scotland, or the urban-rural and geographical character of the postcodes. There is some suggesting that levels of deprivation play a limited role. The groups could therefore conceivably be the result of the differences in hospital policy or local behaviour discussed earlier in the thesis.

11.5.1. Creating groupings on the basis of admissions characteristics for deprived, urban areas of Local Government Districts across Scotland

Having already examined the patterning in admissions characteristics across the rural deprived postcodes of Scotland, this section undertakes an identical analysis with deprived, urban postcodes, considered in groups according to the Local Governmeny district they belong to.

As with the rural data, five groups or 'clusters' were created on the basis of the variables reflecting the character of admissions in the deprived urban postcodes of each Local Government District. All five of these were based on sufficient numbers of admissions to be worth examining. One-way analysis of variance once again suggested that the groups differed significantly at the 0.05 level in most of the factors taken into consideration. The only exception was mean stay, which did not differ significantly between groups[3]. The range of standardised 'distances' between groups was similar to that for the deprived, rural areas, though there is a suggestion that the urban clusters are less distinct overall:

Table 11c: Standardised 'distances' between the urban clusters

Cluster	*1*	*2*	*3*	*4*
2	*26.5*			
3	*24.8*	*12.2*		
4	*21.2*	*11.6*	*17.0*	
5	*21.2*	*10.4*	*13.0*	*7.9*

There is a certain amount of similarity between Cluster 2 and each of the other groups, suggesting that it is an intermediate in terms of admissions characteristics. Elsewhere, clusters 4 and 5 are very similar, 3 and 5 relatively close, while the other groups are reasonably distinct from each other.

The average characteristics of the groupings (cluster centres) are given below, along with the average socio-economic and urban-rural principal component values for the postcodes concerned:

[3] See Appendix 6 for full results for the ANOVA.

Table 11d: Average admission characteristics of the urban clusters

Characteristics	*Cluster*				
	1	*2*	*3*	*4*	*5*
Mean age of admission	*17.0*	*20.0*	*21.6*	*20.0*	*18.5*
Mean length of stay	*2.6*	*2.6*	*2.7*	*3.0*	*3.2*
% Emergencies	*72.8*	*64.1*	*65.5*	*69.9*	*73.1*
% Acute admissions	*47.7*	*57.5*	*52.4*	*62.8*	*57.9*
CIS = 1	*68.0*	*49.5*	*51.6*	*56.5*	*53.0*
CIS = 2 to 5	*32.0*	*41.2*	*32.7*	*38.1*	*37.9*
CIS > 5	*0.0*	*9.3*	*15.7*	*5.5*	*9.1*
Socio-economic PC	*.691*	*1.06*	*1.04*	*1.01*	*1.12*
Urban-rural PC	*.132*	*.533*	*.533*	*.736*	*.650*
Number of cases	*87*	*8040*	*1874*	*8535*	*28560*

Again, several of the variables differ significantly between groups, with most accounting for a difference between at least two clusters. Mean length of stay is perhaps the 'weakest link here. The patterns in each of the individual clusters are described qualitatively below:

Cluster 1: Areas with low mean ages of admission, high emergencies but low acute admissions and a bias towards single admissions per patient.

e.g. Cumbernauld and Kilsyth, Lochaber

This is the smallest cluster in terms of admissions as well as on average the most affluent and least urban: this may explain why it is also overall the most distinctive cluster.

Cluster 2: Areas with low emergency but relatively high acute admissions as well as a fairly even spread of individuals with different numbers of episodes.

e.g. Edinburgh City, Perth and Kinross, Midlothian, Dunfermline, Wigtown, East Lothian, Kirkcaldy

This is the 'East Coast' subset in geographical terms, albeit with a couple of exceptions. The postcodes are on average deprived and moderately urban.

Cluster 3: Areas with a high mean age of admission, moderate emergencies and acute admissions and a bias towards large numbers of admissions per patient.

e.g. Strathkelvin, West Lothian

Although Strathkelvin is sometimes viewed as a relatively affluent area of Grater Glasgow, these postcodes are statistically deprived and moderately urban.

Cluster 4: Areas with relatively high lengths of stay, moderately high emergency and acute admissions and a bias towards a medium number of admissions per patient.

e.g. Cumnock and Doon Valley, Inverclyde, Kilmarnock and Loudoun, Clydebank, Dumbarton, Cunninghame, Renfrew, Angus

Although Angus is a notable exception, this group of postcodes appears deprived and urban, qualitatively and in terms of the principal component values.

Cluster 5: Areas with low mean ages of admission, long stays, high levels of emergency and acute admission and a fairly evenly spread distribution of admission careers, albeit with relatively high multiple admissions.

e.g. Kyle and Carrick, Dundee City, Aberdeen City, Falkirk, Monklands, Clackmannan, Motherwell, Stirling, Glasgow City, Hamilton, Banff and Buchan.

This is quantitatively the most deprived set of postcodes and also relatively urban in character. As with Cluster 4 however, there are apparent interlopers in the form of Clackmannan and Banff and Buchan.

11.5.2. What do the urban deprived clusters suggest?

The cluster analysis for urban areas generated a set of four secure groups and one (cluster one) containing a limited number of cases. Of these clusters, three (groups 2, 3 and 4) appear to be quite close in characteristics according to the distance matrix. Group 1 is more distinctive, perhaps because it is a smaller group, but also because it is the most rural and least deprived by some distance. Groups 4 and 5 are the closest related groups, coincidentally or otherwise drawing most of their 'members' from the same geographical area: the west coast.

The nature of the clusters and the districts that comprise them makes more intuitive sense than for the rural subset. There is evidence of the East-West divide discussed in Chapter 10: the Edinburgh centred East coast local government districts are noticeably concentrated in Group 2. This cluster is characterised by low emergency admissions, meaning that the high general admission rates in these areas must be the result of high elective admissions. The remaining areas, which include the West coast, Strathclyde and the other major Scottish cities, are distributed with two exceptions between groups 4 and 5. Both of these have fairly 'severe' patterns of admission, with long stays and high emergency and acute episodes. Group 5 however is the more extreme of the two, taking the pattern shown in Group 4 further.

The distinction between the two clusters in geographical terms appears to be related to urbanicity: Group 4 are small towns and cities surrounding major conurbations. Group 5 contains the major urban centres. It therefore makes some sense that the differences between them are in degree rather than character. Group 3 is an interesting combination of areas bordering Glasgow and Edinburgh: together the

districts rate as quite rural, which marks them out from the other clusters. They display a regime suggestive of a higher level of chronic illness, with low emergencies and high multiple admissions.

Systematic differences in admission patterns therefore do appear to exist in the deprived urban data which are absent from the deprived rural subset. It is however hard to speculate as to the cause of these. There is spatial patterning, but the contrasting areas are also quite different in overall socio-economic composition. Of the two possible sources of variation, the way patients use hospitals and the way hospitals use them in different areas, it is hard to decide on a 'winner'.

11.6. Attempts at grouping Local Government Districts on the basis of diagnostic profile.

One possible source of information on the reasons underlying the differences in admission characteristics between areas is the patterning of diagnosis across deprived urban and rural Scotland. If patterns of diagnosis appear to co-vary with admission characteristics, then it would appear that differences are the result of either disparities in the kinds of conditions suffered, or those likely to be treated in hospital.

In order to investigate this possibility, a similar cluster analysis to that undertaken for admission characteristics was carried out for deprived urban and deprived rural areas separately. The variables used were the proportion if the diagnostic profile made of each of the diagnostic groups used in previous analyses (non-chronic respiratory, chronic respiratory, gastro-intestinal infections, other infections, accidents and

poisonings, congenital anomalies, non-infective abdominal, symptoms and ill defined conditions, dental conditions and other condition).

The conclusion from this analysis was largely that very little significant patterning exists in diagnostic profile across deprived urban or rural Scotland. Only two entirely secure groupings emerged from the rural analysis, with a third containing just enough cases to be viable. To add to the confusion, the two secure groupings were very similar. The urban analysis created four fairly secure groupings which again were very similar in terms of diagnostic profile, with no perceivable geographical or other trends in the composition of the groups.

The lack of a pattern suggests that area differences in admission characteristics are independent of diagnosis, adding credence to the theory that patient and physician factors relating to hospital services themselves are important: deprived populations have similar or random combinations of conditions that are dealt with in different ways in different regions.

11.7. Summary

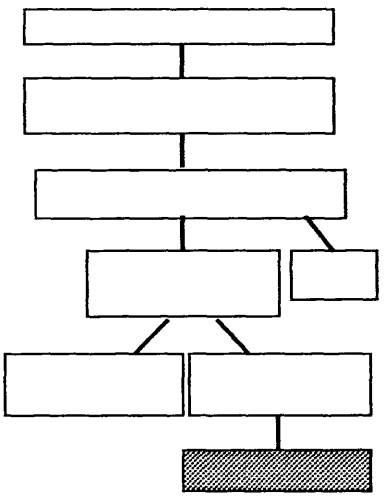
- Several distinct patterns of admission characteristics can be seen in both urban and rural areas.
- The distribution of these patterns in rural areas appears to be random, with no obvious relationship with geographical location or general admission rate.
- In urban areas, however, there is an echo of the divide between Edinburgh and its environs and the rest of the country. It seems there is an 'East Coast effect' on children's hospital admissions possibly related to differences in health care provision for deprived groups.

- Patterns in diagnostic profile in urban and rural groups are indistinct, hinting that patterns in admissions are independent of them.

CHAPTER 12

Variation in admissions between different deprived neighbourhoods of Glasgow City local government district

Data being used:



Deprived Groups in areas of Glasgow City
- Sub-divided by Neighbourhood Type (1991-3 cohort, all causes)

Relevant null hypotheses:

- There is no variation in patterns of admission between deprived urban areas.
- There is no variation in patterns of admission between areas in Glasgow.

12.1. Why examine neighbourhoods within a city?

Previous chapters have demonstrated that variation does exist in rate and character of admissions across deprived Scotland. This has mostly been attributable to differences in the degree of deprivation and urbanicity, but some effects have been area related, notably the 'East-West divide'. It seems likely that such differences are the result of variation in admissions policy in particular areas.

However, admissions within LGDs and urban areas may not be completely homogenous in character. A whole category of potential influences on admissions remains unexamined: the 'residual' factors discussed in the literature review. These

are the 'proximal causes' of the variation arising from deprivation and differences in their nature between areas could potentially cause a great deal of local variation.

Examination of which types of deprived areas (in terms of this study, socio-economic groups 6 and 7) within the Glasgow City local government district have high admission rates and particular admission characteristics might be quite instructive in this context. If urban deprivation affects general admissions in different ways within one city, this suggests either the culture of admissions or the culture of deprivation differs: both interesting possibilities.

In order to conduct this kind of investigation it will be necessary to divide areas of Glasgow on some logical basis and then conduct a similar analysis to that undertaken in the previous chapters.

12.2. Dividing up the areas

In 1990 attempts were made to classify postcodes in Glasgow into similar groups using cluster analysis based on thirty variables from the 1981 census (Womersley 1992)[1]. The result was eight 'neighbourhood types' that 'differentiate the communities in Greater Glasgow in a way which accords well with people's own perceptions' (Forwell 1993)[2]. These categories represent an excellent way in which to divide up the Glasgow City LGD in that they identify different varieties of affluent, medium and deprived area within Glasgow, rather than simply classifying similar socio-economic groups together.

