Homelessness and deprivation in Glasgow: a 5-year retrospective cohort study of hospitalisations and deaths.

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Submitted for the degree of Doctor of Medicine

Division of Community Based Sciences

University of Glasgow

December 2008

Acknowledgements

I am grateful for support and advice on this MD from the outset from **Professor Phil Hanlon** and **Dr Harry Burns**. Phil Hanlon was my supervisor and gave me helpful advice on drafting the thesis. Harry Burns, who proposed the idea of homelessness as “an eighth DEPCAT,” gave permission to use the Community Health Index to sample non-homeless individuals and funded the data linkage.

Caroline Bray advised me on the best format to request the data linkage and on data analyses and SPSS syntax in the early stages of the work.

Dave Clark and **Alan Finlayson** at the NHS Information Services Division matched the homeless dataset with a non-homeless comparison group, linked both to hospital and death records and provided me with the dataset on which I performed the analyses.

Iain Woodhouse and **David Batty** provided helpful comments on late drafts of this thesis.

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Morrison DS, Bray CA. Mortality in Homeless and Socio-economically Deprived Populations: A 5-year Retrospective Cohort Study. *Am J Epidemiol* 2008;167(11):S126.

Gilchrist G, Morrison DS. Prevalence of alcohol related brain damage among homeless hostel dwellers in Glasgow. *Eur J Public Health* 2005;**15**:587-588.

Morrison DS. Dr Laidlaw's prescription for the homeless. *J Public Health* 2005;**27**:401-402.

Morrison DS. Room for one homeless person. *J Epidemiol Community Health* 2003;**57**:163.

List of Abbreviations

CHI – Community Health Index

DEPCAT – Deprivation Category, where 1=most affluent and 7=most deprived

HR – hazards ratio

IHMS – Integrated Housing Management System

ISD – Information and Statistics Division of NHS National Services, Scotland

NHS – the National Health Service

NHSGGC – National Health Service Greater Glasgow and Clyde Health Board

NYSIIS – New York State Intelligence Information System

OR – odds ratio

RR – risk ratio

SMR – Standardised Mortality Ratio

SMR01 – Scottish Morbidity Record number 1

SMR01/GRO(S) – Scottish Morbidity Record number 1 and General Register Office for Scotland death records patient-linked database

Summary

Background

Homelessness shares many similarities with other socio-economically deprived circumstances. It was not known whether the health of homeless people was similar to that of other deprived non-homeless populations.

Aims

To describe hospital admissions and deaths in a cohort of homeless Glasgow adults and to compare these to socio-economically deprived groups within a matched sample of the non-homeless local population.

Methods

A retrospective 5-year cohort study was conducted comparing an exposed (homeless) cohort of adults with an age and sex matched unexposed (non-homeless) cohort from the local general population. All participants' linked hospitalisation and death records were identified. Survival was analysed using comparisons of rates, Kaplan-Meier plots and Cox proportional hazards models. Hospitalisation rate ratios were compared using an exact Poisson method. Additional proportional hazards models were produced to adjust for morbidity, which was identified in hospital records up to 5 years before death.

Results

6323 homeless and 12 625 non-homeless adults were studied. The mean ages of men and women in both cohorts at entry were 33 and 30 years, respectively, and 65% were men.

After 5 years 1.7% of the general population and 7.2% of the homeless population had died. Age and sex adjusted hazards of death, compared with residents of the most affluent areas, were 2.6 (95% CI 1.5 – 4.4) for residents of the most deprived areas and 8.7 (95% CI 5.2 – 14.5) for homeless individuals. Men were at twice the risk of death as women. Homelessness was associated with death on average 12 years younger than the matched general population (41 versus 53 years). A third of deaths in the homeless were caused by drugs and a further 16% by alcohol. In the homeless, adjusted hazards ratios for deaths by drugs were 20.4 (95% CI 12.0 – 34.7), for suicide were 8.4 (95% CI 3.9 – 18.2), for assault were 7.0 (95% CI 2.6 – 19.0) and for alcohol were 4.7 (95% CI 3.1 – 7.1) compared with the non-homeless population.

Homelessness remained an independent risk factor for death after adjustment for morbidities, with a hazard ratio of 2.4 (95% CI 1.3 – 4.3) compared with living in the most affluent non-homeless circumstances. Hospitalisation for alcohol related conditions increased the risk of death from alcohol by 42-fold but homelessness added no further hazard. In contrast, hospitalisation for drug-related causes raised the risk of death from them by 4-fold and homelessness added a further 7-fold risk.

The risk ratio for emergency hospitalisation in the homeless was 6.4 compared with the non-homeless. Admission rates were higher in the homeless for all conditions except cancers. Risk ratios in the homeless compared to the most affluent non-homeless cohorts were highest for cellulitis (risk ratio 112.9, 95% CI 20.2 – 4472.0), drug poisoning (risk ratio 90.0, 95% CI 16.0 – 3565.9) and convulsions (risk ratio 71.5, 95% CI 12.7 – 2834.1) In men, lengths of stay were longest in patients from the most affluent areas and shortest in the homeless. In women, lengths of stay increased with greater socio-economic deprivation but homeless women had stays that were typical of the general population.

There was little difference in elective admission rates across different socio-economic strata. Homelessness was associated with a small reduction in risk of elective hospitalisation in men and a small increase in women compared with the general population. Admissions for treatment of infectious and parasitic disease were 9 times more common in the homeless. Admissions for injuries, poisonings, mental and behavioural disorders, and maternity related diagnoses were around 2-3 more common in the homeless. Homelessness was associated with almost 3-fold increases in elective admissions for abortions but an 80% lower risk of vasectomy. Lengths of stay for elective admissions increased with deprivation and were longest in the homeless.

Conclusions

The morbidity and mortality of homeless adults is significantly worse than that of the most deprived non-homeless populations of Glasgow. Hospital inpatients who are homeless are at greater risk of death for a number of conditions and may benefit from more intensive treatment and follow-up.

Chapter 1. Introduction. Socio-economic deprivation, homelessness and health in Glasgow.

Socio-economic circumstances have a major influence on population health. Edwin Chadwick's *Report on the Sanitary Condition of the Labouring Population and On the Means of Its Improvement*[1] in 1842 began a succession of descriptive analyses of the relationship between poverty and illness. Chadwick both illustrated a general association between poor circumstances and health,

> "In Glasgow, which I first visited, it was found that the great mass of the fever cases occurred in the low wynds and dirty narrow streets and courts, in which, because lodging was there cheapest, the poorest and most destitute naturally had their abodes,"[1]

and a particular problem in Scottish cities,

> "…but there is evidence to which reference will subsequently be made tending to prove that the mortality from fever is greater in Glasgow, Edinburgh, and Dundee than in the most crowded towns in England."[1]

Mortality rates have routinely been described by occupational social class since 1911 in decennial Censuses[2] indicating persistent and increasing differences between affluent and deprived populations. These persistent inequalities in health have also been described specifically in Scotland[3,4,5,6] and Glasgow.[7,8]

Glasgow has suffered particularly badly from socio-economic deprivation. One factor has been the effects of mass immigration throughout the 19th Century that resulted in a population that exceeded both the available decent housing stock and jobs.[9] Another is that the major sources of the city's wealth – imported commodities and heavy industry – declined throughout the second half of the 20th Century and were not replaced by adequate alternatives.[10]

Glasgow has had a homeless population since the city was founded in the 12th Century.[9] Its contemporary problems with homelessness are due to two principal factors. The first is that the risk factors for socio-economic deprivation – overcrowding, unemployment, drug and alcohol misuse – are also risk factors for homelessness.[11, 12] The second is that Glasgow has a long history of large institutions - originally for working men - that became repositories for unemployed men who had no suitable alternative accommodation. These hostel residents became classed as "homeless" and were characterised by very high prevalences of mental illness, alcohol and substance misuse, and poor general health.

In addition to Glasgow's particular problems with homelessness, there was an increase in homelessness throughout the United Kingdom in the second half of the 20th Century. This accelerated in the 1960s as a result of the post-War population increase, slum clearances and the decline in private rented sector accommodation[13] coupled with sharp declines in employment through the 1970s and 80s.[10] Despite legislation to increase local authorities' responsibilities for the homeless in 1977,[14] homeless numbers increased steeply, trebling in Scotland between 1983 and 1993.[13]

Homelessness, like socio-economic deprivation, is associated with poor health.[15] Much of the evidence used to support this association comes from descriptive study designs, either self-reported health needs gathered from non-scientific sources, such as the Rough Sleepers' Initiative quarterly reports,[16] or from Crisis's *Still Dying for a Home*[17] in which the average age of death for rough sleepers in UK cities was reported to be 42 years. A substantial review of single homelessness research in the 1990s[13] identified relatively few papers, most of which were cross-sectional in design and therefore suffered from selection biases and an inability to show any temporal relationship between homelessness and health.

Where analytical methods have been applied to hospital data and death records in the homeless, cumulative incidence has usually been reported, often standardised or stratified by age and sex. This methodology provides a reasonable approximation for true incidence rates in large, open populations with minimal competing causes.[18,19] However, the method becomes less precise when studying smaller populations with high losses to follow-up. Deaths remove individuals from contributing to person-time-at-risk denominator data, as do repeated and prolonged hospitalisations remove them from being at risk of incident hospitalisation. Two more general weaknesses of using Census denominators to calculate cumulative incidence are that they underestimate true incidence rates because denominators never decrease when patients die or are otherwise lost to follow-up, and competing risk have less of an effect. Thus, 5-year cumulative risks may use numerators from a closed cohort but denominators from an open cohort.

Homelessness has been historically regarded as principally a housing problem and was therefore administrated by local authority housing departments. My perspective, as a public health physician working with Glasgow Homelessness Partnership, was that homelessness was a symptom of severe social and economic deprivation. In many ways, becoming homeless was the last descent into absolute deprivation. While homeless people clearly needed immediate shelter, successful prevention would need to be directed at changing the sequence of events that led to it happening.

Given the visibly poor health of homeless individuals and apparent similarities between other forms of socio-economic deprivation and homelessness, two questions emerged. The first was about what was already known in research from the UK and other countries about the health of homeless people. The second was whether the health of homeless people was worse than that of people who lived in deprived but not homeless circumstances.

This thesis therefore had two aims. The first was to critically appraise published literature on the relationships between socio-economic deprivation and homelessness and health. The second was to analyse data on a large cohort of homeless individuals in Glasgow, from a uniquely inclusive sample, to determine absolute risks of hospitalisation, healthcare interventions, and death relative to the experience of deprived but non-homeless individuals.

Chapter 2. Literature review

2.1 Literature review methodology

The purpose of the literature review was to gain a comprehensive overview of relevant previous research on the health of homeless people and to illustrate the major patterns in socio-economic inequalities in health: it was not to carry out a systematic review. Systematic reviews are designed to answer specific questions and may be less comprehensive than conventional literature reviews.[20] Literature of most interest included quantitative research on hospitalisations and deaths among adults.

The following databases were searched using the terms “homeless” and “socioeconomic” combined in turn with hospitalisation, hospitalization, emergency, elective, death, and mortality. Ovid’s (Ovid Technologies Incorporated) online bibliographic search engines were accessed via the NHS e-library.

OVID Medline 1950 to March week 3 2008 EMBASE - 1980 to 2008 week 13 CINAHL - 1982 to March Week 1 2008 ALL EBM - Cochrane DSR, ACP Journal Club, DARE, CCTR, CMR, HTA, and NHSEED on 29th March 2008 PSYCINFO - 1806 to March Week 4 2008

Box 1. Ovid databases searched in 2008.

The results of these searches are provided in Section 2.2 on page 23.

Full citation results were downloaded into RefWorks reference management software.[21] Titles could then be reviewed, words or phrases within all citations identified and papers sorted into folders according to a taxonomy of themes. Titles that concerned descriptions of interventions, editorials on homelessness, and qualitative research were considered less relevant than observational studies that quantified risks of hospital admission and death.

Additional sources on the historical context of homelessness in Glasgow were found through hand-searching, discussions with colleagues in homeless services, and internet searches using both Google and Google Scholar search engines.

2.2 Homelessness, health and socio-economic deprivation: a literature review

This literature review aims to provide the context for the cohort study in Glasgow. It begins with a brief history and then contemporary account of homelessness in Glasgow. Next, it considers what is known about the health of homeless people specifically in Glasgow before considering what is known internationally about the health of homeless people. Three sections address self-reported health, hospitalisations and deaths. Given that part of the hypothesis is that homelessness is an extreme form of socio-economic deprivation, a review of literature on socio-economic differentials in health illustrates the main patterns in morbidity and mortality with particular reference to Scotland.

The searches on Ovid described in Section 2.1 produced the returns shown in Table 1. Ovid can remove duplicates in lists of up to 6000 citations and, where this condition was satisfied, the numbers of duplicates are shown as a footnote to the table.

Table 1. Numbers of unique citations from literature searches on Ovid, March 2008. For databases and methodology, see Box 1, page 22.

Search term		+ homeless	+ socioeconomic
Homeless	15 316		537[a]
Socioeconomic	159 500	537[a]	
Hospitalization	206 002	121[b]	3 110[h]
Hospitalisation	14 091	11[c]	205[i]
Elective	83 103	3[d]	211[j]
Emergency	287 074	184[e]	1 777[k]
Death	725 119	222[f]	7 765
Mortality	674 519	194[g]	14 376

Numbers of duplicates removed where <6000 hits: a, 119; b, 14; c, 1; d, 2; e, 80; f, 106; g, 105; h, 880; i, 78; j, 73; k, 647.

All titles and abstracts of citations in the "homeless" column of Table 1 were read and relevant papers obtained. References cited within papers were sought and internet searches on Google and Google Scholar carried out using the search terms in Table 1 to find grey literature. The literature on socio-economic deprivation was much larger and therefore illustrative titles were selected to describe patterns of health for this thesis.

2.3 A history and aetiology of homelessness in Glasgow

This section provides a brief history of homelessness with particular reference to the United Kingdom and Glasgow.

Homelessness – the absence of somewhere to live – could be argued to have become a distinct condition since human civilizations began to live in settled communities. One of the earliest recorded instances of homelessness occurred in 7-2 BC when the holy family could not find room at the Inn.[22] Definitions of homelessness have continued to evolve as expectations of what constitutes reasonable or normal accommodation have changed.[11, 12]

Stuart Laidlaw,[23] Medical Officer of Health for the City of Glasgow from 1946 to 1955, provided both a historical account and a contemporaneous study of homelessness in Glasgow[9] the latter itself becoming a historical record. Laidlaw did not use the adjective "homeless" to describe residents of common lodging houses and working men's hotels, although his discussion of the history of vagrancy suggests that they fell within the modern definition of homelessness (see Section 4.9, page 148). Laidlaw's history began when the bishopric of Glasgow was founded in the 12th Century. The Dissolution (or Suppression) of the Monasteries from 1536 to 1541 resulted in the loss of their major roles in providing accommodation, charity, medical care and alms for the poor and destitute.[24] The 1579 Poor Law Act responded to the increasing problems of poverty and was the first to authorise Justices of the Peace to collect funds for poor relief and create the post of Overseer of the Poor. The Act also permitted "any responsible man" to keep in his service any man found begging.

Glasgow's population continued to grow over several centuries. After the Union of Scotland and England in 1707, Glasgow's national and international trade links increased and its favourable position on the north Atlantic trade winds led to rapid increases in imports of rum and sugar from the West Indies and tobacco from Virginia. Glasgow's wealth and population were further boosted by the combined effects of the growing industrial revolution and the enforced depopulation of rural areas as a result of the

Highland Clearances in the late 18th Century.[9] However, the large-scale migration also contributed to increasing problems with vagrancy and begging. Glasgow's Royal Infirmary to the east of the city centre was established in 1784 "for the reception of indigent persons under bodily distress in the West of Scotland."[9] Between 1707 and 1800, the city's population rose from 12 500 to 80 000, largely due to immigration.

During the 19th century there were further significant increases in the size of Glasgow and the scale of immigration of poor people. The Irish potato famines in the late 1840s precipitated a large Irish immigration into Glasgow, estimated to be around 50 000 per year but rising to 43 000 in the four months between December 1847 and March 1848.[9]

Many citizens of Glasgow lived in common lodging-houses. Graham[25] described their conditions in the early 19th century:

> "We found in one lodging-house, 15 feet long by 9 feet from the front of the beds to the opposite wall, that 15 people were sometimes accommodated; and when we expressed horror at the situation in which they were placed, the woman of the house, somewhat offended, and, I believe, a little alarmed lest we should cause some enquiry to be made by the police, said, in support of the character of her establishment that *each family* was provided with a *bed*, and that she very seldom had anybody lying on the floor."[25]

Graham was sceptical and went on to describe that there were only 3 beds for 14 residents. Laidlaw[9] also provided accounts of the conditions of the common-lodging houses in about

1818 based on descriptions by Hawkie, a man who lived most of his life in common lodging houses and described them in his autobiography *Hawkie, the Autobiography of a Gangrel*.[26] Hawkie described common lodging-houses in which money was taken for space on a floor and in which up to 4 people – men and women – shared a bed.