Only postcodes in the bottom two socio-economic groups were included in the analysis for this chapter. This effectively excluded the two most affluent

neighbourhood types (1 and 2). The remaining categories contained at least one postcode classified as being deprived in the terms of this project. A description of each of these is given below:

Neighbourhood types:

'*Neighbourhood type 3:* Mixed tenure accommodation, high proportion of families with no children, single persons and students. Mainly non-manual and professional workers e.g. Shawlands, Broomhill, Kelvinside (10% of population).
Neighbourhood type 4: Mainly inter-war local authority housing with ageing and elderly population e.g. Knightswood, Mosspark and Riddrie (17% of population).
Neighbourhood type 5: Mainly post-war local authority housing with young families and skilled workers e.g. Pollok, West Castlemilk and Faifley (20% of population).
Neighbourhood type 6: Mixture of small rented furnished and owner-occupied households with shared amenities; single persons, students, immigrants and high unemployment e.g. Woodlands, Strathbungo and Govanhill (5% of population).
Neighbourhood type 7: Post-war local authority housing with young families, high unemployment and mainly unskilled workers e.g. Drumchapel, Easterhouse and Nitshill (10% of population).
Neighbourhood type 8: Mixed tenure-type but mainly local authority, vacant properties and small, overcrowded households sharing amenities. Ageing population with few children and high unemployment, mainly unskilled workers e.g. Govan, Bridgeton, Ruchill (17% of population).'

From Forwell (1993)[3]

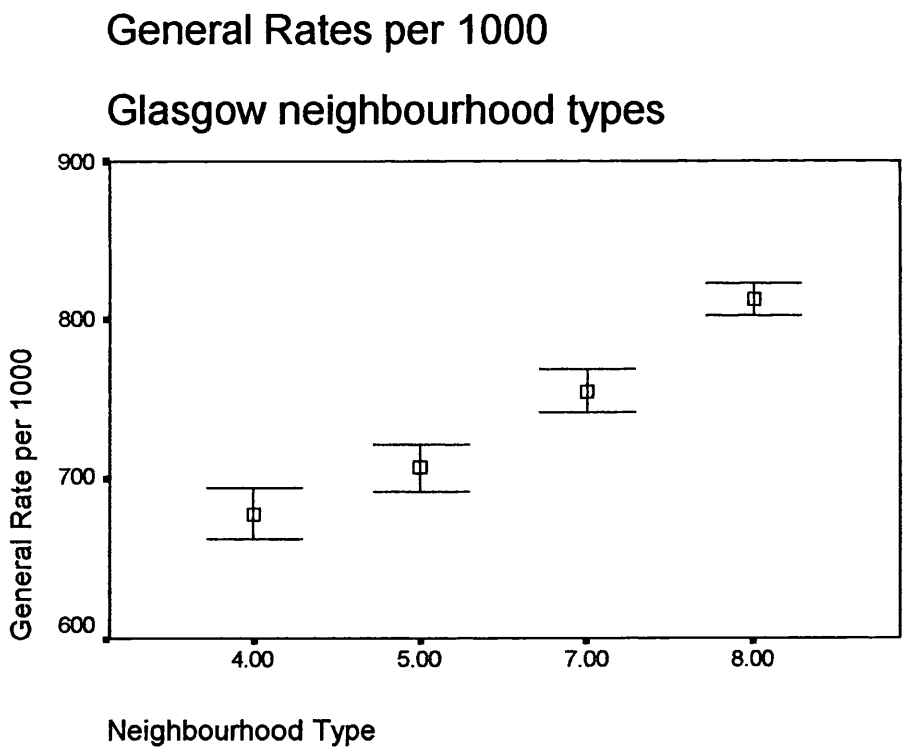
Neighbourhood types 3 and 6 each contained only one 'deprived' postcode (i.e. one in socio-economic groups 6 and 7). This seems too small a sample to give an accurate

representation of patterns within those neighbourhood types: the results for these categories have therefore been omitted from the following analysis.

12.3. Variation in general admission rates within deprived Glasgow

General admission rates were calculated along with confidence intervals for each of the neighbourhood types with sufficient population to make analysis worthwhile. The results are given below:

Figure and Table 12a: Variation in general admission rate by neighbourhood type, deprived areas of Glasgow



Neighbourhood type	*General Rate per 1000*	*Top 95% Confidence interval*	*Top 95% Confidence interval*	*Mean PC 1 value*	*Number of postcodes*	*Mean episodes per person*	*Cohort Population*
3.00	*906.15*	*957.56*	*854.74*	*1.88*	*1*	*1.75*	*124*
4.00	*677.75*	*693.92*	*661.59*	*1.28*	*15*	*1.69*	*3211*
5.00	*706.23*	*720.72*	*691.74*	*1.71*	*9*	*1.81*	*3796*
6.00	*885.89*	*962.25*	*809.52*	*.75*	*1*	*1.59*	*67*
7.00	*755.13*	*768.56*	*741.70*	*2.38*	*9*	*1.90*	*3938*
8.00	*812.28*	*822.92*	*801.64*	*1.80*	*23*	*1.77*	*5177*

Two patterns are evident in these data: firstly neighbourhood types 7 and 8, traditionally viewed as the outer city estates and 'inner city' Glasgow respectively, show higher rates than neighbourhood types 4 and 5. This was perhaps to be expected: while neighbourhood types 4 and 5 may contain pockets of deprivation as extreme as that found in the peripheral estates or city centre tower blocks, the effect of this may be 'diluted' by other areas of the locality. General admissions are therefore likely to be lower, in keeping with the deprivation gradient found elsewhere in the data.

Secondly, rates in neighbourhood type 8 are also significantly higher than those in groups 7 ($z = 6.61$, $p = 0.01$). This runs counter to the deprivation gradient: the mean deprivation score in the latter group is higher than in the former. The reasons for this difference are open to speculation and as will become evident the differences between the two groups' admissions relate to more than just level. Neighbourhood types 7 and 8, while both deprived are quite different demographically and in other aspects of their nature: the experience of child rearing in the 'outer city' estates of type 7 must be quite different in terms of social and practical obstacles to health from the type 8

'inner city' areas. Exploring in more detail how these experiences manifest themselves may reveal how they have arisen.

12.4. Variation in general admission characteristics within deprived Glasgow

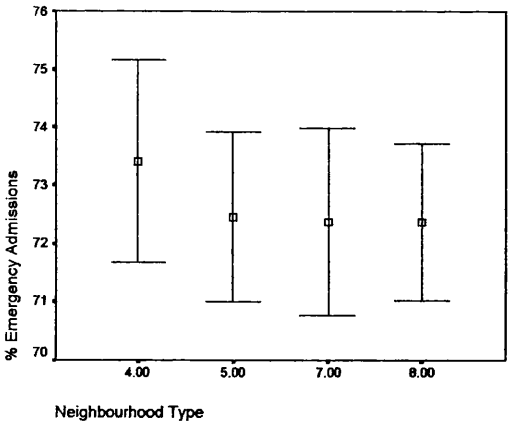
Statistics for the key characteristics of admissions (mean age of admission, mean length of stay, the proportion of emergency and acute admissions and the patterns of admission 'careers) used in previous analyses were generated for the various neighbourhood types. These results are reproduced below:

Table 12b: Variation in admission characteristics by neighbourhood type, deprived areas of Glasgow

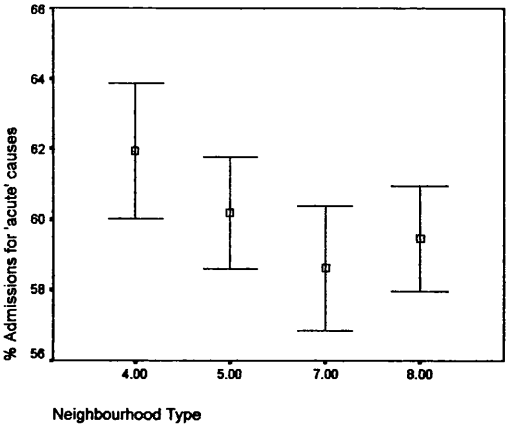
Characteristics	***Neighbourhood Type***			
	4	***5***	***7***	***8***
Mean age of admission (months)	*21.05*	*19.26*	*21.16*	*19.12*
% Emergency admissions	*73.1*	*73.6*	*72.4*	*72.4*
% 'Acute' admissions	*61.6*	*61.1*	*58.6*	*59.5*
Mean length of stay (days)	*3.44*	*3.55*	*3.45*	*3.72*
% where CIS = 1	*54.2*	*53.5*	*50.6*	*54.6*
% where CIS = 2 to 5	*36.8*	*34.4*	*35.3*	*37.9*
% where CIS > 5	*9.0*	*12.2*	*14.0*	*7.5*
Number of cases	*2176*	*2681*	*2974*	*4205*

Figure12b: Admission characteristics for deprived Glasgow neighbourhood types

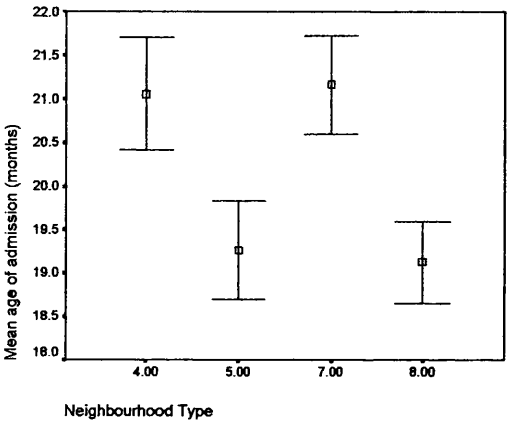
% Emergency admissions



% Admissions for 'acute' causes



Mean age of admission (months)



Mean length of stay (days)

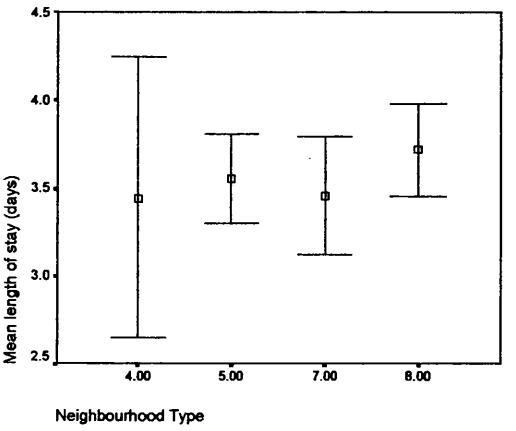
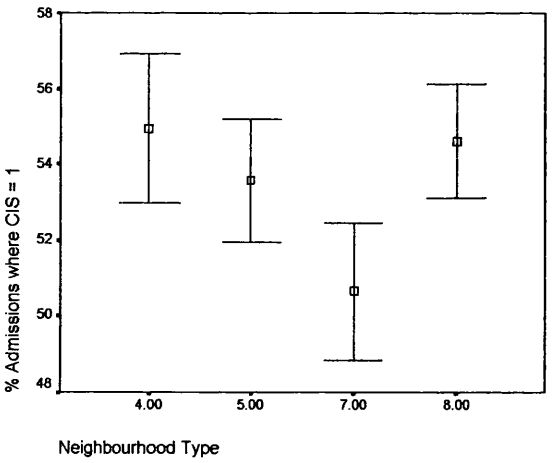
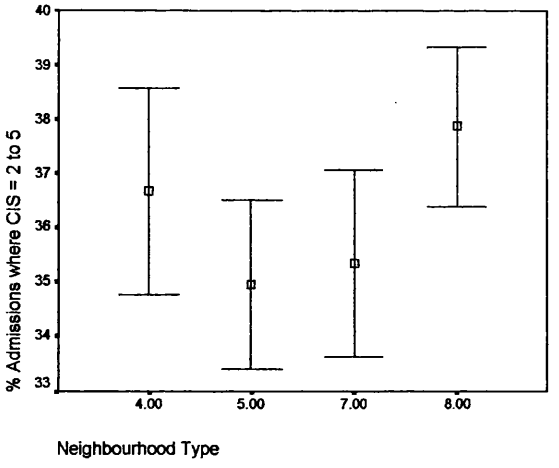


Figure 12c: Patterns in 'admission careers' for deprived Glasgow neighbourhood types

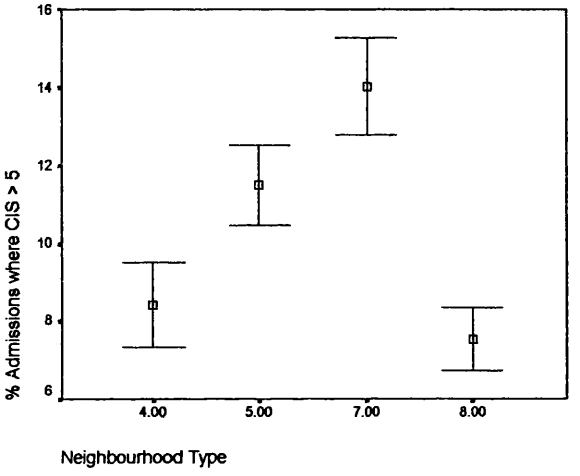
% Admissions where patient had not been previously admitted



% Admissions where patient was being admitted for the 2nd to 5th time



% Admissions where the patient had been admitted at least 5 times previously



Two main features of admission characteristics separate the pattern shown in the different neighbourhood types. Firstly, age of first admission differs significantly between types 4 and 5 and 7 and 8. Secondly, the distribution of 'admission careers' shows variation across the groups. The biggest differences are between groups 7 and 8: the deprived inner and outer city areas and this merits further consideration.

The character of inner and outer city admissions (neighbourhood types 7 and 8 respectively) differs in several ways. Essentially, neighbourhood type 7 is characterised by high numbers of multiple admissions, while the rate in type 8 is the result of more children being admitted for the first or second to fifth time. This is evident from the higher mean number of admissions per person in group 8 and the differing proportions of records in the various CIS groups: the proportion in the CIS > 5 groups is almost twice as high in neighbourhood type 7 as in type 8. In fact, significant differences exist for CIS = 1 ($z = 3.34$, $p = 0.01$) and CIS > 5 ($z = 8.97$, $p = 0.01$).

The nature of these admissions in terms of the emergency/acute variable is similar, but children in group 8 are admitted on average younger ($t = 5.485$, $p = 0.01$). The presence of larger numbers of young families at a higher concentration in the peripheral estates might go some way towards explaining these patterns: it is not inconceivable that children in these areas are dealt with by or access health services differently. If young families are present in large numbers, so theoretically will be the kind of services which identify and treat chronic conditions, hence 'raising their

profile', but also which treat potential hospital admissions earlier through primary care in the health centres and so on.

Elsewhere in the data, groups 4 and 5 also differ slightly, but less markedly than 7 and 8: The only result significant at the 0.05 level is for CIS >5 ($z = 3.58$, $p = 0.05$). It is surprising that these groups are not more distinct, given their disparate demographic nature: group 4 is supposedly composed of 'aging' council estates, while some areas in type 5, for example Pollok, have much in common with the outer city estates, right down to similarities in housing stock.

12.5. Variation in diagnostic profile within deprived Glasgow

Patterns in diagnostic profiles in previous analyses have been unpredictable and hard to interpret. There seems no reason why these results should be any different:

Table 12c: Variation in diagnostic profile by neighbourhood type, deprived areas of Glasgow

Condition	***Neighbourhood Type***			
	4	***5***	***7***	***8***
Non-Chronic Respiratory	*17.6*	*18.2*	*18.5*	*17.1*
Chronic Respiratory	*8.4*	*8.2*	*6.5*	*5.9*
Gastro-Intestinal Infections	*4.9*	*5.9*	*6.1*	*6.0*
Other Infections	*5.2*	*4.7*	*4.1*	*4.7*
Accidents and Poisonings	*9.3*	*9.2*	*9.4*	*10.4*
Congenital Anomalies	*8.8*	*9.4*	*7.5*	*9.4*
Non-Infective Abdominal	*7.5*	*7.3*	*7.5*	*8.5*
Symptoms and ill defined	*16.1*	*15.7*	*14.7*	*16.1*
Teeth	*7.2*	*7.8*	*8.8*	*8.6*
Other	*15.02*	*13.57*	*16.86*	*13.38*
Number of cases	*2176*	*2681*	*2974*	*4205*

Patterns in all four groups above are very similar overall, perhaps reflecting that the urban, deprived diagnostic profile is universal throughout the city. There are however interesting differences between groups in a few of the categories which merit further consideration.

The excess of admissions in 8 does not seem likely to be composed of cases of respiratory conditions: the proportion of records for these causes in neighbourhood type 8 is the lowest of the four groups. Instead the positive differences in proportion between 7 and 8 are in accidents and poisonings, congenital anomalies, non-infective abdominal, 'other' and symptoms and ill-defined conditions. Of these only congenital anomalies ($z = 2.83$, $p = 0.05$) and the 'other' category ($z = 4.09$, $p = 0.01$) are significant. In contrast, 7 has the highest proportion of non-chronic respiratory as well as the lowest congenital anomalies and symptoms. The particularly high proportion of admissions in the 'other' category may explain in part the high number of multiple admissions, given the chronic nature of many of these complaints.

Groups 4 and 5 are again quite similar, with no significant differences between the two groups. Collectively, they have a higher proportion of chronic respiratory conditions than groups 7 and 8 ($z = 4.51$, $p = 0.01$). The opposite is true for teeth ($z = 2.26$, $p = 0.05$). It is not evident exactly why this should be. There are other differences between 4 and 5 and these groups and 7 and 8 together, but these are not significant.

12.5.Explaining the patterns:

The major trends revealed so far in this factor are:

- Neighbourhood types within Glasgow differ in terms of the rate and character of their hospital admissions.
- The most marked differences are between 'inner' and 'outer' city areas (neighbourhood types 7 and 8). These differ in general rate, mean age of admission and the distribution of 'admission careers'.
- The pattern in neighbourhood type 7 is suggestive of the presences of a large subset of 'sickly' children, who are admitted to hospital on several occasions for chronic conditions. This is reflected in the diagnostic profile, where the other category accounts for a greater proportion of type 7 admissions than in group 8.

Differences do exist between the various neighbourhood types that are not explained by deprivation: all the areas in the sample could be considered deprived, albeit to slightly varying degrees. Differences in health care provision on a macro-scale are also eliminated as a source of variation: the areas are all covered by the same health administration. All that remains is the effect of the kinds of 'residual' factor discussed in the literature review: factors relating to individuals and the way they behave, micro-environmental conditions and other factors such as primary care on a very local level.

It is possible to speculate as to some reasons for the differences based on the descriptions of the area types. Type 7, the peripheral 'outer city' estates, such as Easterhouse and Drumchapel for example contain young and often unwaged families,

in comparison to type 5, where young families are present, but are more likely to have an income due to the presence of skilled workers. It might therefore make sense that the former face more problems and hence have higher admissions than the latter.

The other two area types are described as aging and containing few children: bringing up a child in this kind of environment may be a very different experience to doing so in the other areas. For example, health services may be more 'child friendly': GPs may have more experience of dealing with children and the organisation of clinics and surgeries may be more tailored to the needs of young families. Social support networks may also be different: a relatively static population of young mothers may well provide a network of social support not present in an more anonymous, transitory inner city area.

Data from the 1991 census and other sources has been used to develop new measures of deprivation such as the 1998 Urban Studies Index. The table below gives the average value of some of these individual variables for the different neighbourhood types. The features that vary between areas may hint at what more specifically underlies the differences within Glasgow:

		Neighbourhood Type			
		4.00	5.00	7.00	8.00
Lack of basic amenities	Mean	1.15	1.08	.95	.81
Low birth weight ratios	Mean	2.08	2.15	2.24	2.23
Unemployment rate	Mean	1.83	2.02	2.52	2.38
Dependency	Mean	2.64	2.37	2.79	2.74
Non-higher education participation	Mean	1.35	1.97	2.18	1.48
Those suffering from long term illness	Mean	2.56	2.35	2.45	2.55
Index of home content insurance companies prem	Mean	2.58	2.60	2.63	2.62
Income support claimants	Mean	2.68	2.96	3.33	3.14
Children in dependent only households	Mean	1.50	1.59	2.22	1.80
No-car households	Mean	2.75	2.97	3.14	3.18
Households living below the occupancy norm	Mean	1.28	1.54	2.47	2.40
Those classified as permanently ill	Mean	2.22	2.37	2.61	2.48
Non-school participation of 17 year olds	Mean	.82	1.23	1.44	1.03
Single parents	Mean	.90	2.20	2.89	1.82
SMR at 64	Mean	2.22	2.20	2.25	2.31
SMR at 74	Mean	2.14	2.17	2.23	2.24
Household spaces classified as vacant accommo	Mean	.01	1.30	2.47	1.35
Youth unemployment	Mean	2.56	3.02	3.37	2.97
Mean		11.94	13.29	15.38	14.33

Several interesting features separate neighbourhood types 7 and 8, many of which could be potentially linked to children's hospital admissions. For example, non-participation in higher education, non-school participation of 17 year olds, the proportion of single parents and children living in dependent only household are all higher in the peripheral 'outer city' estates than in the 'inner-city' (neighbourhood type 8). These are factors that reflect aspects of the 'relevant' population to children's admissions: parents.

To determine whether this has an impact on the patterns or levels of admission a great deal more research is needed. However, speculating on the basis of the available evidence, larger numbers of admissions per child would fit with the emerging picture of a subset of younger, highly stressed and less educated families encountering difficulties keeping their child healthy. Under these circumstances, a higher level of admissions might be expected, but there is the possibility that hospital services are more difficult to access from say, Easterhouse than Possil. If the parents are younger, they may not yet have worked out how to gain admission. Furthermore the peripheral estates are exactly that: they are further from Yorkhill than most of the type 8 areas. Transport may therefore be a problem, or primary health care services may be the first point of contact in more cases, meaning that a potential admission stops at this stage.

All of this is however merely speculation and a much closer study would be needed to determine what the actual mechanisms at work are. The findings relating to the Urban Studies variables are strangely contradictory: the opposite pattern of rates might be predicted on the basis of them. Features such as non-participation in higher

education, single parents and school non-participation of 17 year olds which might speculatively be predictive of high admissions are more pronounced in type 7 areas than in type 8. Rates however are higher in type 8 areas Quite what causes the observed differences therefore remains a mystery.