By 1846, Smith estimated that there were "5-10 000 persons accommodated in 2d and 3d lodging-houses in Glasgow, 489 of which were officially listed, though 6-700 existed."[27] Edwin Chadwick's landmark report on the labouring populations[1] in 1842 included observations made when he visited Glasgow:

> "… it appeared to us that both the structural arrangements and the condition of the population in Glasgow was the worst of any we had seen in any part of Great Britain. … between Argyll-street [sic] and the river… there were no privies or drains there, and the dungheaps received all filth which the swarm of wretched inhabitants could give…We saw half-dressed wretches crowding together to be warm; and in one bed, although in the middle of the day, several women were imprisoned under a blanket, because as many others who had on their back all the articles of dress that belonged to the party were then out of doors in the streets."[1]

In response to the poor conditions of common lodging-houses in 1847 a Model Lodging Association was formed by group of philanthropists in Glasgow with Lord Provost Hastie as one of the Directors.[9] The Association established lodging houses in both existing and newly-built accommodation. A later member of the Association, Lord Provost Blackie, drafted the City Improvements Bill, which was passed by Parliament in 1866. This Act led to the clearance of many of the worst common lodging-houses and their replacement by municipal lodging-houses of a higher standard. The first municipal lodging-house in Glasgow, Drygate, was opened in 1871. Similar powers were given to all local authorities in the Housing of Working-Classes Act of 1890 to allow them to buy land and establish common lodging-houses. In 1878, Glasgow Corporation owned 7 lodging-houses, which could accommodate 2430 people. The city's Medical Officer of Health, James Burn Russell, commented on the overcrowding in common lodging-houses in 1889.

Laidlaw charted the rise of common lodging-houses and their residents between 1887 and 1954 a period during which the population of Glasgow rose from 512 034 to 1 089 767 inhabitants.[9] The first few years appeared to show a greater number of common lodging-houses than registered accommodation. Thereafter, the number of common lodging houses fell continuously from a peak of about 100 in 1895 to 20 in 1954. Initially, the number of places increased to a peak of nearly 14 000 in 1913, suggesting a period in the early part of the 20th century of larger or more overcrowded lodging-houses. Laidlaw did, however, suggest that several contemporaneous reports indicated improvements in standards of conduct and hygiene during this period.

Notably, Laidlaw's only use of the term "homeless" was made in a quotation by Fyfe in 1894 in which he describes the dissolution of a poor quality lodging-house as a "den for the homeless."[9] Common lodging houses required payment but tended to have a small number of spaces for those who could not afford to pay. For those who were without any means, there were the Poorhouses. In 1894 there were 3 Poorhouses in Glasgow: the City

Poorhouse on Parliamentary Road, Barony Poorhouse in Barnhill, and Govan Poorhouse, Merryflats.

Following the start of the First World War, common lodging house accommodation in Glasgow fell to a minimum of about 6000 beds in 1954. A second form of accommodation emerged in the late 19th Century: working men's hotels, used for itinerant workers such as railwaymen and road hauliers. By Laidlaw's account in 1954[9] there were 6 working men's hostels accommodating 2000 individuals.

A series of welfare reform Acts in the first half of the 20th Century gradually reduced the need for individuals to stay in Poor Houses or common lodging houses. These included the National Health Service (Scotland) Act of 1947 and the National Assistance Act, 1948, which abolished the Poor Law and gave local authorities a duty to provide temporary accommodation for homelessness that "could not reasonably have been foreseen."[13] Laidlaw described the effects of the National Health Service (Scotland) Act of 1947 thus,

> "These social changes and benefits had the effect of reducing the number of vagrants… According to Gray (1931), the proportion of vagrants among the lodgers varied from 1 to 5 per cent.[sic] in 1930. Today the proportion of vagrants among those interviewed was 3.4 per cent."[9]

Laidlaw's optimism for the impact of the NHS, writing only 7 years after its inception, perhaps marks the best historical benchmark against which to judge the health of contemporary homeless people in Glasgow. The encompassing welfare reforms following the Second World War were expected to end poverty and improve the public health such that they could be scaled-back in due course. Laidlaw endorsed the intention that the NHS would be universally accessible, even by disenfranchised people in the poorest accommodation. In practice, the 1948 National Assistance Act led to local authorities providing support for mothers with children, so that families were often split and single men not provided-for at all.[28,13]

Homelessness in the United Kingdom worsened in the 1960s as a result of slum clearances, the decline in private rented accommodation[13] and the population increase following the Second World War leading to inadequate housing stock. Glasgow's respite from the depression of the 1930s was short-lived. The city's role in providing ships and armaments for the Second World War was followed by closure of most of the docks in the 1960s and 70s.

Two events in late 1966 galvanized support for the homeless in the United Kingdom. In November 1966 *Cathy Come Home*,[29] Ken Loach's documentary-style drama, was first screened on BBC television. It depicted a young family's gradually worsening social and economic circumstances that led to homelessness and having their children taken into local authority care. Debates on homelessness followed in Parliament. In December 1966 the charity Shelter had its first meeting in the crypt of St-Martin-in-the-Fields.[30] Shelter successfully campaigned for better legislation to support the homeless.

The first UK legislation on homelessness was the Housing (Homeless Persons) Act of 1977.[14] The Act was a Private Members Bill proposed by the Liberal MP Stephen Ross and supported by the then Labour government.[13] It moved the emphasis from local authorities' Social Work departments, who were principally responsible for supporting homeless families, to their housing departments. The 1977 Act was partly a response to the problem of women with children escaping domestic violence but having no rights to accommodation. The Act required that individuals were homeless (not legal tenants or owners of any property) or about to lose their accommodation within 28 days; they must have local connection (family or employment in the area); be in priority need (homeless families with dependent children and homeless people aged 60 or over); and not be intentionally homeless. These conditions defined "statutory homeless" but local authorities could also choose to support non-statutory homeless.

Despite the 1977 Homeless Act, single homeless people continued to be poorly served and homelessness increased steeply, trebling in Scotland between 1983 and 1993.[13] This was partly due to steep increases in unemployment as the last of Glasgow's heavy manufacturing industries closed, coupled with the effects of the monetarist policies of the Conservative government between 1979 and 1997. While the Conservatives cut local authority spending, which led to reductions in spending on single homeless people, in 1990 they established the Rough Sleepers' Initiative in response to a rapid increase in rough sleeping, particularly in London.[14]

A needs assessment of homelessness and health in Glasgow in 1992[31] indicated that at the time there were 1970 homeless families, 2085 hostel dwellers, about 150 rough sleepers, "40 ++" (indicating a high degree of imprecision and underestimation) abused women with or without children, and 10 pregnant girls in special accommodation – a total of 4255 prevalent homeless people not including approximately 250 travelling people who would not normally be classified as homeless. The validity of the 1970 homeless families estimate is open to question, however, as the breakdown included 1066 single people between 16 and 65 years and a further 38 single elderly. It may be that these numbers represented incident homeless applications throughout 1991.

Homeless applications remained stable from the early to mid-1990s, increased in 1996-7 and then more steeply increased in 2000-01.[32] These increases were due to rises in the number of single people while other groups remained more or less constant. In 1997 a Rough Sleepers' Initiative was established in Scotland. The Rough Sleepers' Initiative comprised £16m worth of diverse projects to work with both rough sleepers and other homeless people and ran initially from 1997 to 2000. A second phase ran from 2000 to 2003. In 1999, the Scottish Minister for Communities pledged to end the need for rough sleeping by the end of the Parliament[33] and the deputy Minister for Communities announced the formation of a Homelessness Taskforce.

The Homelessness Task Force was established by the Scottish Executive in August 1999 with the 3 aims of reviewing the nature and causes of homelessness in Scotland; examining current practice in dealing with cases of homelessness; and making recommendations on how homelessness in Scotland could best be prevented. The final report[34] of the Homelessness Taskforce, published in 2001, noted a progressive increase in applications to Scottish local authorities from 29 068 in 1989-90 to 46 023 in 1999-2000. One conclusion was that Glasgow's local authority hostels for single people should be closed and a fixed-life Homelessness Partnership established to co-ordinate the work.

In 2001, a Homelessness Partnership was created between NHS Greater Glasgow, Glasgow City Council, and Glasgow Homelessness Network (the umbrella organisation for non-statutory homeless agencies). Its principal aims were to close all local authority homeless hostels and provide more suitable accommodation. The Homelessness Partnership was also expected to reduce homelessness occurring in the first place. Needs assessments were commissioned from the author to help shape its strategy.

2.4 The extent, nature, and causes of homelessness in contemporary Glasgow

Methodological considerations in quantifying homelessness

This section is largely drawn from two needs assessments[11,12] that were produced by the author in 2003 and 2004 for the Homelessness Partnership and a further report on repeat homeless presentations[35] which together provide a detailed account of contemporary homelessness in Glasgow relevant to this thesis.

Homelessness can be quantified in terms of incident cases – people becoming newly homeless over a specified time at risk – or as prevalent cases (that is, those who are homeless at a given point in time). Both measures are important because they describe different aspects of the homeless experience. Incidence reflects determinants of homelessness and the failure of primary prevention. Prevalence reflects the failure of secondary prevention – that is, failure to identify those who are homeless and successfully resolve their homelessness. Information to define either incidence or prevalence of homelessness is imperfect. Glasgow City Council's Integrated Housing Management System, described in more detail in Section 4.4, page 139, provides the largest source of information on all applicants and their dependents who present to the Local Authority as homeless. While it does not capture information on people who present to non-statutory homeless organisations, or who are outwith any formal homeless service, over time it is likely to capture the majority of homeless adults in Glasgow. Prevalent homelessness can be estimated by counting bed numbers and occupancy rates in all known homeless accommodation. This makes inclusion of individuals within non-local authority homeless accommodation easier.

It is difficult to estimate precisely the scale of homelessness for two main reasons. The first is that prevalent homeless people are often not identified in any systematic or comprehensive way, particularly if they are not residents of statutory homeless accommodation. The second is that even when homelessness can be identified, it is often a transient but recurrent condition for an individual, without either a clear start point or a clear end point – what Williams[36] described as an "open system". It is easiest to define when it results in contact with statutory services – that is, as incidence of homeless service contact - but difficult to quantify precisely when no services are involved. In particular, homeless people who are staying at "care-of" addresses or in other non-statutory homeless accommodation (such as sleeping rough or in Women's Aid accommodation) are often not captured.

Williams and Cheal[37] used the capture-recapture technique described by Shaw[38] to estimate the prevalences of homelessness in Plymouth and Torbay. The technique was based on the assumption that N_t, the total homeless population, equals

$$N_t = (N_1 \times N_2)/M$$

where N_1 is the size of the first sample, N_2 the size of the second sample, and M the number of individuals who are common to both samples. Although arithmetically a simple calculation, the problem is that it assumes that all individuals have an equal chance of being identified in any survey, that being in one survey does not affect the likelihood of being in the other, and that the homeless population does not change in size between surveys. Williams and Cheal sampled from a variety of different statutory agencies, including housing departments, police, advice agencies, bed and breakfasts, and hostels. Three 1-week samples were gathered to test the validity of the estimates. A very high proportion of the paired samples were common to both. Of most relevance to estimating homeless prevalence in Glasgow was that the majority of Williams and Cheal's sample came from hostels or lodgings (69%), so the results added little to a simple occupied bed count. The authors, however, concluded that the consistency of results supported the validity of the methodology. As the large homeless hostels in Glasgow close as part of the

Homelessness Partnership strategy, the opportunity to easily count prevalent homelessness will diminish. The capture-recapture technique may therefore be worth re-visiting to obtain future estimates of homeless prevalence in Glasgow.

Rough sleeping

Attempts to enumerate rough sleepers in the United Kingdom began when the 1991 Census recorded, for the first time, numbers of individuals without a home and sleeping rough. A total of 2845 individuals were identified in the United Kingdom, with 145 in Scotland.[39] The results of such surveys reflect the efforts made to identify rough sleepers much more than the true prevalence of the population. For example, in the Rough Sleepers' surveys[40] individuals were identified in a week in May and October. The 1-week period prevalences in Glasgow in May 2001 were 172 and in October 2001, 137. By 2003 these had fallen to 88 in May and 100 in October. These cross-sectional surveys were taken to give evidence that the need to sleep rough had actually fallen. However, they are highly selective surveys. Those whose rough sleeping location is deliberately secretive for safety will be missed, as will those in peripheral areas such as housing estates.[41] A more precise estimate was obtained from answers to the question asked to every head of household presenting as homeless to Glasgow City Council in 2003-4, "Did you, or any member of your household, sleep rough last night?" 1166 different individuals, comprising 950 men and 216 women, reported sleeping rough the night before they presented as homeless.[12] The number reporting having slept rough in the 3 months before they presented to the Council over the same period was similar, at 1151 individuals. While this latter figure should not logically be lower than the former, it may be due to recall bias or errors in reporting and recording information. Even these figures are undoubtedly underestimates because they do not include people who slept rough and did not present to the Council. Also, they do not indicate the number of episodes of rough sleeping, as each individual is counted only once in the year. Even when services are involved, losses to follow-up are high and records of "resolved homelessness" are usually not kept.

Incidence of homelessness

The following discussion considers information on adults who attended Glasgow City Council housing services and were deemed homeless and eligible for support. These attendances are known both as "presentations" and "applications," the latter because an individual is considered to be making an application for homeless housing support.

Each calendar year around 9000 adults present to Glasgow City Council as homeless.[35] The number of individuals increased by 13.5% from 8300 in the financial year 2001-2 to 9422 in 2005-6. The total number of annual homeless applications fell by 18% between 2001 and 2006 from 13 248 to 11 246 although the fall was not consistent every year. These diverging trends were due to a reduction in repeat applications, particularly in men.[35] Repeat applications to the local authority do not necessarily indicate repeated homeless episodes, but rather failure to resolve homelessness.

The majority of applicants were male, but there was a continuous reduction in the proportion of men compared to women who presented between 2001 and 2006, falling from 67% to 59%. This was due to a fall in repeat presentations by men, while the number of female presentations remained similar over time.[35]

The incident homeless population is young compared to the general population. Statutory homeless status is conferred only on adults aged 18 and over, with children aged under 16 being looked after by Social Work Services, and special care arrangements also provided for 16 and 17 year olds. In 2003-04, about a third of homeless applicants were 25 or younger and about two thirds were 35 or younger.[12] In 2001-2, the mean age was 37.2 years (95% CI 36.8 to 37.6); in 2005-6, the mean age was significantly younger at 33.4 years (95% CI 33.1 to 33.6 years). Women were younger than men. In 2001-2, the mean age of female applicants was 35.5 years and the mean age of male applicants 38.3 years (independent samples t-test, difference 2.8, 95% CI 2.1-3.6 years). In 2005-6, the mean ages of men and women were 34.5 and 31.9 respectively (independent samples t-test, difference 2.6, 95% CI 2.2 to 3.2 years).

Prevalence of homelessness

The prevalent homeless population had a similar sex profile to the incident population, although it was strongly determined by the type of accommodation. In 2003, Glasgow City Council provided hostel accommodation comprising about 1000 beds spaces in large city-centre based hostels.[11] The Council also provided about 1300 flats, of which 1010 were temporary furnished flats, 117 supported flats for under-25 year olds and 146 flats supported by Assessment and Resettlement Officers.[11] There were about 1000 beds for homeless people provided in a variety of locations by the private and voluntary sectors.

These varied from large hostels to 5-10 bedded facilities. Social Work also purchased accommodation services for up to163 homeless people, provided exclusively by the voluntary sector. In addition, the Rough Sleeper's Initiative reported that at least 484 of their clients in the financial year 2001-02 reported having slept rough.[11] To the total of about 3300 places for known homeless people could be added an arbitrary figure of the "hidden homeless" – including those who had not sought help from statutory homeless services. These may particularly include people in unsuitable long-stay accommodation; people staying in institutions (such as hospitals) because they had nowhere else to stay, and those in insecure accommodation or unreasonable circumstances. Both the 2003 and 2004 needs assessments[11,12] suggest a prevalent figure of about 4000 homeless individuals in Glasgow.