11.7. Summary

- Differences in admission level and character do exist between similarly deprived areas in the same local government district. These cannot be related to deprivation, urbanicity or macro-level differences in hospital admissions policy. This is convincing proof that 'residual' factors do have an influence.
- The most significant differences exist between the 'inner' and 'outer' city. The latter have the highest rates, despite similar levels of deprivation in both. 'Outer-city' areas also appear to have a more 'chronic' pattern of admission, with fewer emergencies and more children with multiple admissions.
- Measured differences in factors relating to the education and experience of young parents also vary between Neighbourhood Types 7 and 8. However, the results are counterintuitive. On the basis of trends such as non-participation in further or higher education, it might be expected that type 7 would have the less experienced parents and therefore the worst health and highest admissions. This is not the case.
- Several other possible explanations for the observed differences could be suggested, but these cannot be investigated through standard data: closer qualitative research is needed.

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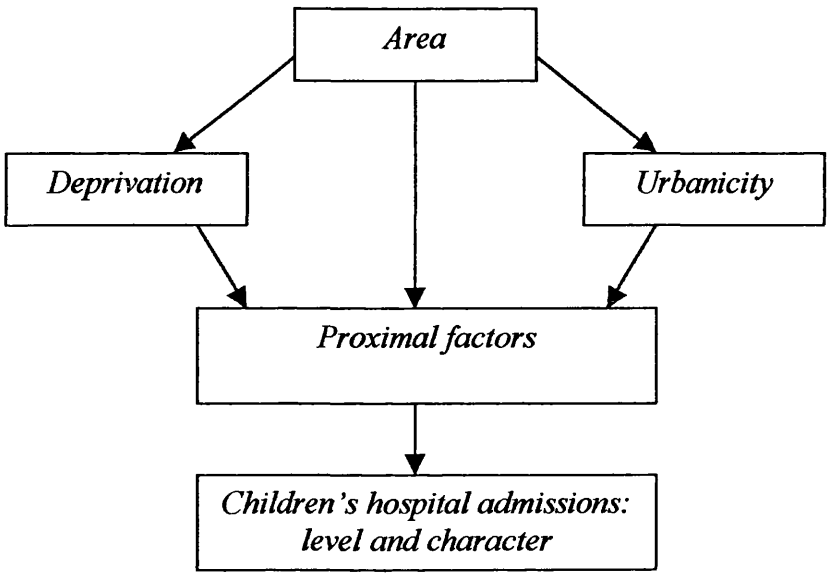
[1]Womersley J 'Socio-economic indicators of deprivation' GGHB 1992
[2]Forwell G 'Annual Report of the Director of Public Health' 1993 GGHB
[3] Ibid.

CHAPTER 13

Discussion

13.1. What have we learned?

The original aim of this thesis was to investigate the variation present in Scottish children's hospital admissions and the factors which underlying this. The literature review identified four main categories of influence that were practical to investigate: deprivation, urbanicity, geographical area and 'proximal' or 'residual' factors. The diagram below represents how the influences of these factors appear to interact on a macro-level.



The effect of area, deprivation and urbanicity, which arguably have a common source, on an individual child's risk of particular varieties of admission is mediated through the action of a diversity of 'proximal' factors. This latter group may also have an influence in its own right. A number of possibilities for these 'proximal factors' were suggested in the literature review[1]: the common theme being that they relate directly to the patients concerned.

This examination of the data has made it possible to speculate in more detail about the mode of action of these four factors, their relative importance and the ways in which they interact to influence the level and character of children's hospital admissions. In terms of the diagram, the parts being developed in more detail are the arrows: the boxes unfortunately will have to remain black for the moment (McPherson 1998)[2].

The following will consider various aspects of each factor in turn: what the data have revealed and what might be behind these effects.

13.2. Mode of action of the factors: deprivation.

The key findings as regards deprivation were:

- Deprivation as measured using the socio-economic principal component was associated with higher general rates of admission and a more 'severe' set of key characteristics. These included higher emergency admissions, lower average ages of admission and longer stays (chapter 6).
- Analysis by region and local government district (chapters 4 and 5) revealed that the effect of deprivation was concealed at this level, probably due to the social heterogeneity of areas. A very strong effect within the local government districts was however shown to exist in chapter 6.
- The degree of deprivation was found to exert its greatest effects in the most deprived groups (chapter 6). Furthermore, deprived groups are more 'affected' by other interacting factors such as urbanicity (chapter 8). The implication is that part of the effect of deprivation is to make families and individuals more vulnerable to the causes of ill-health or hospital admissions.
- The effect of deprivation appears to be similar on most diagnostic groups (chapter 9), adding further credence to the vulnerability argument: deprivation acts as a constant increasing overall risk rather than affecting specific medical complaints. It may not necessarily increase the rate of one disease, but it will make the symptoms worse in an individual child.

The effect of deprivation emerges from these findings as one in which a host of complex factors impact on the process of being ill and seeking admission as well as the biological processes of disease. If deprivation's influence was purely physical and worked through housing, environment, parental smoking and so on, then different effects would be observed for what are traditionally considered the 'diseases of poverty' rather than the similar influence across the spectrum. Watt and Ecob's (1992)[3] 'general vulnerability' appears to apply to children as well as adults. Deprived groups tend to exhibit a narrower spectrum of more 'basic' childhood

illness, but possibly this is because these merit treatment in deprived areas and there is only a limited amount of medical care available.

The finding that deprivation appears to make families more affected by other factors, such as urbanicity, is also significant in this context. If families are reacting, they are not coping: deprivation in relation to health may in part represent a progressive erosion of families physical or practical ability to cope with ill health. The actual specific mechanisms by which this might occur are proximal factors including housing, nutritional status, parent's knowledge of how to treat children's medical conditions, access to and perceptions of medical care to name but a few. Families in deprived areas have less control over these things than more affluent families, but will encounter more difficulties with them: an example of Macintyre's concept of 'deprivation amplification' at work. Even the effects of socio-economic differences appear to be more marked at the bottom end of the spectrum: the worst areas do much worse than simply bad areas. The degree of deprivation is therefore as important as membership of a group below a particular socio-economic threshold.

Deprivation then, appears to be a universal, general influence on children's hospital admissions, mediated by the proximal causes discussed later in this chapter. Its effect is most noticeable within local government districts and at the lower end of the socio-economic spectrum: at a broader level, it is 'diluted' statistically by the presence of more affluent groups.

13.3. Mode of action of the factors: urbanicity.

Urbanicity, like deprivation was measured using a principal component based on census data. The main findings on its role in children's hospital admissions were as follows:

- Urbanicity has a positive effect on general admission rates: more urban areas tend to have higher admissions that are more 'severe' in character (chapter 7). There is a certain amount of inevitable correlation with deprivation, which is largely an urban phenomenon as measured by census based instruments.

- The urban-rural composition of regions and local government districts is related to their general admission rates (chapters 4 and 5): this is not the case with deprivation.
- There is some suggestion of a 'threshold' effect whereby above a certain level of urbanisation, no further increases in general rate occur (chapter 7).
- The effect of the urban-rural gradient is much more marked on deprived groups, suggesting that issues of choice and control over a families environment (e.g. 'coping') come into play (chapter 8).
- The nature of the urbanicity effect on specific diagnostic groups is variable, indicating that its mode of action is specific as well as general and varies with condition (chapter 9). This is in contrast to the more general effect observed with deprivation (chapter 6).

Urbanicity, unlike deprivation, appears to be a both a general and a specific influence on hospital admissions. The general influence appears to relate to the presence of factors influencing the admissions process in areas of a certain level of urbanisation: hence the threshold effect on admissions. The most likely set of explanations relate to access to hospital services. It may be harder practically to get to hospital in rural areas due to greater distances between services and less effective public transport. Patients and doctors will therefore seek alternative ways of dealing with health problems, meaning that general admissions rates and the proportion of emergencies are lower. Whether this is a good or a bad thing is open to debate: essentially, if the treatment received is medically as effective as hospital care it is positive, if not it is negative.

The influence of urbanicity on specific conditions seems likely to be mediated by a diversity of proximal factors relating to both social and physical environment. These could include anything from patterns of mixing with other children with infectious diseases, or indoor and outdoor air quality coupled with the time spent in these specific environments with chronic respiratory conditions. However, congenital anomalies, the diagnostic group most likely to be affected by these factors actually increase in prevalence with urbanicity. The literature review (chapter 1) considered some of the research on the relationship between urban living and health: rates of a

large range of conditions are lower in rural areas independent of actual hospital admissions, which bears out the theory that rural living is somehow 'healthier'.

Urbanicity is evidently an important influence on children' hospital admissions and the differences observed emphasise that children growing up in the town and country have very different experiences. The fact that it has an effect on a regional as well as a postcode level indicates how pervasive it is as a set of influencing factors. Like deprivation, this set of factors can be seen as operating through more proximal causes and interacting with other influences.

13.4. Mode of action of the factors: area.

Investigation into the effect of areas was by exclusion: area variation in hospital admissions was what was left over when the rest had been explained by the other factors. Nevertheless, some patterning was evident in the data. Findings included the following:

- Most of the differences between regions and local government districts were explained by urban-rural differences (chapters 4 and 5). When deprived areas were compared across local government districts, the degree of area deprivation was found to account for some of the difference (chapter 11).
- When deprived postcodes in different local government districts were compared in terms of level and character of admissions, independent area effects do begin to emerge (chapter 10).
- Among urban localities of Scotland, areas around Edinburgh tend to have higher general admission rates than would be predicted by trends in rate with deprivation. Strathclyde and the other major urban regions rank lower than predicted (chapter 10). This divide also applies to the character of admission: episodes in the Edinburgh area tend to involve lower emergency admissions and in the specific case of Edinburgh more multiple admissions. Two variations can be seen in the 'other' diagnostic group, which are essentially degrees of the same 'severe' pattern (chapter 11).
- Among rural localities, a 'North-South' divide is evident in rates within Scotland, whereby more remote northern areas have lower rates than predicted

on the basis of deprivation, while areas bordering on the 'central belt' are higher than expected. The effects on patterns of admission are less marked than in urban wards (chapter 11).

These findings are quite significant, in that they indicate the presence of the kind of inequalities (this term being used initially in its non-pejorative sense) in health services usage and provision discussed in the literature review. These are both dependent on and independent of differences in urbanicity and deprivation. Given that the differences are between administrative areas and not aggregations of people with any intrinsic reality (in the way that, say, a particular ethnic community might be considered to have) it seems likely that the underlying reasons relate to the infrastructures of health and other services such as transport as patients experience them, rather than any environmental or social effects.

The Arbuthnot report provides some evidence that the level of funding and by implication, provision has varied in the past across Scotland: as pointed out in the literature review for example, Lothian has been 4.5% 'over funded' while Glasgow has been 1.7% under funded. Theoretically, if a service is overstretched financially, it may have more exacting criteria for admission. Possibly more important to children's hospital admissions is where the money is allocated. If less is put into hospital services in one area, admission rates may well be lower. Supply factors have been found to have an impact on general admissions: Round (1997)[4] found that rates were higher where GPs had access to community hospital beds. Supply also has a large influence on particular procedures, notably coronary revascularisation: Black et al. (1995)[5] found that usage tended to be higher in areas near a revascularisation centre or cardiologist. This pattern ran counter to the observed pattern of need for the services.

The services in one area may differ from another in nature as well as in level, artefactually as well as in real terms. For example, there may be a convention in certain health boards or hospital whereby criteria for admission in certain age groups or for particular conditions may be particularly exacting. There is some link with deprivation here: if as the results suggest, deprived groups have excesses in particular conditions, then the services where these individuals are the majority will be more geared to dealing with them. This applies equally to the organisation of primary care

services: some types of infrastructure may be more effective than others in dealing with particular social groups. The development of health centres in inner city areas was based on this idea. These are all possible explanations for the divide in deprived admission patterns between the area around Edinburgh and the rest of Scotland.

Glasgow's deprived population for the study cohort is almost 5 times greater than that in Edinburgh (16832 children compared to 3368). It is therefore unsurprising that in the two cities, the deprived are dealt with slightly differently and that Edinburgh has more 'space' for multiple admissions. If an equal number of 'bed days' (Boddy 1999)[6] are available, deprived populations will use them to deal with the more limited range of 'basic' conditions from which they suffer as a result of their various disadvantages. The possibility that there is diagnostic bias in admission over and above that related to deprivation on an local government district level seems unlikely, but there is a possibility that certain hospitals will have conventions among the staff that would create such a pattern.

The effect of area on children's hospital admissions, then, appears to operate largely on an administrative level: it is hard to imagine how it could be otherwise. The end product in terms of admissions, however, is the result of interaction between these services and the patients that use them: once again, the proximal factors are an important intermediary.

13.5. Mode of action of the factors: proximal factors

Proximal factors have been referred to as being of importance in relation all the other three named influences. However, as with area effects, there is little direct evidence in the data for their existence. Nevertheless, working again by exclusion:

- It is clear that something must mediate between the broad concepts of deprivation and urbanicity and the level and character of admissions; otherwise the relationships shown would not be as complicated as they are.
- Variation exists in rate and character of admissions between deprived areas of Glasgow. This cannot be the result of differences in degree of deprivation as some of the trends run counter to this. The effects of area and urbanicity are

also excluded. The only remaining possible causes are the differences in 'proximal' factors that exist on a local level.

The possibilities for specific proximal factors on hospital factors are almost limitless in range and subtlety. An attempt was made in the literature review[7] to identify and categorise these influences. The resulting framework comprised four main groups: bio-medical factors, social factors, practical/logistic factors and factors relating to health services. This will be used in the discussion below, but given that the first two groups relate largely to patient characteristics, these will be considered together.

13.5.1. The possible role of biomedical factors

Bio-medical influences impact directly on the processes of disease itself and as such comprise factors relating to the physiology of the child and the ecology of its environment. This is the subject matter of classical epidemiology and an attractive proposition in that it provides relatively concrete answers to seemingly complicated questions. It is undeniable that deprived, urban children have worse health and as such bio-medical factors must be involved as an intermediary. However, it is highly unlikely that they operate alone as the dominant factor.

The possibility that children might differ systematically by area in medical terms independent of deprivation is less than convincing. While local effects might be conceivable with specific conditions, perhaps relating to concepts such as herd immunity or the presence of particular environmental contaminants, it is hard to imagine a similar scenario with general admissions. The diagnostic mix in a given area might be influenced randomly by the characteristics of the cohort population: if an area contains a large number of children with allergies the consequences are obvious.

The general vulnerability of a population could conceivably vary as a result of two factors: low birth weight and poor nutrition. One might expect however that these would be more likely to vary between families rather than postcode sectors: parents all feed their children slightly differently and birth weight is a function of a host of personal factors. Both factors furthermore are associated with deprivation and according to the Urban Studies index low birth weight ratios do not differ notably

between deprived neighbourhood types. Levels of nutrition could possibly vary systematically as a result of one of the factors identified by Acheson: 'food deserts'. The presence or absence of an affordable source of nutritious food could make the difference between an adequately fed population and a poorly fed one, compromised in their ability to fight infections and other ailments.

In terms of ecology, differences in housing, micro-climate and other factors relating to the biology of the areas might be significant factors: poor and/or damp housing may contribute to a higher proportion of admissions for respiratory conditions, for example. The evidence on this is not unequivocal: McKenzie (1998) in a review of the evidence concludes that 'there is no professional consensus of opinion about the effect of poor housing and the indoor environment on children's respiratory systems'. Associations with smoking are also strong, but this is more a feature of the family than the area. On a very local level, factors such as the presence of a run down playground could influence the rate of accidents and so on.

Biomedical factors are probably only effective in their own right under very specific circumstances. Where diagnostic profiles differ between areas in a novel way for example, there may be evidence for an environmental or medical effect. However, they are an essential intermediary for the influences of urbanicity and deprivation.

13.5.2. The possible role of social factors

There are several possibilities as to why areas might vary socially independently of deprivation and urbanicity. Firstly, it would be naïve to assume that deprivation is a singular phenomenon: areas may be deprived in different ways and for different reasons that may each impact differently on hospital admissions. The kind of deprivation experienced in an area with a high proportion of an ethnic minority such as Pakistanis may be quite distinct from that in a predominantly Afro-Caribbean or white area, for cultural reasons. The culture of deprivation in the inner and outer city (neighbourhood types 7 and 8) could also conceivably be quite different, given the excluded location and mono-cultural demographic profile of the peripheral estates compared with the more mixed and central inner city wards.

The make up of the patient population, and in this study the parents of the patients could potentially have a great influence on the rate and character of hospital admissions. The way children's illness is handled in the home could differ quite markedly as a result of family arrangements, level of education and a host of other factors. It is hard to conceive of this kind of effect being present at local government district level, but such differences could easily exist between neighbourhood types or estates within Glasgow.

The social characteristics of parents are a highly plausible cause of area variation. Again, it is hard to maintain that such a relationship might exist at local government district level but it is quite possible that such features may differ from one area to another. It has already been demonstrated that some of the Urban studies variables which potentially relate to such a phenomenon differ between inner and outer city areas (albeit counter-intuitively): these include non-participation in higher education, children in dependant only households, non-school participation of 17 year olds and the proportion of single parents. All of these are potential correlates of the age and experience of families. Access to local sources of support and advice might also be important: in an area with strong family networks, it seems likely that coping mechanisms will be better developed, leading to lower and less 'severe' admissions.

The way families access services may also have an important bearing on the final result in terms of admissions. The conventions about when to seek medical attention may differ in several ways. Firstly, ideas about the kind of conditions that require a doctor may be different. In some areas, non-chronic respiratory conditions may be considered a normal part of childhood and less of a causes for concern. In others, breathing problems in the night may be viewed as an automatic reason for calling the doctor or visiting Accident and Emergency. One study regarding 'inappropriate' attendances of children at A and E found that the perceptions of accompanying adults were a crucial triggering factor: distance from accident and emergency was also a relevant influence (Prince and Worth 1992)[8]. Class comparisons have been made for GP consultation rates: Saxena, Majeed and Jones (1999)[9] found a class gradient in rates for most causes except preventive activities, for which the relationship was the other way around. However, differences within the deprived groups were only

evident by ethnicity: 'South Asian' groups consult more, a result consistent with Cooper et al (1998)[10].

Similar and related factors are parents' perceptions of the severity of a condition and the level of perceived severity at which they will try to access medical attention. In some deprived groups, a higher level of illness may be accepted as normal but whether this applies to acute conditions is debatable. In theory, as regards hospital admissions, the system of GPs and hospital doctors should act as a filter for low severity cases: Doctors do, perhaps unsurprisingly have 'higher standards' for admission than patients (MacFaul et al 1998)[11]. However, American research has demonstrated that a higher proportion of admissions to children on public assistance are 'non-medical' (Krug et al 1997)[12], meaning that perhaps the a child presenting from one of the peripheral estates would be more likely to be admitted with less worrying symptoms on the basis that (say) recovery might be problematic at home for non-medical reasons. A similar effect has been observed with homeless children, for whom 77% of admissions are socially influenced compared to 43% of controls (Lissaur et al 1993)[13].

These influences could conceivably vary according to area or neighbourhood type but not local government district in conjunction with the predominant local culture. However it is hard to imagine that this would be systematic enough to cause the differences revealed in the data. Possibly areas with a stronger network of social support or conversely areas where support is lacking and access to medical attention problematic would tend to have lower admissions. In the former case, contact with others such as neighbours or grandparents might provide reassurance and/or knowledge about whether the condition of a child is or is not threatening. In the latter, the motivation needed to make a parent feel concerned or empowered enough to seek medical attention might be greater. The influences could however also work the other way around, with family support making it logistically easier for patients to present and the sense of isolation in the other scenario leading to a 'better safe than sorry' decision.

Social factors are clearly a very important influence on children's hospital admissions, both alone and as an intermediary to other factors: medicine is after all 'a social

science'. The underlying mechanisms are complicated and unpredictable, but the effect is highly plausible.

13.5.3. The possible role of practical/logistic factors

Practical factors explaining differences in admission between areas relate largely to ease of access to health services, or the lack of it. This can be the result of the level and character of service provision and fundamental factors such as its location.

Obstacles to either hospital admissions and good health might be present: hospitals in one area may be less well served by public transport for example, or fewer GPs per patient may be available. One study undertaken in inner city Nottingham found a relationship between distance from the single Accident and Emergency department and out of hours usage, but this 'disappeared when deprivation was taken into account' (Carlisle et al 1998)[14].

Like bio-medical factors, practical influences would tend to be quite specific to particular areas, but unlike these, they will operate mostly in their own right. They are not really an intermediary for deprivation, except in the sense that more affluent groups have more resources at their disposal to overcome them.

13.5.4. The possible role of health service factors

Local variation in the level and nature of services provides perhaps the most convincing set of proximal causes affecting admissions. It is certainly the only idea that offers reasons for the variation in local government district rates and character. At the more local levels differences in policy and convention between particular hospitals, coupled with 'practice effects' offer additional explanations for this variation.

Within Glasgow one hospital (Yorkhill) handles the majority of paediatric cases, so the observed neighbourhood type differences may be the result of services outside the acute hospital sector, for example in General Practice. Carlisle et al (1998)[15] found a marked 'practice effect' whereby one practice had 'significantly higher out of hours rates even when deprivation was included in the regression equation'. Similar

phenomena have been detected in other studies (Usherwood et al 1985)[16]. The authors attribute these effects to either population characteristics not included in their measure of deprivation (the Jarman index) or features of the practice itself. However, other research suggests that, while there is a great deal of variation in hospital admission rates between general practices, this is almost all the result of differences in the patient populations (Reid et al 1999)[17]. Other services show a similar pattern: Lynch (1995)[18] found no significant practice effect on the uptake of immunisation with patient population being again the dominant factor.

What practice effects do exist could be explained in two ways: firstly certain practices may be more likely than others to pass patients on into the hospital system. Various factors relating to the individual GP have been suggested to explain this kind of phenomenon. (Reid et al 1999)[19] summarise these as 'the ability to live with uncertainty, ability to manage patient pressure, relationships with local consultants and previous complaints from patients'. The organisation of practices and staffing levels may also be important: Thakker et al (1994)[20] found a significant and notable negative correlation between the number of practitioners and Accident and Emergency admissions, suggesting that less well manned practices tend to refer more.

Secondly, primary care in some practices may be such that more patients are kept at a level of severity below that requiring admission. Evidence concerning the latter is conflicting. Gill (1997)[21] concludes that in American Medicaid patients (a cross section comparable with the cohorts in this study) a 'regular source of primary care' does not reduce the risk of an admission. Meanwhile, Casanova and Starfield (1995)[22] suggest that accountable primary care does reduce admissions for those conditions it directly benefits.

The organisation of care on a local level then, could well account for some differences between areas in terms of hospital admissions. Clearly, there is some interaction with social factors relating to patients. The development of new kinds of services, such as the Emergency GP infrastructure recently developed in Glasgow, has been based on this assumption. Health service factors are perhaps the most likely set of proximal causes to exert effects in their own right rather than mediating others.