Information on occupancy from Glasgow City Council's Integrated Housing Management System was extracted by the author on 22nd September 2004. On this date, the Council provided homeless accommodation for 1758 adults, comprising 1114 men (63%) and 805 women (46%). The two largest types of accommodation were hostels and temporary furnished flats. 84% (533 of 632 places where information on sex was available) of hostel beds and 40% (308 of 778 beds) of temporary furnished flats were occupied by men.

The prevalent population of Glasgow City Council hostel residents was older than those who presented as homeless. 15% were 25 or younger, and 45% were 35 or younger.[12]

The following maps show the geographical distribution of all dedicated homeless accommodation throughout Glasgow City in 2004 and were prepared by the author for a needs assessment.[12] These maps are Crown Copyright with all rights reserved.

Origins of homeless applicants in Glasgow

There was a supposition in Glasgow City Council that the city was a magnet for homelessness in west and central Scotland, with attendant tensions over resources allocated for homelessness for neighbouring local authorities. The most valid measure of where incident homeless cases originated, however, indicated that 88% of Glasgow's homeless applicants gave their current or last address as being within the Glasgow City Council area.[12] This probably over-estimated the proportion of indigenous homeless individuals, however, because those who have been in some form of homeless accommodation, such as a hostel, may list their last address as being within Glasgow although before becoming homeless they were not residents of the area. Information was not available to confirm this hypothesis. No area within Glasgow City could argue that it did not generate homelessness, although crude annual rates of adults who presented per 1000 population varied from 8.0 in the North West to 20.3 in the North East.

Reasons for being homeless

Homeless applicants are asked to give one reason why they are homeless when they present to a housing office. This is classified according to a standard national list, which changes slightly from year to year. For example, in 2001-2, "discharge from institution" was the fourth commonest reason for homelessness but almost disappeared in subsequent years. This is likely to be because it described discharges from prison, for which a new and specific category appeared. The single commonest reason recorded for homelessness was that an individual's family or friends would not, or could not, accommodate them. Together these comprised 36.4% of reasons for homelessness in 2003-4.[12] Discharge from prison (14.4%) and “other” (13.6%) comprised the second and third most common reasons given, respectively.[12] While friends or family no longer accommodating an individual were the commonest reasons for homelessness in both men and women, there were some differences in the prevalence of other explanations for homelessness. In 2001-2, men were more likely than women to have lost a place in a hostel (9.2% vs. 3.0% in men and women, respectively) or been discharged from prison (15.2% vs. 4.8%). Conversely, women were more likely than men to report fleeing domestic violence (17.4% vs. 1.2% in women and men, respectively).

2.5 The health of homeless people in Glasgow

There is limited research evidence on the health of homeless people in Glasgow. In this section the results from five of the highest quality studies are critically appraised. These comprise two analyses of deaths from drugs published in 2000[42] and 2002,[43] a large and well-conducted survey on mental health carried out in 1999,[44] a survey of alcohol related brain damage in homeless hostel dwellers[45] and an estimate of cancer incidence in hostel dwellers.[46] The findings of surveys and needs assessments that were not conducted using validated methods are not considered in detail, here, nor is research from earlier periods when the demographics and health problems of the homeless in Glasgow may have been different. A structured questionnaire survey[47] of 16-25 year olds in Glasgow in 2001-2 and several of the quarterly Rough Sleeping Initiative Core Data Reports[16] were carried out contemporaneously with the cohort study described later in this thesis. However, both these reports suffered from selection and misclassification biases that undermined their scientific validity.

One of the largest and most rigorous surveys of the health of homeless people in the United Kingdom – and the largest in Glasgow – was carried out by Kershaw and others in 1999.[44] The work was commissioned as part of Greater Glasgow Health Board's mental health strategy to explore the particular mental health problems of homeless people. It therefore focussed on mental health and associated health behaviours. 225 individuals were interviewed, selected from hostels run by statutory and voluntary services and from those who had used drop-in centres and had slept rough at some point in the previous week. It did not include homeless families. Validated scoring systems for mental health (CIS-R) and alcohol use (AUDIT) were used. Kershaw found that 73% of respondents had at least one clinically significant neurotic symptom and 6% probably had a psychotic disorder.[44] Drug dependency and hazardous drinking affected 25% and 54% of the sample, respectively, and 82% of respondents were current smokers. However, although 19% of the sample had a history of drug injecting, the report contained no reference to blood borne viruses such as HIV, hepatitis B, or hepatitis C. At the time of the study the prevalence of hepatitis C among injecting drug users was between 72% and 79%.[48,49] Thus about 15% of homeless people would have been expected to be hepatitis C positive. Similarly, no mention was made of tuberculosis, for which excessive alcohol consumption and poor nutrition among homeless people are risk factors.

Kershaw's survey[44] therefore illustrates three main problems of cross-sectional studies: selection biases; information or measurement biases; and inability to establish temporal relationships between exposures and outcomes. Selection biases include the sample being older and having a greater proportion of men than the homeless population; inevitably it did not include those who had died as a result of ill health or who were in hospital; and neither represented homeless families nor homeless people who might be in less hazardous environments. Information biases came from using self-reported information, in particular under-reporting of stigmatised or latent diseases such as tuberculosis, HIV and hepatitis C. And the cross-sectional nature of the information meant that it was not possible to determine the temporal relationship between homelessness and any given factor. It seems at least plausible that anxiety, followed by increased use of alcohol and drugs to lessen it, might increase after becoming homeless rather than only being precipitating factors for homelessness itself.

Given Kershaw's findings of high prevalence of drug use, hazardous drinking, and smoking,[44] the following 3 papers assess drug deaths, alcohol related brain damage and cancer incidence in the Glasgow homeless population.

The numbers of drug deaths in Glasgow homeless hostels increased in consecutive years between 1990 and 1999 from 0 to 16.[42] Of a total 61 deaths, 59 were in intravenous drug users and 79% due to drug overdose, principally heroin. A statistically non-significant increase in deaths was found between September and December. The authors did not attempt to relate numbers of deaths to any denominator but as no major increase in provision of hostel beds occurred throughout the decade it seems reasonable to conclude that the risk increased. A subsequent analysis of all 87 drug deaths in the year 1999 in Glasgow[43] found that 29% had been homeless at some time in the year before death.

Again, no attempt was made to estimate the risk among the homeless population nor to infer whether homelessness was a cause or consequence of illicit drug use.

Kershaw reported that 54% of the homeless were hazardous drinkers,[44] a high prevalence of alcohol-related brain damage (ARBD) might be anticipated. Gilchrist and Morrison's[45] survey comprised a two-stage assessment of a purposive sample of 266 homeless hostel dwellers in Glasgow in 2003. Initial assessments of cognitive impairment (using Addenbrooke's Cognitive Examination) and alcohol dependence in the previous year (using the Fast Alcohol Screening Test) and previous week (using the Leeds Dependence Questionnaire) were carried out by non-specialist research staff. Hostel dwellers with evidence of hazardous drinking and cognitive impairment were referred to a second stage where they underwent clinical assessment for alcohol related brain damage by a psychiatrist and psychologist. The majority of the sample was male (89%) and the mean age 53 years. Alcohol problems were common, with 78% drinking hazardously and 61% meeting the criteria for lifetime alcohol dependence. 82% of the sample had cognitive impairment. After clinical examination, the authors found the age-adjusted prevalence of alcohol related brain damage to be 21% (95% CI 16-26%). The study suffered from selection biases at a number of points. Patients who had died of alcohol related causes would be excluded from the sample population, as well as those who did not consent to participate because of alcohol related brain damage. Follow-up within the study was poor, with only 58% of eligible patients (that is, those with potential ARBD) being seen by a psychologist and psychiatrist for clinical examination. However, the age-specific prevalences from the final sample were applied to the original study sample to adjust for selection bias by age.

Lamont estimated cancer incidence rates in residents of 10 large Glasgow homeless hostels for men between 1975 and 1993.[46] Cancer Registry cases were identified by death record postcodes indicating they were residents of large homeless hostels. Rates were calculated on the assumption that each hostel was fully occupied so each bed contributed a full person-year of observation each year. A sensitivity analysis, assuming 75% occupancy, was also carried out. To refine the crude incidence rate, the population structure of homeless men who participated in a dental questionnaire survey in Leeds[50] was assumed to apply. However, reliable cross-sectional data on Glasgow hostel residents[11,12] indicates that they were younger than the Leeds population. As a result, age-adjusted mortality rates will tend to over-estimate cancer incidence because incidence increases with age. Proportional incidence ratios (PIRs) were also calculated by applying West of Scotland age, sex, and socio-economic specific incidence rates to the assumed age-structure of the hostel population, and then creating incidence ratios of observed/expected. A limitation of this technique is that ratios can only be compared when overall incidence rates between populations are the same[51] and the very high smoking and alcohol prevalences in the homeless (see Section 2.6) suggest that cancers of the lung and head and neck were likely to be much higher. The study reported that the cancers with the highest incident number were those of the lung (49.0%), oral cavity and pharynx (5.1%), and stomach and colo-rectum (each 4.7%). Cancers with the relatively highest incidence rates, however, were of the oral cavity and pharynx (PIR 2.3, 95% CI 1.4-4.0), larynx (PIR 1.7, 95% CI 0.9-3.2), and oesophagus (PIR 1.6, 95% CI 0.9-2.9). Standardised incidence ratios against the West of Scotland population were similar. Assuming 75% hostel occupancy reduced the time-at-risk by a quarter and therefore increased the calculated incidence rates. The authors noted that the incidence ratio of some cancers was not raised in the homeless although socio-economic deprivation was a risk factor. Stomach cancer, bladder and colorectal cancers, according to SMRs supplied by the authors, had a higher incidence in more deprived areas.

SMRs provide a method of comparing age and sex-adjusted death rate ratios between sample populations and a standard population. The ratio is usually multiplied by 100, so that the null value of the standard population is 1x100, but less frequently the simple ratio is quoted.

The results reported by Lamont[46] are certainly plausible given both their consistency with other deprived local populations and with the risks reported by Kershaw[44] – with high levels of cigarette smoking, hazardous drinking, and poor nutrition. However, the assumptions about hostel populations are questionable. Hostels experience a high turnover of residents[11] and length of stay is strongly determined by age.[11] The majority of residents under 30 years old stay for less 4 weeks; while over 40, the majority of residents stay for over 4 months. Thus, while Lamont presented an interesting event rate, it is difficult to interpret this in terms of the actual risk experienced by an individual resident of a homeless hostel. The absence of women, families, or those who were not in other homeless circumstances (such as sleeping rough, living in temporary furnished accommodation, and others) also limits the generalisability of this study. It also underlines the need for a study using a true cohort design to capture actual person-time at risk.

In summary, the most methodologically rigorous studies on the health of homeless people in Glasgow indicated increasing risks of death from drugs[42] and high prevalences of neurotic and psychotic symptoms, drug dependency and hazardous drinking.[44] The prevalence of alcohol related brain damage among Glasgow hostel residents was around 21%.[45] Cancers of the oro-pharynx and lung were common[46] but there were significant methodological limitations of the methods used to estimate incidence that indicated the need for new research.

2.6 Self-reported health and health behaviours in homeless people

Because there is limited evidence available specifically on the health of homeless people in Glasgow, evidence on homeless people's health more generally is now considered. In this section critical appraisals are made of the three largest surveys on health behaviours of homeless people in the United Kingdom, a survey of psychiatric symptoms in hostel residents in Oxford and literature on HIV/AIDS. There follow reviews of literature on hospitalisations and then deaths in the homeless.

Surveys of self-reported health in United Kingdom homeless

Gill and others[52] carried out the most extensive survey of psychiatric morbidity in the homeless that has been published, as part of the OPCS Surveys of Psychiatric Morbidity in Great Britain. This extensive set of interviews resulted in a 238-page report, and a relatively brief critical appraisal of the methodology and results will be given here. Findings on residents of hostels, private sector leased and short life accommodation, adults staying in night shelters, and people sleeping rough between July and August 1994 were reported separately. Rough sleepers were sampled through their use of day centres, potentially biasing this sample towards more organised or resourceful individuals. 235 of the 456 housing departments in Great Britain reported that they had homeless hostels. A representative sample was drawn from each hostel, based on local information about the age structure of residents within the 16 to 64 age group. Questions covered prevalence of psychiatric illness, use of services and treatment, and lifestyle factors such as alcohol, tobacco and drug use and validated assessment tools were employed, namely the Clinical Interview Scheduled – Revised (CIS-R),[53] the Psychosis Screening Questionnaire (PSQ),[54] and the General Health schedule of the GHQ12[55] for self-completion. Most response rates were 68% or higher but only 44% of private and social landlords responded. These are impressive response rates for hard-to-reach populations. 70% of hostel residents were men, a third aged 16-24, and a quarter aged 25-34 years. In contrast, 63% of those living in private sector leased accommodation (PSLA) were women although the age distribution was very similar to that in hostels. Nightshelter users comprised 89% men with 29% aged 16-24, 31% 25-34 and the remaining 40% aged 35-64.

While much information was presented in the report[52] a brief summary is given here. Arguably, all types of homeless circumstances are relevant to this thesis as the analysis does not discriminate between individuals whose previous or subsequent homeless circumstances included rough sleeping, hostel accommodation, private sector leased accommodation, or rough sleeping and the use of night shelters.

Prevalence of potential neurotic illnesses such as depression and anxiety was 38% in hostel residents and 35% for residents of private sector leased accommodation (PSLA). After pilot work the authors found that the survey instrument, CIS-R, was not feasible for use on nightshelters users. Presumably this was also the case for rough sleepers, but there was no mention of the CIS-R in the relevant section. Using the General Health Questionnaire threshold of 4 or more to equate to a CIS-R of 12 or more, 59% of nightshelter residents and 57% of rough sleepers were psychiatric “cases” compared with 39% of hostel residents and 42% of PSLA residents. For both nightshelter users and rough sleepers, follow-up interviews to determine psychotic symptoms had poor response rates and prevalence estimates were likely to be biased. The prevalence of psychotic illnesses was 8% among hostel residents, 2% among PSLA residents. No final estimate of psychosis was made for nightshelter users or rough sleepers. 16% of hostel residents, 3% of PSLA residents, 44% of nightshelter residents, and 50% of rough sleepers were alcohol dependent and 6% of hostel residents, 1% of PSLA residents, and 12% of rough sleepers were dependent on non-cannabinoid drugs. Smoking rates ranged from 16% of PSLA residents - which was lower than the contemporaneous UK national average[56] - to 90% of rough sleepers. No reliable final estimates of alcohol or drug use were provided for nightshelter users.

Gill and others' survey[52] indicates the practical difficulties in obtaining valid morbidity estimates among homeless people, particularly the most itinerant groups who use nightshelters or sleep rough. Consistent CIS-R scores could not be obtained from all 4 homeless groups that were interviewed. However, some general conclusions can be made from these extensive surveys. There were high levels of mental illness, drug, alcohol, and cigarette use among homeless individuals throughout the UK consistent with those in the

Glasgow homeless population.[44] Where comparisons can be made, the prevalence of psychiatric "caseness" increased with greater homeless vulnerability from hostel residents, to PSLA residents, to nightshelter users, to rough sleepers. The high prevalence of psychotic illness in hostel residents (8%) compared with PSLA residents (2%) is not readily explained and unfortunately comparisons with the other two homeless groups could not reliably be made. Drug and alcohol use were less clearly related to vulnerability, as might be perceived. Rough sleepers and nightshelter residents had very high levels of alcohol dependence (50% and 44%, respectively) while PSLA residents had lower levels than the general population (3% vs. 5% in the general population[52]). Drug use was also highest in hostel users followed by rough sleepers. Selection biases are likely to significantly affect some of these estimates. However, the findings of Gill's survey should not be dismissed. They raise questions about whether, if mental illness and substance misuse are causal factors for homelessness, better preventive services might reduce the risk of homelessness. They may also indicate a high level of need for specialist services, although this is not an automatic conclusion. For example, rough sleepers who are alcohol dependent are unlikely to have the prerequisite social stability to allow them to engage with an alcohol treatment programme. Resolution of homelessness may be a necessary first step.