13.6. Relative importance of the four factors.

Given that the four sets of factors investigated by this study are all interconnected to varying degrees, it is hard to identify which are the most important. In terms of which factors produce the most variation, deprivation and urbanicity are dominant. However, from the point of view of looking to effect changes in health outcomes, the proximal factors seem to be the key for two reasons. Firstly, it is clear that all the other factors exert their effect through the proximal influences. Indeed, certainly in the case of deprivation and urbanicity, the other factors are essentially thematic combinations of proximal factors. Secondly, the proximal influences offer the best possibilities for action. As already stated, tackling deprivation is an honourable but long-term goal. Subtle but carefully judged changes to primary care and hospital services could have untold benefits both alone and in reducing the negative effects of deprivation.

13.7. Questions raised by the thesis and how they might be answered

This thesis stops short of answering the question it posed in more than a theoretical way. Very little can be proven from standard data about the actual mechanisms influencing children's hospital admissions: most of the conclusions are fairly speculative. In order to find out about these mechanisms a different and more detailed kind of study is needed into the proximal influences discussed in the previous sections.

The research would probably be qualitative in nature and involve interviewing cross sections of young families from different areas and backgrounds who had recently had experience of the admissions process. Possible lines of enquiry would include their perceptions of the various health services, what influenced the various decisions they made in the run up to admission and what actually took place in their view after this. Other possibilities in relation to health service factors would be a survey of the views of health professionals that were involved at some point in the admissions process.

13.8. Summary and conclusion.

This thesis has surveyed the extent and nature of variation in children's hospital admissions and proposed a set of interconnected influences on this process.

Deprivation, urbanicity and area effects independent of these appear to operate through a diverse set of proximal influences to create final admission patterns.

The research has been carried out from the 'top-down', starting with trends and dissecting them to find what underlies them and so on. The trends themselves however are the result of the actions of individuals from the 'bottom-up': families reacting to the constraints and influences on their lives. This fact is probably the key to improving the health of populations: while identifying trends is useful, explaining them is more important. As such it is clear that further qualitative research is needed to provide evidence about what actually affects the people most concerned with child health: families.

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CHAPTER 14

Acknowledgements

I am indebted to the following people for a host of reasons. In no particular order: Dr .Andrew Boddy (PHRU), Professor Jim McEwen (Department of Public Health), Heather Baillie (PHRU), Kenneth Gibb (Urban Studies), Danny McKay (Urban Studies), Monica Lynch (Gorbals Health Centre), Dr Kathryn Milburn (Behavioural Sciences, University of Edinburgh), Dr Albert Burton (Woodside Health Centre), Keith Murray (Department of Public Health), Sister Anne Fullarton, Dr George Morris (SCIEH), Dr David Stone (PEACH), Dr Pat West (MRC Social and Public Health Sciences), Dr Helen Sweeting (MRC Social and Public Health Sciences), Philip McLoone (MRC Social and Public Health Sciences), Peter Jamieson (GRO Scotland), Ross Elder (ISD Edinburgh), Karen McNee (Scottish Office), Dr Peter Evans (Department of Public Health), Professor Graham Watt (Department of General Practice), Dr Kate MacIntyre (Department of Public Health), Greg Rose, Stephen Moss, John Kennedy, Dr Rhona McDonald, Manolo Ma Diaz Gomez, Joerg-Peter Rau, Barto Mesa-Lao, Jenny Marsden, Dr Yoganathan Vellupillai, Olivia Wu, Dr Jaquiline Atkinson, David Docherty, Maurice Bloch, Russel Ecob, Dr Oliver Blatchford, Dr Anthony Boyce, Dr Crispin Jenkinson, Dr Stuart Wood.

APPENDIX 1

Diagnostic Groupings – 9th Revision International Classification of Diseases[1]

The groups of codings were assigned on the basis of groups of clinical features. The other category comprises all conditions not classified elsewhere. Only those conditions comprising 1% or more of this category are listed by name below.

Diagnostic grouping	*ICD-9 codes*	*ICD section titles*
Non-chronic respiratory	460-466 480-487	Acute respiratory infection, pneumonia and influenza.
Chronic respiratory	470-478	Other diseases of the upper respiratory tract
	490-496	Chronic obstructive respiratory disease and allied conditions
Gastro-intestinal infections	001-009	Intestinal infectious diseases
Other infections	031-041	Other bacterial diseases
	47-49	Other non-arthropod-borne viral diseases of the central nervous system
	050-057	Viral diseases accompanied by exanthem
	070-079	Other diseases due to viruses and Chlamydiae
	680-686	Infections of skin and subcutaneous tissue
Accidents and Poisonings	800-999	Chapter XVII: Injury and Poisoning
Congenital anomalies	741-759	Chapter XIV: Congenital anomalies
Non-infective abdominal conditions	530-579	Chapter IX: Diseases of the Digestive System <u>except</u> 520-529 (diseases of oral cavity, salivary glands and jaws)
Teeth	520-529	Diseases of oral cavity, salivary glands and jaws
Symptoms and ill-defined conditions	780-799	Chapter XVI: Symptoms, Signs, and Ill-defined Conditions

continued....

Diagnostic Groupings – 9th Revision International classification of Diseases – continued

Diagnostic grouping	*ICD-9 codes*	*ICD section titles*
Other	204	Lymphoid leukaemia
	216	Benign neoplasm of skin
	228	Haemangioma and lymphangioma, any site
	345	Epilepsy
	375	Disorders of lacrimal system
	378	Strabismus and other disorders of binocular eye movements
	381	Non-suppurative otitis media and eustachian tube disorders
	382	Suppurative and unspecified otitis media
	389	Deafness
	519	Other diseases of the respiratory system (includes – e.g. – tracheostomy malfunction and disorders of mediastinum)
	599	Other disorders of urethra and urinary tract
	603	Hydrocele
	605	Redundant prepuce and phimosis
	691	Atopic dermatitis and related conditions
	692	Contact dermatitis and other eczema
	719	Other and unspecified disorders of joint
	765	Disorders relating to short gestation and unspecified low birthweight
	770	Other respiratory disorders of fetus and newborn

Diagnostic Groupings – 9th Revision International classification of Diseases – continued

Diagnostic grouping	*ICD-9 codes*	*ICD section titles*
	774	Other perinatal jaundice
	779	Other and ill-defined conditions arising in the perinatal period

[1]Manual of the International Classification of Diseases, Injuries, and Causes of Death 1975 Revision (9th revision) Geneva: World Health Organisation 1977 pp.3-45

APPENDIX 2: Local Government District rates and confidence intervals

Appendix 2 a: General rates of admission by Local Government District, 1981-3 and 1991-3 cohorts[1]

Region	*LGD*	*1981-3 Rate*	*95% CI*	*1991-3 Rate*	*95% CI*
Borders	*Ettrick & Lauderdale*	*452.78*	*423.9 - 481.7*	*799.68*	*776.9 - 822.5*
	Tweeddale	*431.25*	*386.0 - 476.5*	*626.62*	*585.0 - 668.2*
	Berwickshire	*329.84*	*290.6 - 369.1*	*649.12*	*612.6 - 685.6*
	Roxburgh	*364.61*	*335.8 - 393.4*	*591.63*	*564.0 - 619.3*
(Regional rate)		*(399.34)*		*(676.15)*	
Central	*Stirling*	*614.4*	*596.1 - 632.8*	*647.06*	*629.0 - 665.1*
	Clackmannan	*618.38*	*596.2 - 640.5*	*591.23*	*569.3 -613.2*
	Falkirk	*673.56*	*661.0 - 686.1*	*590.51*	*577.4 - 603.7*
(Regional rate)		*(647.06)*		*(605.87)*	
Dumfries	*Wigtown*	*439.3*	*410.0 - 468.7*	*697.19*	*669.5 - 724.8*
Galloway	*Annandale & Eskdale*	*374.23*	*345.5 - 403.0*	*630.45*	*603.8 - 657.2*
	Nithsdale	*484.08*	*509.6 - 458.6*	*675.79*	*655.8 - 695.8*
	Stewartry	*358.64*	*323.9 - 393.3*	*562.42*	*526.1 - 598.8*
(Regional rate)		*(424.80)*		*(653.33)*	
Fife	*Kirkcaldy*	*501.91*	*489.0 - 514.8*	*652.66*	*640.0 - 665.3*
	Dunfermline	*432.56*	*419.1 - 446.0*	*663.63*	*650.6 - 676.7*
	North East Fife	*308.96*	*289.2 - 328.7*	*495.54*	*474.4 - 516.7*
(Regional rate)		*(443.39)*		*(630.25)*	
Grampian	*Aberdeen City*	*778.25*	*768.7 - 787.8*	*729.1*	*719.1 - 739.1*
	Banff & Buchan	*542.6*	*525.5 - 559.7*	*564.27*	*547.5 - 581.1*
	Kincardine & Deeside	*663*	*640.8 - 685.2*	*518.35*	*497.3 - 539.4*
	Gordon	*532.13*	*514.5 - 549.8*	*485.28*	*467.7 - 502.9*
	Moray	*473.29*	*456.4 - 490.2*	*531.42*	*514.5 - 548.3*
(Regional rate)		*(630.81)*		*(605.37)*	
Highland	*Inverness*	*434.39*	*413.3 - 455.5*	*658.3*	*639.8 - 676.8*
	Ross & Cromarty	*407.01*	*385.8 - 428.3*	*592.59*	*570.5 - 614.7*
	Sutherland	*379.17*	*334.9 - 423.5*	*455.61*	*407.5 - 503.8*
	Badenoch & Strathspey	*338.9*	*289.0 - 388.8*	*403.69*	*353.3 - 454.1*
	Skye & Lochalsh	*517.59*	*467.5 - 567.7*	*470.02*	*421.1 - 518.9*
	Nairn	*397.96*	*348.5 - 447.4*	*435.9*	*385.7 - 486.1*
	Lochaber	*350.36*	*317.5 - 383.2*	*378.05*	*342.3 - 413.8*
	Caithness	*278.66*	*253.4 - 304.0*	*419.48*	*388.8 - 450.1*
(Regional rate)		*(388.96)*		*(541.56)*	
Lothian	*Edinburgh City*	*666.89*	*659.1 - 674.7*	*712.21*	*705.1 - 719.3*
	Midlothian	*539.32*	*521.8 - 556.9*	*693.27*	*676.9 - 709.6*
	West Lothian	*428.37*	*415.9 - 440.9*	*650.06*	*637.9 - 662.2*
	East Lothian	*480.27*	*461.07 -499.5*	*681.2*	*665.2 - 697.3*
(Regional rate)		*(577.20)*		*(693.23)*	