Bines[57] presented the findings of two surveys of single homeless people both carried out in 1991. The first source of data came from a national survey of homeless people carried out by the Centre for Housing Policy at the University of York, which sampled hostels dwellers, those living in bed and breakfasts, and rough sleepers who used day centres and "soup runs."[57] The second survey came from the first wave of the British Household Panel

Study in 1991, the Living in Britain Survey. Details of the sampling methodology were not given but Bines described them as nationally representative. It allowed comparisons to be made between the general and homeless populations using the same survey methodology. Results from both surveys were reported together and the discussion supplemented with quotations from homeless people as part of the Department of the Environment study Quarterly Homelessness Returns. Bines reported one or more health problems in 55% of the general population and between 62% and 78% of the homeless. Those in more vulnerable homeless circumstances reported greater health problems. Diagnostic groups were self-reported and no validation was attempted. However, the most common health problems in homeless and non-homeless groups were musculoskeletal (24% - 42% of the homeless vs. 23% of the general population) and depression, anxiety or nerves (28% - 40% of the homeless vs. 5% of the general population). After standardisation for age and sex, the highest ratios of morbidity were for fits or loss of consciousness (Standardised Morbidity Ratio, 1982) and depression (SMR, 1152). Up to 55% of homeless women and 37% of homeless men reported mental health problems, compared to 7% and 3% of the general female and male populations, respectively. Alcohol problems were reported to be common but specific numbers from either survey were not provided. Registrations with a GP were 61% among day centre users and 80% in hostel and bed and breakfast residents.

The third survey that has been appraised is Westlake and George's[58] survey of single homeless people in Sheffield to determine prevalence of mental illness. This survey of self-reported symptoms, using validated tools, was carried out over a 12-hour period although the date of the study was not given (the paper was published in 1994). The sample included residents of a variety of types of accommodation but not rough sleepers. The completion rate appeared to be 88% although no exact figure was provided. Results were compared to a survey from a non-homeless London population surveyed in 1982 using the Nottingham Health Profile.[59] Total and component scores (energy, pain, emotional reactions, sleep, social isolation, and physical mobility) of the Nottingham Health Profile were statistically significantly higher in the homeless compared to the general population. The authors also found that the Nottingham Health Profile scores were significantly associated with self-reported psychiatric problems but only the social isolation and physical mobility components were significantly associated with previous psychiatric inpatient admissions. The authors suggested that those with a history of psychiatric inpatient care were older, which may have accounted for their poorer physical mobility, but they seemed reluctant to accept the finding of social isolation. On the face of it, the effects of psychiatric admissions and mental illness might logically, if unfairly, seem likely causes of social isolation.

Psychiatric symptoms in Oxford hostel residents

Marshall[60] described the severity of psychiatric symptoms among 48 residents of two homeless hostels in Oxford in the late 1980s. The sample was chosen by hostel workers who were asked to identify individuals with severe and enduring mental illness. Thus, the study did not attempt to assess the prevalence of psychiatric morbidity but given that only 5 of the 48 participants had no clinically significant psychiatric symptoms, it might be inferred that at least 31% (43/146 residents) were mentally ill. Validated psychiatric assessment questionnaires were administered by the paper's author. Marshall found that while all subjects had been drug and alcohol free for 2 weeks prior to interview, lifetime prevalences of drug and alcohol problems were 21% and 27% respectively. 48% of interviewees had severe handicap and 26% moderate handicap, indicating that they would be unlikely to cope independently if discharged from the hostel. 37% of the sample had clinically significant neurotic symptoms and 67% had florid psychotic symptoms. The author concluded that homeless hostels in 1989 were becoming inadequate alternatives to long stay psychiatric wards following changes to care in the community.

HIV/AIDS

Although Human Immunodeficiency Virus (HIV) and Acquired Immuno-Deficiency Syndrome (AIDS) featured in a number of studies on homeless people, much of the literature describes risk behaviour and educational interventions to prevent infection. A number of papers that comment on HIV/AIDS or risk factors, such as injecting drug use, are discussed below in homeless hospital populations.[61,62,63,64,65] The conspicuous absence of HIV or other blood-borne viruses in self-reported surveys has also been noted.[44]

In this section a brief review is made of six studies that describe HIV prevalence in the homeless and one that describes the impact of highly active anti-retroviral therapy (HAART) on its prevalence.

Beech and others[66] reported on prevalence of HIV among 150 homeless adolescents (14 to 23 year olds) in Memphis. 70% of the sample were male, typical for most homeless populations and for that in Glasgow.[11, 12] 16% were HIV positive. Pfeifer[67] reported on a similar sample of homeless 14-24 year olds in Hollywood, California. 11.5% were HIV positive on testing. Surratt and Inciardi[68] found no significant differences between HIV infection rates in homeless (22.5%) and non-homeless (24.9%) female sex workers in Miami. They hypothesised that the female sex workers cycled in and out of homelessness and thus the distinction between homeless and non-homeless was not valid.

Herndon and others[69] reported on HIV prevalence in urban homeless women in Los Angeles County, California, in 1997. The results came from self-reports obtained by interviews. 68% of homeless women reported that they had been tested for HIV in the previous year and 1.6% of the total sample said they were HIV positive. Those who were tested were likely to be systematically different from those who were not. In particular, pregnancy was the most common reason for obtaining an HIV test. Thus a more chaotic and at-risk third of the homeless population may have had significantly higher HIV prevalence.

Klinkenberg[70] reported on the prevalence of HIV, hepatitis B and hepatitis C among 172 homeless patients with severe mental illness and substance use disorders in Missouri. Two-year follow-up included HIV testing. HIV prevalence at baseline was 6.2% and no patients developed infection during follow-up. The majority of HIV-positive patients were male and African-American, largely reflecting the fact that 78% of the sample was male and 69% African-American. 44% of the sample had either hepatitis B or C, and 18% had both. Small numbers may partly have been responsible for the lack of statistically significant results and wide confidence intervals but schizophrenia and drug use significantly raised the odds of having hepatitis B infection. Empfield's[71] study on 203 hospitalised homeless mentally ill patients from 1989 to 1991 in New York City can be compared with Klinkenberg's results.[70] HIV prevalence was 6.4%. Prevalence was greater in patients under 40 years old and no sex difference was found.

Pulvirenti and others[72] considered the impact of highly active anti-retroviral therapy (HAART) on 6045 hospitalisations for HIV/AIDS in an inner city hospital serving predominantly poor people in Chicago from 2000 to 2005 inclusive. They stated that among reductions in admissions for many HIV-related conditions was a fall in homeless admissions between the two dates. However, there was an overall increase in HIV-related admissions. Other, non-HIV infectious diseases admissions did not increase over the period.

In conclusion, three large surveys of self-reported health in UK homeless populations and a survey of Oxford hostel residents identified high prevalences of self-reported physical and mental morbidity compared with the general population. Alcohol and drug dependence prevalences of 40-50% were reported. More vulnerable homeless circumstances (for example, sleeping rough compared with living in a hostel) were associated with higher prevalences of ill health. Homelessness was associated with increased prevalence of HIV due to high prevalences of risk behaviours, such as injecting drug use and sex working. HIV infection rates in homeless adolescents of 12-16% have been reported.[66,67] The lowest HIV prevalence reported was among urban homeless women,[69] a self-reported 2%, and the highest, of 23%, among female sex workers.[68] The introduction of HAART therapy appears to have reduced hospitalisations for HIV treatment[72] in the homeless as well as other non-homeless populations. New analyses are needed that reflect the longstanding availability of HAART in the United Kingdom as well as its HIV infection rates in high risk groups.

While all surveys used validated health assessment tools, none triangulated their findings with objective measures of health. These surveys indicate a need for more robust quantitative evidence on the health of homeless people. The next two sections therefore consider literature on hospitalisations and deaths in the homeless.

2.7 Hospital admissions by homeless people

The literature on hospitalisation patterns in homeless people can be broadly divided into four groups: those that encompass general admissions and papers that focus specifically on mental health, alcohol, and tuberculosis. Literature on each of these topics in turn is critically appraised below.

General hospitalisations

Eleven of the highest quality studies on general hospitalisation patterns in the homeless have been considered, here. The majority are cross-sectional in design, taking inpatient data over a period and cross-tabulating proportions of patients with different characteristics. There were two cohort studies - one from Honolulu[61] and one from Chicago[62] - and one was a case-control study.[73] These three methodologically strongest studies are reviewed first before considering the evidence from the largest and most rigorous cross-sectional studies. A summary of these papers is provided in Table 2 on page 79.

Martell and others[61] carried out a retrospective cohort study on homeless hospitalisations by users of the Kalihi-Palama Health Care for the Homeless Project in Honolulu, Hawaii. Rates of hospitalisation among the homeless were compared with age and sex adjusted Hawaii state general population rates. Half of the homeless cohort was under 35 years and a further third between 35 and 45 years. Three quarters were male and 49% white. Their age and sex demographics were therefore similar to the Glasgow homeless population.[11, 12] One per cent were HIV positive. Seventeen percent of the cohort had at least one acute hospital admission and 3% were admitted to the state psychiatric hospital.[61] The mean length of stay among the homeless was 10 days compared with the state average of 8 days. Acute hospital admission rates among the homeless were 5.6 times greater than the general population (542 vs. 96 per 1000 person-years). Unfortunately, diagnosis-specific admission rates were not provided, only numbers and proportions of patients. Psychiatric admissions were the most common diagnostic group (80 individuals), with schizophrenia being the commonest single diagnosis. Traumatic diagnoses were the second commonest group (50 individuals), with fractures and dislocations, blunt trauma and lacerations among the most frequent diagnoses. 35 patients were admitted for cellulitis, 25 for addiction to alcohol or substance abuse, and 14 for symptoms of withdrawal from alcohol. 19 patients were admitted for neurological disorders – an even mixture of seizures, syncope, and transient ischaemic attacks and strokes. Only 1 patient was admitted with HIV related causes, and apart from cellulitis, no other infectious diseases were recorded. The main limitations of this retrospective cohort study design were in selection biases. Patients who died during or after hospitalisation and those that did not use the Health Care for the Homeless Project would be excluded. These are likely to result in a more healthy or health-care seeking population under study. These biases could be mitigated by a prospective cohort design.

Buchanan and others[62] presented results from the only prospective cohort study of homeless hospitalisations that was identified by the literature search. The study quantified the effects of respite care on health care use in a selected group of homeless adults. It described 12 months' follow-up of individuals who had been identified as homeless while hospital inpatients and then referred to a local respite care centre in Chicago. Because demand for respite care exceeded supply, a comparison of health care use between two cohorts could be made: homeless individuals who did and did not receive respite centre support. The respite care cohort spent significantly fewer days as inpatients (3 vs. 8 days, $p<0.002$), had non-significantly fewer emergency department visits (1 vs. 2, $p=0.09$) and non-significantly greater outpatient clinic visits (7 vs. 6, $p=0.6$).[62] There was a significant 11.3 day reduction among the respite care cohort in inpatient bed days used in 12 months by patients whose presenting condition was HIV/AIDS. Unfortunately, the opportunity to calculate admission rates was missed and the generalisability of its findings limited because a condition of being considered for respite care was being drug and alcohol free.

A case-control study in Massachusetts[73] in the early 1990s compared female homeless shelter users (cases) with women from low-income households (controls). A variety of measures of health service use and health-related behaviours was assessed. Housed women scored higher, indicating better health, on all component parts of the SF-36 described in the paper (physical functioning, role functioning-physical, bodily pain and social functioning) although mental component scores of the SF-36, for example, were not presented. Differences in SF-36, self-reported chronic health conditions, obesity, smoking, drug injecting and alcohol did not achieve conventional statistical significance although they consistently found homeless mothers to be in poorer health. Homeless women were twice as likely to have been hospitalised in the previous year compared to women from low-income households.[73] Homeless women were significantly less likely to have a regular source of care (89% versus 96%) and were more likely to use both outpatients and hospital emergency departments (3% vs. 0%). Homeless women reported significantly more barriers to care in the previous year, particularly because of lack of transportation, lack of knowledge about services, being busy with other priorities, having no child care, and feeling depressed. However, homeless women also reported being twice as likely to have been tested for tuberculosis. Two limitations of this study are that it appeared to be under-powered to confirm potentially important differences between homeless and deprived women and that comparisons with deprived women underestimate the magnitude of poor health in homeless women compared to the general population. A further point is that although the authors describe their study as a “case-control” it lies somewhere between being a case-control study and a cross-sectional survey because there is not a hypothesis that homelessness is an outcome and the self-reported health measures risk factors for it. As with any case-control study, it was not possible to determine the temporal and therefore causal relationship between risk factors and outcomes.

The remainder of this section considers evidence from cross-sectional studies of hospital records.

Salit's analysis of nearly 19 000 admissions to New York City public hospitals[74] in the early 1990s, like Weinreb's case-control study,[75] compared the homeless to low-income patients. Salit's[74] homeless sample comprised 82% men, with a third under 35 years old and 88% under 55 years, again demographically similar to the Glasgow incident homeless population,[11, 12] although in New York 56% were black, and 21% each Hispanic and white. Compared with non-homeless patients, the homeless were more likely to be male, black and middle-aged. The excess in men is consistent with the demographics of the homeless population and was also found in a Canadian analysis[76] but the older age compared to the non-homeless is not consistent. The majority of homeless individuals, 80%, were insured by Medicaid. As with Morris's[77] San Diego analysis, Salit compared proportions of all diagnoses in homeless, public hospital, and Medicaid private hospital patients and therefore all proportions added up to 100%. Thus for all "excess" diagnoses in homeless people there were the same percentage of deficit diagnoses, often spread across a number of diagnostic groups. The results did not compare rates of hospitalisation between different groups. The most common principal diagnoses among the homeless were substance abuse (29% of all admissions), mental illness (23%), respiratory disorders (17%), AIDS (17%) and trauma (13%). By comparison, 22% of discharges by Medicaid patients in private hospitals and 9% of public hospital discharges were due to substance abuse. This pattern may be explained by the relatively poor provision of inpatient addictions services in public compared to private hospitals. Discharges for mental illness comprised 9% and 5% of public hospital and private Medicaid hospital discharges, respectively.

Raynault's comparison between homeless and non-homeless deprived admissions in Montreal similarly reported that admissions for organic psychoses and functional psychoses were increased with odds of 6 and 11 respectively.[76] Discharges due to AIDS were 11% in Medicaid private hospital discharges and 6% in public hospital patients. The authors therefore highlighted the excess of substance abuse, mental illness, AIDS and trauma among the homeless. They did not, however, balance their perspective by commenting on the corollary – lower rates of a large number of other conditions, including diseases of the circulatory system (8% of homeless discharges, 17% of non-homeless). A low rate of circulatory diseases in the homeless was also observed in homeless hospitalisations in Montreal.[76] Moreover, percentages of diagnoses were divided into substance abuse plus mental illness, and "other". The "other" group was then presented as percentages of 100. Thus, 52% of homeless discharges are due to substance abuse and mental illness but the remaining 48% of admissions are presented as percentages of themselves. This means, for example, that AIDS discharges in the homeless, at 17%, represent 17% of 48% of "other" diagnoses, while in private hospital patients, AIDS discharges are 11% of 73% of "other" diagnoses. Both in fact represent the same proportion - 8% - of all discharges.

Several approaches to calculating lengths of stay were presented for the New York City analysis[74] but the consistent finding was of longer lengths of stay in homeless of 3 to 5 days compared with non-homeless individuals. Excess lengths of stay in the homeless were greatest for mental illnesses and shortest for the treatment of trauma and substance abuse. Patients who discharged themselves against medical advice and those with hospital stays over 150 days were excluded from the analyses. Both may be more common among the homeless than non-homeless and thus introduce a bias toward shorter stays in this group; that is, true homeless lengths of stay may be even longer than reported. The authors concluded that two approaches were needed to reduce the excess of mental illness and substance abuse admissions by homeless people in New York City. The first was better preventive treatment and the second was more accessible housing to which to discharge homeless people so that excess lengths of stay might be reduced. These conclusions were echoed in the accompanying editorial by Starr,[78] who identified rising housing costs in New York City since the 1970s, deinstitutionalization of the mentally ill, and increasing prevalence of street drugs as causal factors in homelessness and ill health. Starr concluded that these risk factors were all highly mutable and "upstream" preventive action was needed.

Discharge from the armed services is often followed by homelessness and thus the Veterans Affairs Medical Centers in the United States treat a high proportion of homeless adults. About 70 million Americans, a quarter of the population, are eligible for Veterans Affairs benefits and services because they are veterans, family members or survivors of veterans.[79] Adams and others'[80]analysis of veterans' hospital use found that homeless patients were significantly more likely to be Black (35% vs. 21%), single (89% vs. 57%)

and earn less than $10 000 per year (77% vs. 56%) compared to non-homeless veterans. A significantly greater proportion of homeless patients were discharged with a psychiatric diagnosis (42% vs. 22%) or substance abuse (38% vs. 7%) with a correspondingly lower proportion with diseases of other major systems. Homeless individuals were younger by 3-18 years than non-homeless patients, in contrast to no difference in age found between the groups in the San Diego County Medical Services.[77] Several selection biases might affect the findings of Adams's study.[80] The results came from annual 1-day surveys, and may therefore have been subject to selection in favour of patients with longer inpatient stays – another example of Neyman bias. Those excluded because of lack of data were significantly more likely to be homeless (23% vs. 12%). Thirdly, the data only represented patients within the Veterans Administration system and not the general homeless population.

The most common diagnoses in homeless admissions in the San Diego County Medical Services study[77] in the mid-1980s were disorders of the skin, subcutaneous tissue and breast (21%) within which cellulitis was the commonest single diagnosis (13% of all). The proportion of admissions in the non-homeless due to this group of diagnoses was 9%. The ratio of diagnoses of substance use and substance-induced organic mental disorders was 5.2 compared with the non-homeless. Both observations were significant at the $p<0.001$ level.

Victor and others[81] analysed general hospital use by residents of bed and breakfast hotels in London in the late 1980s. The analysis comprised a one-month sample of inpatient admissions to two general hospitals, a 1-in-4 sample of paediatric outpatients over 1 year, and attendances at one casualty department over 1 week. The authors reported an admission rate for local residents of 3 compared with 13 per 1000 per month in the bed and breakfast population, "giving a one month admission odds ratio of 4.5 (90% confidence interval 3.6 to 5.5)." As these were admission risks, the ratio was a risk ratio and the use of a 90% confidence interval was unusual. In the paediatric clinic, 94% of homeless children and 86% of the general population were referred directly to the clinic. In the casualty department attendance rates were 4 per 1000 from the general population and 10 per 1000 among hotel dwellers. Hotel residents were younger and less likely to be registered with a GP than the general population. The two key weaknesses of this study were firstly in the method used to estimate the bed and breakfast population, and misclassification biases if bed and breakfast residents were not homeless. For example, the average homeless family size was estimated to be 3 but no justification was given for this number. Secondly, turnover of residents in bed and breakfast was likely to be high. Notably, 6 inpatients recorded as having no fixed abode were excluded from the study. Undoubtedly this analysis took much time to gather new data without electronic patient records and may indicate high rates of use of hospital services by bed and breakfast residents but the methodology was imprecise and highlights the difficulties of using ecological homeless population data to estimate event rates.

One explanation for the poor health of the homeless is that they are unable to access appropriate health care. Kushel and others[82] described barriers to health care among the 1996 National Survey of Homeless Assistance Providers and Clients, a nationally representative sample of homeless service users. Lang[83] analysed patterns of emergency department use at two sites in France to determine the degree to which they were being used for non-emergency treatment in lieu of primary care. The demographics of the National Survey of Homeless Assistance Providers and Clients was similar to those in other studies of homeless hospitalisations: two thirds were male and about two fifths each were white and African American.[82] Forty-five percent were “literally homeless” as opposed to living in poor quality or insecure accommodation. The health profile found that half had a comorbid illness. Two fifths each had mental health conditions, alcohol abuse, and drug abuse in the past year. About a third had visited an emergency department and a quarter had been hospitalised in the year preceding the survey. Barriers to health care were assessed by asking respondents if they had been unable to receive health care they thought they needed and then separately performing a logistic regression to determine characteristics of individuals who reported barriers. Having health insurance, which only 44% of respondents had, was associated with greater use of ambulatory care (OR 2.5), hospitalisation (OR 2.6) and lower reporting of barriers to needed care (OR 0.4). The authors therefore concluded that more widespread provision of health insurance might improve the health of homeless people by reducing barriers to receiving necessary medical care. A limitation of the study is that it was performed only on service users: those who experienced barriers that actually stopped them using health services would not be included. It is therefore likely that the study underestimated the effects of the factors that it analysed as perceived barriers to health care – age, sex, race, being a veteran, true homelessness, locale, insurance, comorbid illnesses, mental illness, and substance abuse. Of these, only health insurance and number of comorbid illnesses were statistically significantly associated with likelihood of being unable to receive needed care. It was also the case that the study could only determine the characteristics of those who reported being unable to receive necessary medical care and it was therefore subject to reporting bias – that is, some individuals may have been more likely to report barriers independently of whether they encountered them. It should also be noted that the sample may have been too small to detect differences between groups that existed. A number of factors appeared to be consistently associated with increased odds of reporting barriers to access (for example, mental health condition, alcohol abuse, and drug abuse) but confidence intervals were wide and included the null value of 1.

Lang's[83] cross-sectional survey in 1993-94 in two French cities used a validated tool to determine whether emergency department cases were urgent or not. About a third of visits were considered to be for non-urgent reasons, with a slightly higher proportion in Paris than in the regional university hospital at Besançon (35% vs. 29%).[83] This was largely explained by the higher proportion of homeless individuals using emergency departments for non-urgent reasons in Paris (14%) compared with Besançon (4%). The odds of non-urgent to urgent use of the emergency department in homeless compared to non-homeless individuals was 2.0 but did not achieve statistical significance. One conclusion from the study was that homeless people used emergency departments in the absence of planned primary care.

Lim and others[84] assessed homeless women's access to medical care by surveying homeless women in shelters and soup lines in Los Angeles County in 1997. The main analysis comprised multivariable logistic regression on outpatient, inpatient and health screening using a range of potential risk factors including demographic, health behaviours, social and economic factors, and health status assessed using the RAND Physical Function Scale. They found that 30% of their sample had been hospitalised (although the Discussion repeatedly used a figure of 35%), 89% had at least one outpatient visit, and 92% had at least one health screen in the 12 months before interview. Women living on the streets were least likely to have been hospitalised. Multivariable analysis found few significant results. However, having health insurance increased the probability of hospitalisation nearly three-fold as did having a regular source of care. The authors concluded that greater availability of health insurance and a regular source of care might improve access to health care among homeless women. While this may be true, one problem with this analysis was that its measure of health at the time of interview was of limited value in assessing whether women were in need of hospital inpatient care in the previous 12 months. There may also have been confounding in that women who were in poorer health and were unable to obtain access to health care may have been more likely to become and remain homeless.

In summary, the literature on homeless general hospitalisations in North America and Europe shows consistent patterns of higher probabilities of admission than deprived non-homeless populations. These may be due to a mixture of high levels of morbidity and lack of access to preventive primary care. Most of the literature is cross-sectional and is therefore often performed on unrepresentative samples of the homeless. It is also unable to describe absolute risks.

Table 2. General hospitalisations in the homeless: summary of papers.

Study	Population	Design	Main results	Comments
Martell[61]	Kalihi-Palama Health Care for the Homeless Project patients, Hawaii, 1988-90.	Retrospective cohort comparing homeless with age, sex adjusted general population rates	Admission rates 5.6 times higher in homeless (542 vs. 96 per 10^3 person-years. Mean length of stay homeless 10 days vs. general pop^n 8 days. Commonest diagnoses psychiatric, trauma, cellulitis and alcohol-related.	Survivor and other selection biases limit generalisability.
Buchanan[62]	Patients discharged into homelessness, Chicago, Illinois, 1998-2000.	Prospective cohort comparing those who did and did not receive respite care.	Respite care associated with fewer inpatient days (3 vs. 8 days), fewer emergency department visits (1 vs. 2, n/s), greater outpatient visits (7 vs. 6, n/s), 11.3 fewer inpatient bed-days per year in HIV/AIDS patients.	Admission rates and risks not calculated. Respite care only offered to alcohol and drug free homeless.
Weinreb[73]	Female shelter users, Worcester, Massachusetts, 1992-5.	Case-control – female shelter users (cases) and low-income women (controls)	Shelter users scored lower (poorer health) on all SF-36 components, were twice as likely to have been hospitalised in previous year, less likely to have regular source of care, more likely to use outpatient and emergency room services, twice as likely to have had TB tests.	Temporal relationship between homelessness and health cannot be established.
Salit[74]	Homeless inpatients, New York City, New York, 1992-3.	Cross-sectional study comparing homeless and non-homeless inpatients.	Most common diagnoses in homeless were substance abuse (29%), mental illness (23%), respiratory disorders (17%). Lengths of stay 3-5 days longer in homeless.	Rates, risks and temporality cannot be reported. Proportions only.
Raynault[76]	Inpatient admissions, Montreal, Quebec, 1992.	Cross-sectional study of homeless and non-homeless deprived hospitalisations	ORs in homeless for organic psychoses 6 and for functional psychoses 11 compared with deprived non-homeless. Also excess substance abuse, and trauma in homeless. Homeless AIDS discharges 6-11% of all. Lower proportion of cardiovascular diseases in homeless	Rates, risks and temporality cannot be reported. Proportions only.

Table 2 (continued). General hospitalisations in the homeless: summary of papers.

Study	Population	Design	Main results	Comments
Adams[80]	Veterans Affairs Medical Centers, USA, 1996-98.	Cross-sectional comparison of homeless and non-homeless inpatients.	Homeless vs. non-homeless: psychiatric diagnosis 42% vs. 22%; substance abuse 38% vs. 7%. Homeless 3-18 years younger.	Proportions of admissions not rates; only VA users.
Morris[77]	Inpatients to San Diego County, California, 1985-6.	Cross-sectional comparison of homeless and non-homeless inpatients.	Commonest homeless diagnosis skin disorders 21% vs. 9% in non-homeless. Homeless had higher proportion of substance use and substance-induced organic mental disorders and lower proportion of circulatory diseases.	Proportions of admissions not rates.
Victor[81]	A&E, inpatient and paediatric outpatients, London, 1987-88.	Cross-sectional survey comparing bed and breakfast residents to general population.	Inpatient admissions in homeless 12.6 vs. 2.8 per 10^3 per month in general population, OR 4.5. Direct referrals to paediatric outpatient clinic 94% in homeless vs. 86% in general population. A&E attendance rates10 vs. 3.8 per 10^3 in homeless and general population.	Validity of denominator estimates uncertain.
Kushel[82]	National Survey of Homeless Assistance Providers and Clients, USA, 1996.	Cross-sectional survey of nationally representative sample of homeless healthcare users.	Use of ambulatory care associated with 3 or more comorbidities, health insurance, female sex, and less vulnerable homeless circumstances. Emergency department use associated with mental illness and 2 comorbidities. Hospitalisation in the prior year associated with having insurance.	Selection bias in including only service users; no comparison with non-homeless made.
Lang[83]	A&E patients in Paris and Besançon, France, 1993-4.	Cross-sectional survey of urgency of A&E patients.	29-35% homeless patients deemed non-urgent. OR non-urgent in homeless vs. non-homeless 2.0 (n/s).	Rates and risks not provided.
Lim[84]	Homeless women in shelters and soup lines, Los Angeles County, California, 1997.	Cross-sectional community-based survey.	30% had been hospitalised, 89% ≥1 outpatient visit, 92% ≥1 health screen in previous year. Health insurance and regular source of care associated with 3-fold increase in hospitalisation.	Temporal relationship between risks and outcomes not known.

Mental health

Three of the methodologically strongest studies on homeless hospitalisations for mental illness are considered in this section. The first is a prospective study of psychiatric admissions in Australia, the second a large cross-sectional analysis using Veterans Affairs data from the United Sates, and the third a case-series from Switzerland. A summary of their findings is provided in Table 3 on page 84.

Carter[85] performed a 6-year prospective study on a cohort of patients who had been admitted to a general hospital in Newcastle, Australia, for deliberate self-poisoning. Patients were followed-up for subsequent psychiatric hospitalisations. The results therefore do not represent the experience of either homeless or other community populations. Further, the opportunity to calculate risks was not taken, only odds of admission in a logistic regression model. However, they do indicate that homelessness was associated with a 3-fold increase in odds of psychiatric hospitalisation following self-poisoning. This made homelessness the third greatest risk factor for psychiatric hospitalisation next to having a suicide plan or high ideation, or having a major longstanding psychotic illness.

Sajatovic[86] analysed correlates with bipolar disorder among veterans treated under the Veterans Affairs services from 1998 to "the present" in a paper published in 2006. The characteristics of 10 264 veterans with bipolar disease only were compared with 4668 patients who had comorbidities, such as post-traumatic stress disorder, anxiety, dementia or substance abuse. As noted in other studies using Veterans Affairs clinical data,[80,86] the population was on average 70 years old and 95% male, making it older and with fewer women than the Glasgow homeless population.[11, 12] The use of χ^2 across 5 diagnostic groups (bipolar disease alone or with 4 other comorbid conditions) in Sajatovic's analysis[86] was of limited value. The prevalence of homelessness in these first 4 groups ranged from 0.9% to 1.9% making the prevalence of homelessness among comorbid substance abuse patients, at 13.2%, of a different order of magnitude. It is not clear, therefore, whether the smaller differences observed between other comorbidities were significant or the overall χ^2 of $p<0.0001$ reflected the effect of substance abuse alone.

Lauber and others[87] reported a large descriptive case-series on the characteristics of homeless psychiatric discharges in the Canton of Zürich, Switzerland, from 1996 to 2001. One percent of all admissions were deemed homeless in that they had no permanent accommodation on discharge. Nearly three quarters were men and the mean age was 32 years, making them demographically similar to the Glasgow incident homeless population.[11, 12] Homeless psychiatric inpatients were more likely to be single (74% vs. 44%) and male (72% vs. 48%) compared with non-homeless patients. Homeless patients were more likely to have disorders related to illicit drug use (18% vs. 6%), multiple drug use (33% vs. 7%), and dual diagnosis (29% vs. 17%) but less likely to have an affective disorder (17% vs. 21%). A third of admissions were compulsory in both homeless and non-homeless patients but while just over half were irregular discharges in the homeless just under a fifth were in the non-homeless. Although point estimates showed differences in male and female diagnostic casemix in the homeless, only schizophrenia and other psychotic disorders, and affective disorders, showed significant sex differences with the former being more common in men and the latter more common in women. Multiple regression analysis found, perhaps unsurprisingly, that the largest risk factor for homelessness on discharge was being homeless on admission. Drug use and being single raised the risk of homelessness on discharge by threefold. Thus Lauber[87] identified a high prevalence of drug related major mental illnesses among young homeless men who often fail to resolve their homelessness after inpatient psychiatric care.

In summary, homelessness is associated with greater likelihood of psychiatric admission following self-poisoning and is associated with greater psychiatric co-morbidities. Results were consistent in North America, Europe and Australia. Substance misuse is more common among homeless psychiatric inpatients compared to the non-homeless. The only cohort studied identified in the literature search did not quantify the risks of hospitalisation for psychiatric illness, indicating a need for new cohort studies comparing risks of mental health hospitalisations in homeless and non-homeless populations.

Table 3. Hospitalisations for mental health in the homeless: summary of papers.

Study	Population	Design	Main results	Comments
Carter[85]	Patients admitted to general hospital for self-poisoning, Newcastle, Australia, 1996-2002.	Prospective cohort of psychiatric hospitalisation following discharge.	Homelessness increases odds of psychiatric hospitalisation 3 times.	Most patients not homeless; risks not calculated.
Sajatovic[86]	National Psychosis Registry of Veterans Affairs patients, USA, 1988-?2005	2-year prospective cohort after diagnosis of bipolar affective disorder.	13% of patients with bipolar disorder and substance abuse were homeless: homeless prevalence 0.9-1.9% of other diagnostic groups.	Risks not presented; interpretation of statistical analysis imprecise.
Lauber[87]	Psychiatric inpatients, Zürich, 1996-2001.	Case-series comparing patients homeless on discharge with non-homeless.	Homeless psychiatric patients more likely to be male (72% vs. 48%), single (74% vs. 44%), illicit drug users (18% vs. 6%), multiple drug use (33% vs. 7%) and dual diagnosis (29% vs. 17%).	Descriptive but not hypothesis-testing design.

Alcohol

The high prevalence of hazardous alcohol consumption in the homeless has been noted in surveys described earlier.[44,45,52,57] There have also been references to hospital admissions for alcohol related conditions in some of the papers reviewing homeless hospitalisations more generally.[61,73] Takano's survey of male welfare institution residents in Tokyo also described high prevalences of alcoholic psychosis, dependence syndrome and cirrhosis.[88] However, in this section a critical appraisal is made of research that focuses specifically on homeless hospitalisations for alcohol related conditions. The results are summarised in Table 4 on page 88.

Palepu and others[64] presented analyses from the HIV Alcohol Longitudinal Cohort (HIV-ALC), a cohort in which patients with both HIV and alcohol problems were recruited in Boston, Massachusetts, between 1997 and 2001. The principal research question was whether being engaged in substance abuse treatment services reduced hospitalisations. Self-reported hospitalisations in the 6 months before up to 7 sequential interviews were recorded. No significant relationship was found between engagement in treatment services and hospitalisations. Homelessness was significantly associated with being twice as likely to have been hospitalised in the 6 months prior to any interview.