[1] For a full table with confidence intervals, see appendix 2

Region	*LGD*	*1981 Rate*	*95% CI*	*1991 Rate*	*95% CI*
Strathclyde	*Cumnock & Doon Valley*	*505.36*	*481.6 - 529.1*	*764.22*	*744.4 - 784.1*
	Monklands	*555.6*	*541.3 - 569.9*	*686.13*	*671.7 - 700.6*
	Motherwell	*450.9*	*438.3 - 463.4*	*674.93*	*662.6 - 687.3*
	Renfrew	*431.37*	*420.3 - 442.4*	*660.88*	*650.1 - 671.6*
	Inverclyde	*534.9*	*519.2 - 550.7*	*642.26*	*625.9 - 658.6*
	Clydesdale	*412.87*	*392.5 - 433.2*	*675.51*	*655.3 - 695.7*
	Hamilton	*368.78*	*354.9 - 382.6*	*658.69*	*643.9 - 673.5*
	Glasgow City	*484.02*	*478.2 - 489.8*	*640.49*	*634.8 - 646.2*
	Kyle & Carrick	*479.83*	*464.1 - 495.6*	*621.54*	*605.8 - 637.3*
	Cunninghame	*480.25*	*467.1 - 493.4*	*641.01*	*628.1 - 654.0*
	Clydebank	*386.6*	*365.0 - 408.3*	*568.62*	*544.8 - 592.5*
	Argyll & Bute	*288.43*	*270.6 - 306.3*	*545.06*	*524.3 - 565.8*
	Kilmarnock & Loudoun	*401.87*	*384.8 - 418.9*	*559.15*	*541.6 - 576.8*
	Bearsden & Milngavie	*330.41*	*303.9 - 357.0*	*501.16*	*473.4 - 529.0*
	Strathkelvin	*354.58*	*339.1 - 370.1*	*501.08*	*483.6 - 518.6*
	Cumbernauld & Kilsyth	*341.16*	*323.1 - 359.2*	*472.88*	*453.4 - 492.4*
	East Kilbride	*334.73*	*317.8 - 351.6*	*449.53*	*432.5 - 466.5*
	Dumbarton	*302.18*	*286.8 - 317.5*	*391.03*	*373.8 - 408.3*
	Eastwood	*251.04*	*231.3 - 270.8*	*418.42*	*397.8 - 439.1*
(Regional rate)		*(437.92)*		*(609.52)*	
Tayside	*Dundee City*	*621.4*	*609.6 - 633.2*	*688.72*	*677.2 - 700.3*
	Perth and Kinross	*447.07*	*431.5 - 462.7*	*658.45*	*644.4 - 672.5*
	Angus	*409.19*	*392.7 - 425.7*	*492.31*	*475.7 - 508.9*
(Regional rate)		*(519.88)*		*(630.39)*	
	Orkney	*356.84*	*320.9 - 392.9*	*406.04*	*369.7 - 442.4*
	Shetland	*497.47*	*465.7 - 529.3*	*518.67*	*486.9 - 550.4*
	Western Isles	*323.58*	*296.1 - 351.0*	*471.3*	*439.6 - 503.0*

APPENDIX 3

Full results for Chapter 8: Interacting effects of socio-economic and urban-rural gradients

Socio-economic/Urban-Rural PC groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Mean age of admission for 'rural' groups	*20.10*	*20.53*	*20.62*	*20.10*	*20.51*	*20.31*	*19.23*
Mean age of admission for 'urban' groups	*20.17*	*20.06*	*20.18*	*20.42*	*19.60*	*19.72*	*19.39*
Mean age of admission for 'deprived' groups	*20.76*	*20.22*	*19.93*	*19.62*	*19.17*	*19.68*	*19.64*
Mean age of admission for 'affluent' groups	*20.52*	*20.16*	*20.37*	*20.54*	*20.17*	*20.06*	*20.11*

Socio-economic/Urban-Rural PC groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*
% Emergency admissions for 'rural' groups	*66.1*	*65.6*	*64.5*	*64.5*	*61.3*	*65.6*	*68.5*
% Emergency admissions for 'urban' groups	*62.3*	*64.3*	*65.1*	*66.6*	*68.2*	*69.5*	*72.0*
% Emergency admissions for 'deprived' groups	*63.2*	*66.3*	*64.7*	*65.1*	*62.5*	*64.2*	*64.7*
% Emergency admissions for 'affluent' groups	*62.3*	*62.7*	*66.1*	*68.2*	*71.0*	*71.5*	*70.7*

Socio-economic/Urban-Rural PC groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*
% Acute admissions for 'rural' groups	*56.0*	*54.9*	*56.6*	*55.5*	*51.4*	*53.8*	*54.7*
% Acute admissions for 'urban' groups	*54.9*	*55.6*	*56.2*	*56.1*	*57.7*	*58.6*	*60.1*
% Acute admissions for 'deprived' groups	*53.7*	*56.0*	*56.0*	*55.3*	*54.8*	*56.3*	*55.6*
% Acute admissions for 'affluent' groups	*53.1*	*50.5*	*54.7*	*57.0*	*59.1*	*60.8*	*58.9*

Socio-economic/Urban-Rural PC groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Mean length of stay for 'rural' groups	*2.68*	*2.60*	*2.41*	*2.70*	*2.71*	*2.65*	*3.09*
Mean length of stay for 'urban' groups	*2.53*	*2.61*	*2.90*	*2.69*	*2.87*	*2.85*	*3.17*
Mean length of stay for 'deprived' groups	*2.44*	*2.60*	*2.65*	*2.44*	*2.65*	*2.63*	*2.78*
Mean length of stay for 'affluent' groups	*2.81*	*2.72*	*2.81*	*2.95*	*2.88*	*3.06*	*3.21*

Socio-economic/Urban-Rural PC groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*
% CIS = 1 for 'rural' groups	*61.4*	*59.5*	*60.9*	*57.3*	*55.6*	*55.3*	*51.7*
% CIS = 1 for 'urban' groups	*57.2*	*57.2*	*52.8*	*56.2*	*54.4*	*54.0*	*51.8*
% CIS = 1 for 'deprived' groups	*62.4*	*61.1*	*57.8*	*55.9*	*55.4*	*56.9*	*56.3*
% CIS = 1 for 'affluent' groups	*59.9*	*54.0*	*53.5*	*52.2*	*54.0*	*52.2*	*53.5*

Socio-economic/Urban-Rural PC groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*
% CIS = 2 to 5 for 'rural' groups	*33.6*	*33.4*	*34.4*	*34.9*	*35.8*	*34.7*	*36.1*
% CIS = 2 to 5 for 'urban' groups	*34.2*	*34.8*	*35.5*	*34.8*	*36.8*	*37.9*	*38.3*
% CIS = 2 to 5 for 'deprived' groups	*32.9*	*32.2*	*35.5*	*35.0*	*35.8*	*33.9*	*34.4*
% CIS = 2 to 5 for 'affluent' groups	*35.6*	*33.6*	*36.8*	*37.3*	*37.7*	*38.4*	*37.8*

Socio-economic/Urban-Rural PC groups	*1*	*2*	*3*	*4*	*5*	*6*	*7*
% CIS > 5 for 'rural' groups	*5.0*	*7.1*	*4.7*	*7.8*	*8.6*	*10.0*	*12.2*
% CIS > 5 for 'urban' groups	*8.6*	*8.1*	*11.7*	*9.0*	*8.7*	*8.1*	*9.9*
% CIS > 5 for 'deprived' groups	*4.7*	*6.8*	*6.7*	*9.1*	*8.8*	*9.2*	*9.3*
% CIS > 5 for 'affluent' groups	*4.4*	*12.4*	*9.7*	*10.5*	*8.3*	*9.3*	*8.7*

APPENDIX 5

Characteristics and diagnostic profiles for deprived areas of local government districts

Table 10e: Characteristics of admissions for deprived rural postcodes in different local government districts

	Mean Age	*% Emergency*	*% Acute*	*Mean Stay*	*% CIS = 1*	*% CIS=2 to 5*	*% CIS = 5*	*Total cases*
Nithsdale	*19.17*	*59.7*	*52.4*	*3.34*	*43.7*	*36.4*	*19.9*	*813*
Kirkcaldy	*21.52*	*63.2*	*58.9*	*2.62*	*50.2*	*41.6*	*8.2*	*231*
Annandale and Eskdale	*20.13*	*66.7*	*53.0*	*2.10*	*50.8*	*42.6*	*6.6*	*183*
Perth and Kinross	*24.19*	*60.0*	*51.4*	*2.50*	*49.3*	*30.0*	*20.7*	*140*
Clydesdale	*20.65*	*65.4*	*51.2*	*2.97*	*44.9*	*32.7*	*22.4*	*486*
Cumnock	*18.86*	*70.1*	*57.0*	*2.75*	*52.8*	*38.8*	*8.5*	*1120*
Roxburgh	*19.71*	*72.1*	*48.3*	*2.85*	*51.7*	*28.4*	*19.9*	*201*
Argyll and Bute	*17.10*	*77.6*	*60.6*	*2.71*	*57.9*	*38.5*	*3.6*	*442*
Falkirk	*19.34*	*70.0*	*51.8*	*2.53*	*61.8*	*30.9*	*7.3*	*110*
Renfrew	*10.86*	*100.0*	*85.7*	*1.86*	*85.7*	*14.3*	*.0*	*7*
Ross and Cromarty	*20.49*	*66.3*	*52.8*	*3.06*	*56.7*	*36.4*	*6.8*	*409*
Kyle and Carrick	*19.20*	*76.2*	*57.7*	*2.53*	*59.1*	*36.0*	*4.9*	*369*
Angus	*22.42*	*66.4*	*57.8*	*2.42*	*57.1*	*36.5*	*6.4*	*545*
Wigtown	*15.30*	*67.2*	*53.4*	*3.83*	*55.0*	*31.3*	*13.7*	*131*
Midlothian	*18.97*	*79.3*	*69.0*	*2.59*	*48.3*	*34.5*	*17.2*	*29*
Berwickshire	*10.45*	*81.8*	*54.5*	*2.45*	*54.5*	*45.5*	*.0*	*11*
Moray	*24.42*	*62.5*	*47.9*	*2.90*	*54.0*	*29.9*	*16.2*	*365*
Banff and Buchan	*18.34*	*67.8*	*52.3*	*3.13*	*59.6*	*30.1*	*10.3*	*478*
Nairn	*23.84*	*57.8*	*54.9*	*1.80*	*62.7*	*36.3*	*1.0*	*102*
Caithness	*20.45*	*51.1*	*41.5*	*2.05*	*54.1*	*34.1*	*11.8*	*229*
Skye and Lochalsh	*19.77*	*72.9*	*54.2*	*2.35*	*50.0*	*41.7*	*8.3*	*48*
Sutherland	*21.87*	*68.7*	*51.5*	*2.75*	*54.5*	*32.1*	*13.4*	*134*
Western Isles	*17.75*	*67.1*	*55.2*	*3.76*	*65.0*	*33.6*	*1.4*	*143*
Lochaber	*17.79*	*64.4*	*58.4*	*3.10*	*67.4*	*31.3*	*1.3*	*233*

Table 10h: Characteristics of admissions for deprived rural postcodes in different local government districts