A follow-up study[65] of the HIV-ALC cohort compared homeless and non-homeless participants in further detail. A multivariable regression model was used to predict self-reported use of ambulatory, emergency room and inpatient hospital care over time. Female sex was associated with increased use of all three health services. Homelessness was associated with non-significant increases in the use of ambulatory care, and, confirming Palepu's earlier analysis,[64] a statistically significant doubling in use of both emergency room and inpatients beds. The authors therefore concluded that being homeless increased the use of emergency departments and hospitals among HIV infected individuals. A particular strength of this study was that re-interviewing allowed a more precise classification of homelessness, so that individuals whose homeless status changed over time could be reclassified. However, it was not possible to say exactly whether homelessness precipitated the need for medical care, followed it, or was non-causally associated with it. As health-care use was self-reported, these data may also have been subject to information biases. Lastly, results from the study can only be applied to patients with the dual diagnoses of HIV and alcohol, a much smaller population than those with alcohol problems alone.

Larson[63] carried out a methodologically similar analysis of 6-month retrospective reports of hospital use to the HIV-ALC study[64,65] over the same period and also in Boston, Massachusetts. The study determined the use of emergency department and inpatient care by patients who were about to enter a detoxification programme and did not have primary care cover. The mean age of participants was 36 years and 75% were men (which was similar to the incident homeless in Glasgow[11, 12]) 46% were black and 37% white. Nearly half of participants had spent at least a month in a homeless shelter in the previous 5 years. Homeless patients had twice the odds of emergency department use in the previous 6 months after controlling for other medical needs. Larson thus corroborated the findings of the HIV-ALC study.[64,65]

Two limitations of these study designs were that they demonstrated an association but did not measure either the risk of hospitalisation among homeless individuals with alcohol problems or the temporal, and therefore causal, relationship between alcohol problems, homelessness, and hospital treatment.

Copeland and Indig[89] reported on the characteristics of clients of alcohol and drug services in New South Wales in 2000-1. Again, the sample was demographically very similar to the incident homeless Glasgow population.[11, 12] 9% of clients described themselves as being homeless or having no usual residence. Principal drugs used overall were alcohol (37%), heroin (33%), and cannabis (10%). Among the homeless, principal drugs were alcohol (14%), heroin (10%) and cannabis (4%). The homeless were 1.6 times more likely to receive referral to another service than those living in other situations. Homeless clients were less likely to receive an outpatient withdrawal service rather than a residential one. The homeless also spent significantly fewer days in residential withdrawal services than those with other accommodation, although there were no differences in lengths of stay.

In summary, North American and Australian literature provides consistent results that compared with non-homeless individuals with alcohol problems, the homeless are twice as likely to receive emergency department or inpatient care. These repeat cross-sectional study designs suffer from potentially large selection biases. Homeless patients may be less likely to participate in research, or be inpatients, or have died – all excluding them from study. Prospective cohort studies are therefore indicated to compare the risks of hospitalisation for alcohol-related problems in the homeless with the general population.

Table 4. Hospitalisations for alcohol problems in the homeless: summary of papers.

Study	Population	Design	Main results	Comments
Palepu[64]	HIV Alcohol Longitudinal Cohort, Boston, Massachusetts, 1997-2001.	Prospective cohort comparing hospitalisations in patients receiving and not receiving substance abuse treatment	Homelessness doubles likelihood of hospitalisation among patients with HIV and alcohol problems.	Prospective design a strength; self-reported use only; specialist sub-group of homeless.
Kim[65]	HIV Alcohol Longitudinal Cohort, Boston, Massachusetts, 1997-2001.	Prospective cohort comparing ambulatory, emergency room and inpatient hospital use in patients receiving and not receiving substance abuse treatment	Homelessness increased use of ambulatory care (n/s) and doubled odds of emergency room attendance and inpatient hospitalisation.	Prospective design a strength; self-reported use only; specialist sub-group of homeless.
Larson[63]	Residential detoxification patients, Boston, Massachusetts, 1997-99.	Cross-sectional describing hospital and emergency department use in prior 6 months	47% in a homeless shelter for at least 1 month in past 5 years. OR of emergency department use in homeless 1.9.	Corroborates similar work;[65,64] self-reported.
Copeland[89]	Addiction services clients, New South Wales, Australia, 2000-1.	Cross-sectional description of clients' characteristics.	Among homeless, main drugs used were alcohol (14%), heroin (10%) and cannabis (4%). Homeless 1.6 times more likely to be referred to other services than non-homeless. Homeless less likely to receive outpatient care and fewer days in residential withdrawal services.	Risks not available; only service users so absolute prevalences not known.

Drugs

High prevalences of homeless self-reported drug use,[44,52] drug deaths[42] and hospitalisations among female shelter uses[73] have been described earlier in this section. A common theme to the critical appraisal of these cross-sectional studies is that they were unable to determine the temporal sequence, if any, that related homelessness to drug use. Winkleby and others[90] aimed to explore this relationship. They conducted a nurse-led cross-sectional survey of 1437 homeless adults who used three National Guard armouries, which provided half of all homeless shelter beds for the Santa Clara County of California. The survey was carried out between November 1989 and March 1990 and achieved at 98% response rate. Respondents were asked about substance misuse and psychiatric illness before and since becoming homeless and results were compared to non-homeless responses from three Californian surveys. Homeless lifetime, prehomeless prevalence and non-homeless prevalences were reported.[90] Period-prevalence is something of a misnomer as it captures both incidence and prevalence,[19] so there are important differences in what these three measures describe. Homeless lifetime prevalence presumably included all incidences of substance misuse and hospitalisation over an individual's life, while prehomeless prevalence described, necessarily, a shorter sub-category of time. Non-homeless prevalence was probably a true cross-sectional prevalence proportion that did not include cumulative incidence. Thus Winkleby's method was biased towards describing the highest "prevalence" in currently homeless people, a lower prevalence in the prehomeless, and the lowest in the non-homeless general population. The authors acknowledged several limitations of their methodology – those of cross-sectional study designs, validation of self-reported responses, and selection of the homeless sample – but not their assimilation of different forms of prevalence and incidence measures. The paper reported that the odds of drinking alcohol to excess before becoming homeless, compared to non-homeless individuals, were 2.3 and 4.0 in men and women, respectively. Illegal drug use was 1.4 and 1.9 times higher in pre-homeless compared to non-homeless men and women, respectively, and psychiatric hospitalisation odds were 4.6 and 5.9 in men and women. Exact percentages were not provided, but a bar chart suggested that in most cases the homeless lifetime prevalence was about 5% higher than the pre-homeless prevalence. While the authors reported that "the prevalences of substance abuse and psychiatric hospitalization before homelessness… … were 15% to 33% lower than lifetime prevalences" this appeared to describe the differences between non-homeless and homeless groups. It is tempting to conclude that the study[90] indicated that the individuals who became homeless had much higher prevalences of substance misuse and psychiatric illness than the general population, and that becoming homeless added a smaller but significant additional risk. However intuitive this conclusion is, Winkleby's[90] methodology makes it unsound.

Tuberculosis

Tuberculosis has historically had a close relationship with homelessness. It was the third equal most common cause of death among Glasgow's common lodging-house and working men's hotels in 1953.[9] The majority of recent research on tuberculosis in the homeless comprises evaluations of the effectiveness of different treatment strategies[91,92,93,94,95,96] rather than descriptions of prevalence, incidence, hospitalisation or mortality. Hwang's systematic review of effective healthcare interventions in the homeless[97,98] noted that cash incentives improved attendance for an initial tuberculin test.[99] In people with tuberculosis, directly observed therapy, cash incentives,[95,100,101] and non-cash vouchers[100,101] at each visit were equally effective in improving course completion rates. The references given in Hwang's review,[97] however, are to Rotheram-Borus's work[102,103] on HIV risk behaviour and not to the tuberculosis trials.

Marks and Taylor described hospitalisation rates for tuberculosis in a prospective 6-month cohort study of 1365 adults with tuberculosis in 10 public health departments across the United States identified by the Centers for Disease Control in 1995-6.[104,105,106] In Marks's paper[104] the number of homeless patients was not stated but a comparison was made between homeless and non-homeless patients. The text reports, without figures, that homeless tuberculosis patients were more likely to be male, aged 25 to 44 years, or non-Hispanic Black compared with non-homeless patients. These are typical of the demographics of homeless adults in the USA. A quarter of homeless tuberculosis patients were also HIV positive, compared with 12% of non-homeless patients. Homelessness was associated with significantly raised odds of being hospitalised for tuberculosis (OR 1.4) but the difference became non-significant after adjustment for age, sex, race, substance use and HIV status. Homeless patients with HIV, however, were at increased risk (OR 1.7) of hospitalisation for tuberculosis. Three quarters of homeless patients were hospitalised at least once during 6 months' follow-up, compared with half of other patients. From a hospital perspective, 15% of patients admitted for tuberculosis were homeless. Homeless hospitalisation rates for tuberculosis were 107.3 per 100 person-years compared with 70.4 for non-homeless patients.[104] Median lengths of stay were 6 days longer in homeless compared with non-homeless patients (18 vs. 12 days). The combination of homelessness and lack of medical insurance was associated with odds of a long hospital stay (not defined in the paper) of 1.8. As with other North American studies, there are particular issues around race, health insurance, and healthcare costs that are not easily translated into European or British contexts. Marks's study[104] was not able to estimate the true risk of hospitalisation for tuberculosis in homeless people, only the risk among those who were diagnosed with the infection and recorded by the Centers for Disease Control. Without knowing infection rates in the whole homeless and non-homeless populations, the relative risks cannot be estimated. Patients who died were excluded from multivariable analyses, introducing a possible selection bias if sicker homeless individuals were removed. The numbers of deaths were not provided. Taylor's analysis[105,106] of the same 1995 cohort also reported that homeless patients were at raised risk (risk ratio 2.5) of being hospitalised during community treatment.

In summary, the historical relationship between tuberculosis and homelessness[9] remains an important one and there has been a focus on research evaluating the most effective treatment strategies. Prospective analyses of homeless patients diagnosed with tuberculosis indicates that they are at twice the risk of being admitted to hospital for treatment than the non-homeless, lengths of stay are longer, and HIV is more prevalent.

2.8 Deaths in homeless people

The last topic on homeless health that is reviewed concerns deaths. Most of the methodologically highest quality literature on homeless health is in this area. As a health measure, deaths have several advantages. They are comprehensively collected in accessible registers in all developed countries. This makes prospective cohort studies of deaths in homeless people relatively easy and helps to address the limitations of cross-sectional surveys, which are unable to describe temporal relationships between homelessness and health. Death is also an unequivocal health state, in contrast to some self-reported behaviours and conditions. One of the main limitations of using deaths data, however, is that homeless populations are generally young and might therefore be expected to have low absolute death rates. Also, deaths are only useful measures of fatal conditions and are not sensitive measures of health behaviours, chronic non-fatal illnesses or most mental health disorders. The findings of the papers reviewed in this section are summarised in Table 5 on page 107.

Much of the literature on the health of homeless people comprises cross-sectional survey methodologies. The homeless charity Crisis produced two reports on homeless deaths that have been widely quoted. The first, *Sick to Death of Homelessness*,[107] was published in 1992 and updated in *Still dying for a home*[17] four years later. *Sick to Death of Homelessness*[107] described the findings from a case-series of 86 homeless coroners' reports of homeless deaths from the 10 London boroughs in 1991-92. The mean age at death was 47 years in the 68 cases where age was known. The commonest causes of death were suicide (23%), other natural causes (17%) and joint third, pneumonia and hypothermia, and drug overdose (13%). Alcohol was the principal cause of death in 5% of cases but included in 14% of all death certificates. The authors also calculated a crude annual death rate of 3085 per 100 000 and an excess mortality ratio of 2.8 using the 1991 Census denominator for inner London homeless. The methodology of the latter estimate was not clear. Coroners' reports are a selective group of deaths and the authors estimated that only half of deaths in the homeless were reported to a Coroner. The first of five conclusions to the report was that a longitudinal study of hospital admissions and deaths in the homeless was needed.[107]

Still Dying for a Home[17] reported on 74 coroners' records of homeless deaths in London, Bristol and Manchester from 1995 to 1996. The average age at death, 42 years, was 5 years younger than the previous study[107] but the causes of death were similar. Aside from a higher proportion of deaths from natural causes (34% compared with 17% in 1991-92) proportions of deaths by suicide, pneumonia and drugs were within 1 percent of the estimates 4 years earlier. The excess mortality ratio was higher than previously estimated at between 3.8 and 5.6.[17]

Hanzlick and Parrish[108] reported on a case-series of 128 death certificates of homeless people in Fulton County, Georgia, from 1988 to 1990. The mean age at death was 46 years and 98% were men. About half of deaths occurred in public places or vacant buildings. 55% of homeless deaths were from natural causes (compared with 60% of the local general population) and both homicide and suicide (in contrast to Crisis's findings[17,107]) were less common than in the general population at 8% and 3% of deaths in the homeless compared with 15% and 5% in the non-homeless, respectively. However, non-vehicular accidents were much more common in the homeless compared with the general population (27% vs. 10%). The estimated crude death rate in the homeless was between 281 and 426 per 100 000 depending on the denominator used. The authors concluded that patterns of death in the homeless were broadly similar to those of the non-homeless general population. Two limitations of this study were in the validity of the estimated size of the homeless population used to create mortality rates, and in misclassification biases in death records that may have under-classified homelessness and therefore biased any observed difference in death rates to the null.

Nine large cohort studies have been carried out on mortality among homeless people. Three are from Europe (England,[109,110] Copenhagen,[111] and Stockholm[112]), three are from large American cities on the eastern seaboard,[113,114,115] two are from Canada[116,117,118,119] and one is from Australia.[120] They have been reviewed in these three geographical groups, below.

Deaths in European homeless

Shaw and Dorling reported on two homeless populations in England. Their first analysis[109] was a response to Roy's[119] letter on Montreal street youth. Their second[110] reported on deaths in three different homeless circumstances. The initial study[109] used data from the homeless charity Crisis,[17] who had identified death certificates for men in 1995 and 1996 in which "no fixed abode" was entered. They found death rates of 41.1 per 1000 in 16-29 year olds; 71.9 per 1000 in 30-44 year olds; and 157.6 per 1000 in 45-64 year olds. These translated into Standardised Mortality Ratios of 3732 in 16-29 year olds; 3127 in 30-44 year olds; and 2074 in 45-64 year olds. A particular limitation of this study was that denominator data for the number of rough sleepers was likely to be imprecise and greatly undercounted. This would lead to greatly increased apparent SMRs. In contrast to North American literature, below, death risks in the English sample were not found to be at their highest in the youngest age group. It seems likely that this was because the excess mortality caused by HIV/AIDS and homicides, which dominate North American causes of death in younger homeless people, are not features of the UK homeless population.

Shaw and Dorling[110] later presented findings on mortality among homeless people in three groups: male rough sleepers in London; male hostel residents in Oxford; and male and female residents of bed and breakfasts/bedsits in Brighton. For the first analysis on male rough sleepers in London, they used the numerator data presented by Grenier[17] for males in the year September 1995 to August 1996 inclusive. As with their earlier study,[109] their assumptions on the size of the denominator for rough sleepers, this time taken from the 1991 Census, were unlikely to be accurate either at the time or when their study took place, 4-5 years later. Standardised Mortality Ratios were 3732 for males aged 16-29 year olds, 3127 for 30-44 year olds, and 2074 for 45-64 year olds. The all-age male SMR was "over 2500" although the precise figure was not given. The second analysis was on individuals whose last residence was in one Oxford homeless hostel from 1981 to 1992. They found death rates of 12.6 per 10 000 and 52.0 per 10 000 for 16-44 year old and 45-64 year old men respectively.[110] Although death rates were higher in the older group, SMRs were lower - 731 and 684 in the younger and older groups respectively. Absolute numbers of deaths were small – 39 – making these SMR estimates imprecise and not statistically significant for 16-44 year olds. The third series,[110] on residents of bed and breakfasts and bedsits in 1981-92, was based in Brighton because the 1991 Census found that the town had the highest rough sleeping rate in the United Kingdom. The analysis included "notorious" accommodation in poor repair. It is difficult to validate whether the latter group of residents would be considered homeless or very socio-economically deprived. It is important to note that the Brighton analysis was carried out on small areas containing bed and breakfasts or bedsits, not on residents of individual properties. Thus, it must have included accommodation that was no longer used by the Council to temporarily house homeless individuals. This misclassification bias would result in an underestimate of true death risks because lower-risk, non-homeless individuals were included. Male death rates were 4.5 per 10 000 in 16-44 year olds and 51.1 per 10 000 in 45-64 year olds, yielding SMRs of 260 and 673 respectively.[110] Female death rates were 2.7 per 10 000 in 16-44 year olds and 2.6 per 10 000 in 45-64 year olds, yielding SMRs of 436 and 550 respectively. Finally, SMRs were converted into life expectancies. These were 42 years for rough sleepers (the same as in Crisis's later report[17]), 63 years for hostel residents, and 67 years for bed and breakfast residents. These analyses all suffered from significant potential errors from non-valid estimates of the denominators at risk. They underline the need to obtain absolute numbers at risk and have precise person-time at risk data.

A 10-year prospective cohort study of homeless hostel residents in Copenhagen[111] found standardised mortality ratios for women of 5.6 and 2.8 in men. Several imprecise diagnoses – including suicide, natural causes, and unintentional injuries were significantly higher than the general population. The SMR for unintentional injuries was 14.6 and for unknown causes, 62.9. Deaths rates were particularly high in 15-34 year olds.

Beijer[112] reported on a five-year prospective cohort of 82 homeless men who had been in contact with a community-based mental health outreach team in Stockholm. The SMR among this group was 4.7 times the general population, with higher risks among drug users. After 5 years' follow-up, three quarters of the cohort remained homeless, indicating a chronic mixture of social vulnerability and mental illness.

Deaths in North American homeless

Hwang and others reported on homeless adults who had used the Boston Health Care for the Homeless Program and subsequently died between 1988 and 1993 in two studies. In the first,[121] erroneously described as a case-control study in its title, a cross-sectional study was carried out to determine use of health services in the year prior to death. The most frequent causes of death were HIV/AIDS (19%), heart disease (17%), and cancer (11%). Overall, 27% of those who died had no health care contacts in the year before death. However, 20% had 6 or more outpatient visits. Logistic regression identified the 3 largest unadjusted odds ratios of any health care contact in the year before death were 2.6 associated with HIV infection, 2.2 with injecting drug use, and 2.1 with cocaine abuse.[121] The authors concluded that health care was underused among this group of homeless individuals. Selection bias is a particular problem with this approach, making inferences about "risk factors" of questionable validity. Apart from selection in death records and healthcare use, the cohort comprised only one sub-group of the United Kingdom "homeless" criteria. Certainly, patients with chronic diseases (including HIV, drug and alcohol abuse, and mental illness) had an increased likelihood of having used health care resources, which seems appropriate. Deaths from external causes (including murder, suicide, motor vehicle injuries) comprised 19% of deaths. In these cases, it is difficult to argue that a particular health service intervention might have reduced the risk of death.

Hwang used the same dataset from the Boston Health Care for the Homeless Program in a prospective cohort study of deaths.[115] The mean age at death was 47, and the crude mortality rate of persons aged 18 to 64 was 1114 per 100 000 person-years. Although the oldest death occurred in an 86 year old, a cut-off of 64 was used because numbers of older individuals were very small and therefore likely to skew age-standardised rates. Age-specific and race-adjusted rate ratios for death in 18-24 years olds were 5.9 in men and 11.8 in women; in 25-44 year olds they were 3.0 in men and 3.9 in women; and in 45-64 year olds mortality rate ratios were 1.6 in men and 1.5 in women.[115] All were statistically significant at the 95% level. Homicide was the commonest cause of death in all 18-24 years olds and in women aged 25 to 44.[115] AIDS was the leading causes of death among 25 to 44 year olds (both sexes combined). Age- and race-standardised death rates per 100 000 from AIDS were 481.9 in black men, 331.4 in white men, 232.4 in black women, and 65.6 in white women. In persons aged 45 to 64 years, heart disease was the commonest cause of death. The limitations of both of Hwang's Boston studies[121,115] are that only those who used the Health Care for the Homeless Program were included; homeless status could not be guaranteed throughout the whole period of observation; deaths outwith Massachusetts were not included; and misclassification errors in death certificates were likely. A further limitation is that while standardisation compares the study population with that of the age, sex and ethnically matched local population, it does not provide information that can be readily compared with other populations. Stratum-specific rates would have been preferable.

Standardised mortality ratios for New York City shelter users between 1987 and 1994 were 3.9 in men and 4.7 in women when the US population was used.[114] These SMRs fell to 2.2 in men and 3.7 in women when the New York City population was used as the standard, reflecting the high death rate, particularly from HIV and particularly among young men, in New York. A prospective cohort study of homeless people in Philadelphia, Pennsylvania[113] reported on a cohort comprising adults who had used either the mental health program (which identified homeless persons as those on the street between 6 pm and midnight and who stated that they had no place to stay and no money to pay for lodging) or the Office of Services for Homeless Adults (which referred homeless people to a network of shelters) between 1985 and 1998. Of the 60% for whom age was known, the mean was 34 years. The crude mortality rate was 7.7 per 1000 person-years of observation. Crude mortality rates were highest in white men (8.9 per 1000 person-years) and lowest in white women (5.4 per 1000 person-years).[113] Deaths were strongly seasonally patterned, with 53% occurring in the 4 summer months June to September. The commonest causes of death were injuries (21%), heart disease (19%), and "ill-defined" causes (16%). Where data on age were available, a rate-ratio was calculated to compare deaths with the general population of Philadelphia. The death rate ratios were 4.5 in white women and 2.2 in non-white women. Death rate ratios were 4.9 in white men and 1.6 in non-white men although the latter estimate was not statistically significant. Generally, the greatest risk of death occurred in younger people and diminished with increasing age, contrasting with results from England in which death rates were lowest in the youngest homeless adults.[109, 110]

Years of life lost before 75 were also calculated for race/ethnic, age, and sex-matched Philadelphia populations in 1987 for comparison. Numbers of years of life lost per 10 000 person-years were 97 in the general population and 345 in the homeless cohort.[113] The differences were largest in white men and women, possibly because non-homeless white people have relatively few years of life lost.

Deaths in Canadian homeless

Hwang followed his Boston cross-sectional study[121] with a retrospective cohort study of men who had used a homeless shelter in Toronto in 1995.[118] A similar study[117] on a cohort of women using Toronto homeless shelters in 2002 was also performed. All homeless shelter admissions throughout Toronto were routinely compiled on a single central database. Death rates were calculated until censor on 31 December 1997. 92% of eligible men, 8933 individuals, entered the cohort and 201 (2%) died. The crude mortality rate was 876 per 100 000 person-years and risk of death increased with age. Compared to the general population relative risks of death were 8.3 among 18-24 year olds, 3.7 among 25-44 year olds, and 2.3 among 45-64 year olds. All were statistically significant at the 95% level. No seasonal trend in death rates was found, in contrast to the summer excess reported in Pennsylvania.[113] The highest standardised mortality rates were among 45-64 years olds (225.7 per 100 000 person-years for cancer, and 200.6 per 100 000 person-years for cerebrovascular disease) although risk ratios were 0.9 and 1.4 respectively.[118] These low risk ratios may be because of competing causes at younger ages. For example, among 25-44 year olds, high death rates for AIDS (114.8 per 100 000 person-years in 25-44 year olds, RR 1.7); and unintentional poisonings (113.2 per 100 000 person-years, RR 14.4) were noted. The authors also compared death rates with studies in Philadelphia, New York, and Boston and noted that the Toronto rates were lower.[118] This may partly have been because samples from Boston[121] and Philadelphia[113] included individuals living on the street and thus at higher risk. Also, Canada has universal health insurance that should not present the barriers to care of the US system.

Hwang[122] published an analysis of the same male Toronto cohort two years later, focussing on whether the risk of death was related to the pattern of homelessness – that is, transitional, episodic, or chronic. The hypothesis was that the risk of death might increase during periods of actual homelessness. The study is relevant to this thesis, because homeless status after entry into the cohort was not known. Univariate analysis found that age, being homeless in the month of death, and episodic homelessness were statistically significant risk factors for death.[122] In the multivariable model age and homelessness in the month before death were statistically significant when the latter was modelled as a dichotomous variable, but recent homelessness ceased to be statistically significant when it was entered as a continuous variable. It is not possible to disentangle the causal relationship between actual homelessness at the time of death and other confounding risk factors for both homelessness and death itself. For example, it might be assumed that declining health led to a return to a homeless shelter and was then followed by death. However, Hwang[122] does reasonably propose that the hazards of being homeless are in themselves risk factors for death, particularly for murder and suicide. Cross-sectional studies[109] suggest that people living on the street have higher mortality than those in shelters, and those who are housed have lower mortality still. In conclusion, this study[122] found only that age was a significant risk factor for death in Toronto homeless shelter users, and that there was no significant risk associated with patterns of homelessness, including actual homelessness in the month before death.

Cheung and Hwang's[117] parallel study of single homeless women was conducted among Toronto homeless shelter users in 1995. Women with dependent children and those using facilities solely for victims of domestic violence were excluded. The same methodology for the male Toronto shelter users' study was employed.[118] In addition, a literature review identified papers on mortality rates in comparable homeless individuals. 26 deaths occurred among 1981 single women followed-up for a mean period of 2.6 years. The mean age at death was 39 years. The crude mortality rate was 498 per 100 000 person-years. The authors calculated death rates among women, divided into "young" and "old" strata using varying definitions of these two groups in each study and then compared their rate ratios with age-matched local general populations. In the Toronto cohort, the death rate ratio compared to the general population was 10.1 in women aged 18-44, and 1.2 in women aged 45-64 years. The highest rate ratios were in the considerably younger Montreal population aged 14-25 years, which was 31.2. In all cases, death rates were significantly raised above the general population level at younger ages, but in the older group none of the rate ratios was significantly raised above the null value of 1 in any of the 7 cities that were included. Because the total numbers of deaths was small (21 in 18-44 year olds, and 6 in 45-64 year olds) the precision of estimates of the causes of death in describing the true proportions of all deaths is likely to be subject to much random error. However, HIV/AIDS, and poisoning (unintentional, undetermined, or purposeful) comprised 9/21 (43%) of deaths among the young group. These findings indicate that the very high excess risk of death among younger homeless women might be attenuated via specific programmes to prevent and treat HIV/AIDS, and, perhaps less convincingly, through "addressing" mental health issues. A final analysis was presented comparing death risk ratios between men and women in each of the 7 cities. In the majority of cases (Toronto,[118,117] Montreal,[119,116] Copenhagen,[111] New York,[114] Philadelphia,[113] and Brighton[110]) there was no significant difference between age-specific death risks in younger women and men. While the authors concluded that death risks were "much" lower in the 45-64 year age group (rate ratios from 0.3 to 0.7) in most cities, it appears that only Boston and New York confidence intervals did not include the null value of 1. In summary, the paper indicated a high excess risk of death among homeless women under 45 in a number of American and European cities. As with other studies on homeless deaths – particularly those in North America in the 1980s to mid-1990s – findings were dominated by the effects of HIV/AIDS. They may have limited applicability to the United Kingdom because of the introduction of highly-active antiretroviral therapy (HAART) in the mid-1990s, and universal health care provided by the NHS.

Roy and others presented their prospective cohort study of street youth in Montreal initially as a research letter[119] published in 1998, which reported on the prospective follow-up of 517 street youths. In this earlier paper, a standardised mortality ratio of 31.2 was reported in females and 9.2 in males. A subsequent paper,[116] presenting a longer follow-up of the Montreal street youth, was published in 2004. Participants were excluded from follow-up once they reached 30 years old, so an average follow-up period of 33.4 months was achieved. The paper appeared to assume that death records were complete and therefore all deaths had been identified from eligible participants. Results were standardised using the Quebec general population. The SMR was 11.1 in males and 13.5

in females[116] in the second paper, but 9.2 and 31.2 in males and females, respectively, in the initial letter.[119] Cox regression identified HIV infection, daily alcohol use, homelessness in the last 6 months, drug injecting, and being male as particular risk factors for death. Nine of 10 deaths had a confirmed cause: 4 were due to suicide by hanging, 3 died from drug overdoses, 1 died in a road traffic accident, and 1 died from liver failure after fulminant hepatitis A.

Deaths in Australian homeless

Babidge and others[120] carried out a 10-year cohort study of deaths among homeless psychiatric patients in Sydney, Australia. Participants were homeless hostel residents who had been referred to specialist inner city mental health services. 73 men (11%) and 10 women (14%) died, with mean ages at death of 50 and 57 respectively. The commonest causes of death in men were cardiovascular disease (32%), suicide (26%), and accidents (14%). As the total number of deaths in women was only 10, meaningful sub-classification of diagnoses was not possible. 71% of men were suffering from schizophrenia. It is not possible to accurately translate this into a prevalence for schizophrenia among the 700 male hostel residents observed over a decade, because the turnover of patients was not reported. However, it does suggest a high prevalence of the condition, and perhaps further evidence for a severe downward social drift in individuals with schizophrenia.[123] SMRs in men and women were 3.1 and 3.8 respectively. There was no clear association between SMR and age. In men, SMR increased to a maximum of 5.0 at ages 40-49 years and fell with increasing age thereafter. Perhaps surprisingly, men without schizophrenia had higher SMRs than those with it. The all-age SMR in male schizophrenics was 2.5 and in non-schizophrenics was 4.4. The authors speculated that non-schizophrenics included a greater proportion of those with personality disorders; that alcohol and drug problems were less common than typical for schizophrenics in Sydney,[124] or other selection biases favouring referral of less healthy non-schizophrenics to the mental health clinics.

In conclusion, international literature on deaths among homeless people showed many consistent patterns. Typical ages at death were 39 – 47 years. Compared with local general populations, the risk of death was about 5 times greater. The relative risks of death varied, however, with SMRs of up to 14 reported in street youth in Montreal.[119,116] Some North American research found higher risks of death in younger people, while other analyses found that increasing age was a risk factor. Canadian and US reports also found high proportions of deaths due to HIV/AIDS and homicide and most research reported drug use, suicide and accidents as major causes of death. One paper reported seasonal increases in deaths – surprisingly in the summer – another did not.

As Crisis's landmark reports[17,107] concluded, new research is needed to determine risks of death in a UK homeless population, where hazards of HIV/AIDS and firearms injuries are low, using longitudinal methods to calculate absolute risks, rather than locally-standardised mortality ratios or cumulative incidence.

Table 5. Deaths in the homeless: summary of papers.

Study	Population	Design	Main results	Comments
Crisis[107]	Coroners' reports, London, 1991-2.	Cross-sectional, descriptive data over 12 months.	Mean age at death 47 years. Causes of death suicide (23%), other natural causes (17%), pneumonia, hypothermia and drug overdose (13%). Annual mortality 3085 per 10^5.	Selection bias in sample. Call for longitudinal study of deaths and hospitalisations.
Crisis[17]	Coroners' reports, London, Bristol, Manchester, 1995-6.	Cross-sectional, descriptive data over 12 months.	Mean age at death 42 years. Causes of death natural (34%), suicide (22%), drugs (14%), pneumonia (14%).	Selection bias in sample.
Hanzlick[108]	Death certificates, Georgia, 1988-90.	Cross-sectional, descriptive data over 12 months.	Mean age at death 46 years, 98% men. 55% natural causes compared with 60% in general population. Homicide 8% (3% in general popn.) and suicide 3% (5% in general popn.). Crude homeless death rate 281-426 per 10^5.	Misclassification may under-detect homeless; denominator to calculate death rate imprecise.
Shaw[109]	Coroners' reports, London, Bristol, Manchester, 1995-6.	Cross-sectional, estimating death rates from rough sleeper counts.	Death rate 41.1 per 10^3 at 16-29, 71.9 per 10^3 at 30-44 and 157.6 per 10^3 at 45-64: SMRs 3732, 3127 and 2074 respectively.	SMRs likely to be very over-estimated.
Shaw[110]	Rough sleepers, London, 1995-6; male hostel dwellers, Oxford, 1981-92; B&B dwellers, Brighton, 1981-92.	Cross-sectional, using Census denominators.	All-age male SMR in London rough sleepers "over 2500." Male hostel resident mortality 12.6 per 10^4 at 16-44 and 52.0 per 10^4 at 45-64: SMRs 731 and 684, respectively. B&B mortality in men 4.5 per 10^4 at 16-44 and 51.1 per 10^4 at 45-64. In women, mortality 2.7 per 10^4 at 16-44 and 2.6 per 10^4 at 45-64. Life expectancies in rough sleepers 42, in hostel residents 63 and B&B residents 67.	Small numbers caused imprecision. B&B population subject to misclassification. No person-time collected.

Table 5 (continued). Deaths in the homeless: summary of papers.