	Mean Age	% Emergency	% Acute	Mean Stay	% CIS=1	% CIS=2 to 5	% CIS = 5	Total cases
Perth and Kinross	22.07	68.7	55.3	3.03	45.8	46.0	8.2	550
Edinburgh City	18.45	66.7	59.5	2.60	45.3	42.7	12.0	3497
Aberdeen City	17.75	72.5	61.6	3.29	51.3	40.4	8.3	2292
East Lothian	20.28	63.1	59.2	2.13	48.1	41.7	10.2	655
Wigtown	17.71	59.8	56.6	2.88	49.8	42.6	7.6	249
Dunfermline	19.93	64.5	56.5	2.75	51.3	38.9	9.8	1081
Cumnock and Doon Valley	20.34	64.9	54.2	2.25	60.0	38.7	1.3	225
Midlothian	20.34	64.2	60.1	2.48	47.7	40.8	11.5	755
Dundee City	19.55	70.8	59.9	2.55	49.8	42.0	8.2	2832
Cunninghame	19.38	68.5	59.9	2.71	53.1	40.3	6.6	1964
Kyle and Carrick	18.24	69.0	56.6	2.93	52.8	40.2	7.0	555
Stirling	16.05	75.7	56.5	3.64	52.2	35.3	12.5	680
Glasgow City	19.92	72.9	60.1	3.54	53.4	36.3	10.3	12511
Renfrew	20.11	76.4	66.1	2.41	52.8	38.9	8.3	2180
Angus	18.89	67.3	64.3	2.60	57.3	38.0	4.7	171
Hamilton	19.73	76.2	58.4	3.17	52.3	40.1	7.6	1002
West Lothian	21.72	65.3	56.6	2.88	51.4	32.9	15.7	1354
Motherwell	19.16	71.4	58.6	2.93	53.8	38.6	7.6	3361
Strathkelvin	21.54	65.8	48.3	2.43	51.7	32.5	15.8	520
Inverclyde	19.91	74.0	67.1	2.47	55.3	36.5	8.2	1733
Monklands	18.89	76.8	56.8	3.06	53.3	36.7	10.1	2127
Falkirk	17.97	74.5	55.9	2.94	54.3	36.0	9.7	1797
Kirkcaldy	21.33	61.5	55.2	2.58	58.6	35.8	5.7	1253
Clackmannan	18.14	77.9	57.8	4.18	53.2	36.7	10.1	791
Banff and Buchan	17.96	66.5	54.7	3.26	56.7	34.5	8.8	612
Kilmarnock and Loudoun	20.45	65.8	60.2	3.63	57.2	36.8	6.0	932
Clydebank	20.37	74.5	64.5	3.40	58.6	37.6	3.7	805
Dumbarton	20.47	68.2	66.5	4.17	57.3	37.7	5.0	525
Cumbernauld and Kilsyth	19.33	70.7	45.3	3.29	69.3	30.7	.0	75
Lochaber	14.58	75.0	50.0	2.00	66.7	33.3	.0	12

Table 10h: Diagnostic profiles for deprived rural postcodes in different local government districts

Key

NC = Non-chronic respiratory	CR = Chronic respiratory
GI = Gastro-intestinal infections	OI = Other infections
AP = Accidents and poisonings	CA = Congenital Anomalies
NIA = Non-infective abdominal	SID = Symptoms and ill-defined
T = Teeth	O = Other

LGD	*NC*	*CR*	*GI*	*OI*	*AP*	*CA*	*NIA*	*SID*	*T*	*O*
Nithsdale	*15.3*	*3.7*	*3.3*	*4.0*	*10.9*	*8.2*	*10.2*	*14.1*	*6.4*	*15.3*
Kirkcaldy	*13.7*	*5.7*	*7.5*	*6.6*	*9.3*	*7.0*	*10.6*	*14.1*	*11.0*	*13.7*
Annandale and Eskdale	*21.0*	*10.2*	*4.5*	*1.9*	*7.0*	*13.4*	*7.6*	*14.0*	*5.7*	*21.0*
Perth and Kinross	*19.4*	*4.0*	*4.0*	*4.0*	*8.9*	*10.5*	*7.3*	*14.5*	*8.9*	*19.4*
Clydesdale	*13.9*	*4.3*	*.9*	*2.0*	*8.9*	*5.6*	*9.8*	*16.8*	*4.0*	*13.9*
Cumnock and Doon Valley	*15.7*	*7.4*	*7.5*	*5.5*	*10.5*	*6.3*	*6.4*	*15.5*	*5.6*	*15.7*
Roxburgh	*13.3*	*5.2*	*5.2*	*5.2*	*8.7*	*4.0*	*4.0*	*19.7*	*6.4*	*13.3*
Argyll and Bute	*14.5*	*4.1*	*.3*	*2.3*	*9.2*	*6.6*	*11.5*	*26.8*	*3.1*	*14.5*
Falkirk	*15.0*	*3.7*	*1.9*	*6.5*	*19.6*	*10.3*	*3.7*	*4.7*	*.0*	*15.0*
Renfrew	*42.9*	*.0*	*14.3*	*14.3*	*14.3*	*.0*	*14.3*	*.0*	*.0*	*42.9*
Ross and Cromarty	*19.4*	*4.6*	*5.9*	*7.1*	*11.5*	*15.3*	*3.1*	*9.4*	*3.8*	*19.4*
Kyle and Carrick	*18.5*	*8.2*	*8.2*	*4.1*	*12.0*	*3.2*	*5.9*	*13.8*	*2.6*	*18.5*
Angus	*16.2*	*7.4*	*4.6*	*6.1*	*9.4*	*10.5*	*9.4*	*11.6*	*4.4*	*16.2*
Wigtown	*16.5*	*3.9*	*8.7*	*8.7*	*6.3*	*17.3*	*7.9*	*11.8*	*3.1*	*16.5*
Midlothian	*28.6*	*10.7*	*10.7*	*10.7*	*7.1*	*3.6*	*10.7*	*3.6*	*.0*	*28.6*
Berwickshire	*18.2*	*18.2*	*9.1*	*9.1*	*.0*	*27.3*	*9.1*	*.0*	*.0*	*18.2*
Moray	*11.0*	*6.3*	*8.4*	*4.6*	*11.2*	*9.2*	*7.2*	*10.1*	*1.4*	*11.0*
Banff and Buchan	*11.1*	*6.4*	*6.6*	*3.6*	*14.0*	*14.3*	*7.4*	*10.6*	*.2*	*11.1*
Nairn	*20.8*	*5.2*	*3.1*	*2.1*	*20.8*	*9.4*	*5.2*	*4.2*	*2.1*	*20.8*
Caithness	*11.9*	*2.5*	*2.5*	*3.0*	*14.9*	*9.5*	*4.0*	*10.9*	*5.0*	*11.9*
Skye and Lochalsh	*28.9*	*4.4*	*15.6*	*8.9*	*6.7*	*2.2*	*6.7*	*2.2*	*4.4*	*28.9*
Sutherland	*16.7*	*4.5*	*7.6*	*4.5*	*12.1*	*20.5*	*8.3*	*6.1*	*2.3*	*16.7*
Western Isles	*20.2*	*3.2*	*5.6*	*3.2*	*12.9*	*12.1*	*5.6*	*18.5*	*3.2*	*20.2*
Lochaber	*23.9*	*1.3*	*4.9*	*8.0*	*9.7*	*15.0*	*5.8*	*11.5*	*.4*	*23.9*

Table 10h: Diagnostic profiles for deprived urban postcodes in different local government districts

NC = Non-chronic respiratory	CR = Chronic respiratory
GI = Gastro-intestinal infections	OI = Other infections
AP = Accidents and poisonings	CA = Congenital Anomalies
NIA = Non-infective abdominal	SID = Symptoms and ill-defined
T = Teeth	O = Other

LGD	*NC*	*CR*	*GI*	*OI*	*AP*	*CA*	*NIA*	*SID*	*T*	*O*
Perth and Kinross	15.6	7.2	8.6	3.5	10.9	7.6	5.1	17.0	7.2	16.99
Edinburgh City	13.5	6.3	6.3	6.2	12.6	7.7	9.0	16.2	5.1	19.67
Aberdeen City	14.8	8.3	9.2	4.4	17.5	7.1	8.0	10.6	.4	14.02
East Lothian	14.9	10.6	5.8	4.4	10.4	8.9	7.8	14.9	5.2	17.05
Wigtown	17.3	8.9	3.6	2.2	11.1	11.6	6.2	16.9	2.2	17.35
Dunfermline	18.7	4.9	6.8	4.6	10.1	9.7	9.0	13.7	5.7	18.71
Cumnock	13.1	10.3	8.9	3.8	14.6	6.1	6.1	9.4	6.1	16.38
Midlothian	17.9	10.0	5.4	3.4	11.7	10.0	7.2	14.7	5.6	14.65
Dundee City	17.9	6.8	5.9	3.4	10.4	5.8	9.2	15.9	8.2	18.43
Cunninghame	19.1	4.7	5.8	6.6	11.9	7.6	5.5	15.2	5.2	15.88
Kyle and Carrick	17.2	7.4	7.2	5.3	11.5	10.3	5.7	14.2	2.5	18.18
Stirling	15.2	5.4	1.8	5.1	10.3	10.4	8.3	14.7	.5	18.44
Glasgow City	17.9	7.0	5.9	4.7	9.6	8.6	7.8	15.7	8.1	20.00
Renfrew	15.7	7.4	.8	3.4	12.4	7.1	11.2	18.7	4.3	19.35
Angus	20.0	9.1	3.6	6.1	9.7	6.7	11.5	10.3	4.8	16.95
Hamilton	17.4	12.3	7.9	4.7	7.1	6.7	6.5	13.6	8.8	18.92
West Lothian	14.8	8.2	6.9	6.5	9.9	8.5	7.5	14.1	5.2	14.95
Motherwell	16.1	8.8	5.2	5.1	11.5	8.1	10.8	11.7	3.3	28.48
Strathkelvin	14.6	5.4	5.8	4.4	7.8	8.0	5.6	12.4	8.6	16.03
Inverclyde	15.6	6.2	.7	5.7	11.6	6.2	14.4	15.5	2.3	17.76
Monklands	17.2	6.1	10.8	6.1	9.9	8.1	5.8	15.1	4.9	21.60
Falkirk	15.6	6.7	1.5	5.8	12.2	9.2	8.2	10.1	.6	21.85
Kirkcaldy	11.4	5.3	5.1	4.6	12.3	7.0	12.3	12.3	12.1	17.59
Clackmannan	12.3	4.9	2.2	4.3	13.4	8.3	12.6	14.3	.5	27.20
Banff and Buchan	13.2	5.4	9.4	7.8	13.7	5.7	6.6	9.9	.3	30.20
Kilmarnock and Loudoun	14.3	6.9	3.4	4.9	17.2	9.6	6.4	13.8	5.8	27.40
Clydebank	19.7	6.6	4.5	4.2	11.6	7.8	8.3	15.6	5.7	27.99
Dumbarton	12.1	8.4	1.6	5.1	13.3	9.4	10.5	18.8	3.7	17.19
Cumbernauld and Kilsyth	12.5	4.2	2.8	5.6	11.1	11.1	4.2	9.7	15.3	23.61
Lochaber	18.2	.0	18.2	9.1	18.2	9.1	9.1	.0	.0	18.18

APPENDIX 6: One way Analysis of Variance results for the K-Means Cluster Analysis (Chapter 11)

Rural Clusters

	F	*Significance*
Mean age of admission	*2.717*	*.061*
Mean length of stay	*2.749*	*.059*
% Emergency admissions	*15.148*	*.000*
% 'Acute' admissions	*25.356*	*.000*
Admissions where CIS = 1	*19.899*	*.000*
Admissions where CIS = 2-5	*18.588*	*.000*
Admissions where CIS > 5	*11.363*	*.000*

Urban Clusters

	F	*Significance*
Mean age of admission	*5.677*	*.002*
Mean length of stay	*1.748*	*.171*
% Emergency admissions	*7.845*	*.000*
% 'Acute' admissions	*11.634*	*.000*
Admissions where CIS = 1	*18.722*	*.000*
Admissions where CIS = 2-5	*8.999*	*.000*
Admissions where CIS > 5	*21.425*	*.000*

N.B. Due to the process by which the groups were created, these F-Tests cannot be used as rigorous statistical tests of differences between groups. They are intended for statistical use only.