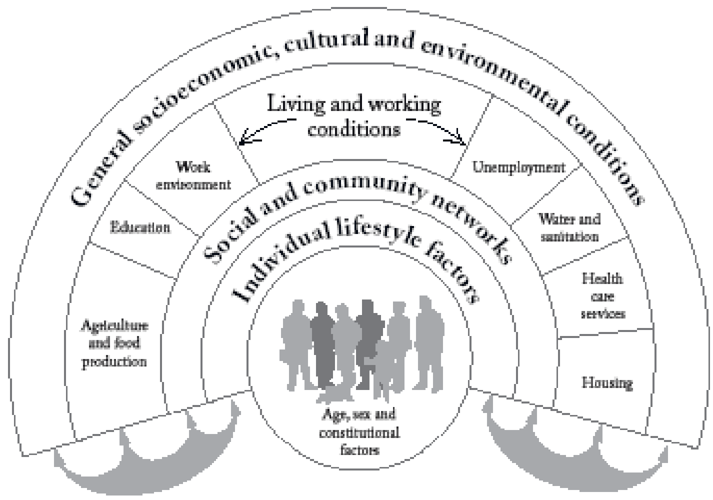
Study	Population	Design	Main results	Comments
Nordentoft[111]	Homeless hostel residents, Copenhagen, 1991.	Prospective cohort, 10-year linkage to death records.	SMRs in women 5.6 and men 2.8, overall 3.8. SMRs for suicide 6.0, natural causes 2.6, and unintentional injuries 14.6.	
Beijer[112]	Men using community mental health outreach team, Stockholm, Sweden, 1995-6.	Prospective cohort, 5-year follow-up.	SMR 4.7. Three-quarters of subjects remained homeless after 5 years.	Selected population with mental illness.
Hwang[121]	Homeless health care programme users, Boston, Massachusetts, 1988-93.	Retrospective cohort on health service use 1 year before death.	Commonest causes of death HIV/AIDS and external causes (19% each), heart disease (17%) and cancer (11%). 73% used health services in year before death. Odds of using services greater with HIV infection (OR 2.6), injecting drug use (2.2) and cocaine abuse (2.1).	Selected sub-group of homeless, only; users of 1 health programme only.
Hwang[115]	Homeless health care programme users, Boston, Massachusetts, 1988-93.	Prospective cohort of deaths.	Mean age at death 47 years, crude mortality 1114 per 10^5. Mortality ratios in men and women 1.5 and 1.6. Leading cause of death homicide in all 18-24 and 25-44 women; AIDS in 25-44 men; heart disease at 45-64.	Standardised rates make international comparisons difficult; stratum-specific preferable.
Barrow[114]	Shelter users, New York City, New York, 1987-94.	Prospective cohort of deaths, follow-up 7 years.	SMRs 3.9 in men, 4.7 in women against US pop^n; 2.2 in men and 3.7 in women against New York City pop^n.	As above.
Hibbs[113]	Mental health and homeless health service users, Philadelphia, Pennsylvania, 1985-88.	Prospective cohort of deaths.	Crude mortality 7.7 per 10^3, 8.9 and 5.4 per 10^3 in white men and women. RRs 4.9 and 4.5 in white men and women compared with general popn. 53% deaths in 4 summer months. Causes of death injuries (21%), heart disease (19%) and ill-defined (16%).	

Table 5 (continued). Deaths in the homeless: summary of papers.

Study	Population	Design	Main results	Comments
Hwang[118]	Male shelter users, Toronto, Ontario, 1995.	Retrospective cohort of deaths, up to 3 years follow-up.	Crude mortality 876 per 10^5. RR death, compared to general population 8.3 at 18-24, 3.7 at 25-44 and 2.3 at 45-64 years. No seasonal trend. SMRs highest for cancer and cerebrovascular diseases. Rates lower than other North American cities.	Selective sample of homeless circumstances, only.
Hwang[122]	Male shelter users, Toronto, Ontario, 1995.	Retrospective cohort of deaths, up to 3 years follow-up.	Increasing age (HR 1.7), recent homelessness (HR 1.1) increased hazards of death in multivariable model. Pattern of homelessness (transitional, episodic, chronic c/w shelter use) not associated with hazard of death.	As above, plus confounding by risks of death increasing risks of recent homelessness.
Hwang[117]	Female shelter users, Toronto, Ontario, 2002.	Retrospective cohort of deaths.	Mean age at death 39 years. Crude mortality 498 per 10^5. RR death compared to general population 10.1 at 18-44 and 1.2 at 45-64 years. HIV/AIDS and poisoning commonest causes.	High AIDS/HIV rate partly reflects healthcare system and availability of HAART after the study finished.
Roy[119,116]	Street youth, Montreal, Quebec, 1995-6.	Prospective cohort of deaths.	SMR (Quebec population) 11.1 in males, 13.5 in females. HIV, daily alcohol use, homeless in prior 6 months, drug injecting and male sex risk factors for death. Commonest causes suicide by hanging and drug overdose.	
Babidge[120]	Homeless refuge dwellers using psychiatric services, Sydney, 1988-91.	Prospective cohort of deaths, up to 11 years follow-up.	Mean age at death 50 in men and 57 years in women. 71% of men had schizophrenia. Commonest causes cardiovascular (32%), suicide (26%) and accidents (14%). SMRs 3.1 in men and 3.8 in women. No clear age trend in deaths. Male schizophrenic SMR 2.5, non-schizophrenic SMR 4.4.	Small numbers of women. Limited generalisability. Absolute risks not presented.

2.9 Socio-economic deprivation and health

Homelessness shares many characteristics of other forms of socio-economic deprivation[125] (see The Main Determinants of Health figure, below) and it might be expected to share similar health risks. In particular, homelessness is associated with poor educational attainment,[126] unemployment,[127] hazardous living conditions,[128,129] poor levels of sanitation,[130] poor access to health services,[131,132,133] poor social and community networks[134] and high prevalences of damaging individual health behaviours, such as alcohol consumption, drug use and smoking.[44,52] In addition, and by definition, housing quality is either the poorest available or absent.



The Main Determinants of Health, Dahlgren and Whitehead 1991.[125]

There are two reasons for considering patterns of health in socio-economically deprived populations. The first is to compare them to those in the homeless to infer whether homelessness exerts a similar magnitude of risk. The literature review on the health of the homeless identified the need for more comprehensive cohort studies of deaths and hospitalisations. The second reason for this review, therefore, is to hypothesise on what might be expected in future cohort analyses of homeless hospitalisations and deaths if they shared similar characteristics to other deprived populations.

Morbidity, hospitalisation and deprivation

Overall, the odds of reporting poor health are about twice as great between the affluent and deprived within countries.[135] In a comparison of 11 western European countries, Great Britain was fourth worst between Norway (worst) and Germany (best) for inequalities in self-reported health.[135] Inequalities in morbidity have been found across all European countries. Mackenbach[135] argued that inequalities were of a similar order despite differences in income distribution and other social inequalities while Wilkinson[136] argued that the size of inequalities in health varied between countries in direct proportion to a range of measures of social, educational and financial inequalities within them.

Interpretation of socio-economic differentials in hospital admission rates is more complex than for deaths. This is because hospitalisation represents the interaction between a number of factors. These include incidence and severity of illness, availability and effectiveness of preventive primary care services, primary care referral patterns to hospitals, and hospital admission policies. Perhaps as a result of this greater complexity, fewer analyses of socio-economic patterns in hospitalisation rates have been published compared with those for deaths.

There is a consistent trend toward increasing risk of hospital admission for acute myocardial infarction and increasing socio-economic deprivation in both sexes.[137] The ratio of age-standardised admissions between the most affluent and most deprived is just under 2. Although admission rates fell throughout the 1990s, by 2003 the admission ratio between affluent and deprived in Scotland was still 1.8.[138] Paradoxically, angiography after first acute myocardial infarction is more commonly carried out in patients from more affluent areas and they are investigated in a shorter time following their infarct.[137,139] Higher rates of coronary artery bypass grafting and shorter waiting times for surgery are also seen in patients from more affluent areas[137,139] probably because it is more likely to be offered following angiography. Deprivation is also associated with higher rates of hospitalisation for cardiac failure following myocardial infarction.[140] Adjusted proportional hazards for cardiac admissions following an initial myocardial infarction were 1.11 for each unit of DEPCAT in a Scottish population. First admissions for stroke, however, were 24% higher in men and 58% higher in women from the most affluent compared to the most deprived areas of Scotland,[137] possibly because competing causes remove more deprived populations at earlier ages.

The relationship between cancer incidence and socio-economic circumstances is highly site-specific. There is a small excess of female breast cancer diagnoses in women from more affluent areas compared to the most deprived,[137] and little significant socio-economic difference in colo-rectal cancer incidence. There is a 3-fold higher incidence of cancers of the trachea, bronchus, and lung in residents of the most deprived areas compared to the most affluent[137] which largely be explained by higher smoking prevalence in more socio-economically deprived populations. In 2003, 47% of men and 45% of women in the most deprived areas were smokers compared with 20% of men and 16% of women in the least deprived.[141]

Patients with diabetes from the most socio-economically deprived areas report 57% lower adjusted rates of hospital attendance[142] despite poorer diabetic control and greater diabetic complication rates. First admissions with schizophrenia show strong correlations to deprivation with a 3-fold difference in men and women between the most affluent and most deprived groups.[137] The excess of schizophrenia in more deprived populations is probably the result of downward social drift[143] although Messias contests this widely-held view.[144]

Mortality and deprivation

There are 5.2 year differences in expectation of life at birth in males between those in social classes I and II and social classes IV and V; and 3.4 year differences in females.[145] All-cause Standardised Mortality Ratios (SMRs) in England and Wales in 1991-93 increased from the lowest of 66 in social class I (professional) to the highest, 189, in social class V (unskilled). Evidence from the Longitudinal Study in England and Wales[145] found that, compared to the reference group III manual, deaths in women in social classes I and II were 24% lower and in social classes IV and V 17% higher. Mortality increased with age in men and the social class differential also decreased with age.[145] In 60-64 year old men the social class I/V death rate ratio was about 3, while at 30-34 years the ratio was 4.5. Western European mortality data[135] showed that differences between manual and non-manual occupational groups in England were third worst at 7.5%, with France the poorest (risk difference 11.5%) and Norway, Switzerland and the Netherlands best with differences of about 5%.

Cause-specific mortality increases with decreasing social class but the size and nature of the differences varies with particular causes.[145] These differentials reflect a mixture of both incidence of, and survival from, each cause. The differential between social classes I and V is similar for stroke and ischaemic heart disease in men, at about 3-fold. In women, risk ratios for deaths from ischaemic heart disease vary by a factor of 1.7 between social classes I and II and IV and V. Lung cancer shows a higher differential with SMRs in social classes I and V of 45 and 206, respectively, a ratio of 4.6.[145] While death ratios increase more or less steadily with decreasing social class for stroke, ischaemic heart disease and lung cancer, the increase from social class IV to V is much greater in each case; thus the SMRs rise from about 125 to over 200 in this last step. The social class I/V ratios for accidents and suicide are about 4 but the gradient between them is not steadily incremental. In both cases, SMRs in social class I are about half the national rate of 100 and increase to around the national rate in social class IV. There is then a doubling of accident and suicide rates in men in social class V. In contrast, skin cancer SMRs are highest in social class I, at 136, and show little consistent pattern across social classes II to V, which are 106 and 100, respectively.

Deaths from lung cancer, stroke and ischaemic heart disease increase with age after about 40 years in all social classes.[145] In each of these conditions the socio-economic differential decreases with increasing age. There is little discernible difference in the social class differential for accidents with increasing age, particularly in the large excess experienced by men in social class V. For suicide and undetermined deaths rates rise with age from 20-24 years and fall or level-off around 45-49 years. The largest excess in suicides in men in social class V is seen between 30 and 39 years of age.

Deaths from infectious diseases (excluding HIV) show an inconsistent pattern with social class although they are lower in social classes I and II than IV and V.[145] The highest SMRs for septicaemia are in social classes III non-manual and V while for viral hepatitis the highest SMR is in social class III non-manual and lowest in III manual. Deaths from tuberculosis showed a consistent increase with decreasing social class such that there was a 9-fold difference between social classes I and V. Deaths from HIV in England and Wales in 1991-93 were approaching their highest rate before the introduction of HAART. As noted above, these reflect both incidence of infection and survival from HIV. Deaths from HIV were highest in social classes III non-manual and II and significantly lower in social classes III manual, IV and V. These are surprising, considering that injecting drug would be expected to be almost exclusively found in social class V.

Deaths from neoplasms in men increase and survival decreases[146] with decreasing social class but are dominated by the pattern of the most common cancers – those of the trachea, bronchus and lung. As noted above, men in social class V have nearly 5 times the risk of death from lung cancer as those in social class I in England and Wales in 1991-93[141] but around a three-fold difference from affluent to deprived was reported in Scotland from 1986 to 1995.[137] In women, lung cancer deaths also increase from social classes I and II to

IV and V, but the differential is smaller, at 2.3 fold.[145] This may be partly an effect of merging social classes. These differences can largely be explained by differentials in smoking prevalence and intensity,[141] described below. One-year survival from cancers of the trachea, bronchus and lung falls from 26% in the most affluent quintile to 22% in the most deprived.[141] Female breast cancer deaths show an unusual pattern with socio-economic status due to two contrasting characteristics. The first is that incidence of breast cancer is slightly higher in more affluent women (105 to 92 age-standardised registrations per 100 000).[137] But survival is progressively poorer among women from more deprived circumstances.[137] Compared with III manual women, those in social classes I and II and IV and V experience statistically significant increases in death risks of 14% and 17% respectively. Death from stomach cancer is also highly class-dependent, ranging from an SMR of 64 in social class I to 193 in social class V – a three-fold difference. Deaths from cancers of the colon show no consistent relationship with socio-economic circumstances while survival is significantly better among more affluent populations.[141]

Among deaths from endocrine causes, deaths from diabetes form the largest group. There is a four-fold difference in SMRs for diabetes mellitus between men in social class I and V.

Deaths from mental disorders might be considered poor indicators of the frequency of mental ill health and are biased towards certain conditions with a higher mortality such as substance misuse. However, they show very large differentials between social classes, driven largely by the effects of drug dependence and non-dependent abuse of drugs and alcohol dependence syndrome.[145] These show SMR differentials between social classes I and V of 22 and 3, for drugs and alcohol respectively. Suicide risk increases with deprivation,[147] with a 2-fold difference between most affluent and most deprived populations in men and a 4-fold difference in women.[137] The effect of socio-economic status is greater in those under 30 years of age.[137].

Deaths from disorders of the nervous system are dominated by the excess of epileptic deaths in social class V.[145] SMRs in social classes I to III manual are below the general population average of 100 but rise to 129 in social class IV and 275 in social class V. The ratio of deaths from epilepsy in social classes I and V is over 7.

Circulatory diseases are the commonest causes of death in men with ischaemic heart disease accounting for three quarters of them.[145] The socio-economic patterns of increasing deaths from both ischaemic heart disease and stroke are similar, with about a 2.5[137] to 3-fold[145,2,148] increase in mortality rates between most affluent and most deprived groups under 65 years of age. Survival after myocardial infarction is also poorer in more deprived populations.[149,150] Smoking prevalence and average cigarettes per day among smokers are both higher in more deprived areas. Much of the variation associated with deprivation disappears after adjustment for demographic, biologic (fibrinogen, lipids, blood pressure, and others), psychological, and behavioural risk factors.[151] In women, risks of death from ischaemic heart disease and stroke are about 67% and 40% higher, respectively, in social class V compared to social class I.[145]

Respiratory deaths largely comprise pneumonia and chronic obstructive pulmonary disease (COPD). There are progressive increases in SMRs associated with decreasing social class in men for pneumonia, COPD and asthma.[145] The ratios of SMRs in social classes I to V range from 14 for COPD to 3-4 for pneumonia and asthma. Deaths from asthma are relatively uncommon and may reflect differential rates of severity and poor control rather than differences in incidence.[152] Again, much of these variations can be explained by smoking prevalence and intensity.[141]

Half of deaths from disease of the digestive system in men are from chronic liver disease and cirrhosis and a further 14% from ulcers.[145] These conditions are all strongly socio-economically patterned, with social class I:V differentials of 4-5 fold. While Drever and Whitehead state that "drinking patterns are known to have a social class gradient"[145] the relationship is not clear. Overall alcohol consumption in men shows little association with social class, while there is a small increase in consumption among women from higher social classes.[145,141] Binge drinking increases with greater socio-economic deprivation but the differentials between most affluent and most deprived groups are of the order of 1.5-fold or less.[141]

Renal failure is the commonest cause of death from diseases of the genitourinary system and there is a progressive increase in risk of death in men from social class I to social class V.[145] About a third of deaths from diseases of the musculoskeletal system are due to rheumatoid arthritis and there is just under a 5-fold difference in male SMRs from social class I to social class V.[145] Poorer function and survival in more deprived patients have been found in clinical case-series of rheumatoid patients[153] that are not explained by differences in treatment compliance.

External causes of injury and poisoning accounted for 12% of deaths in men aged 20-64 in England Wales between 1991 and 1993.[145] There are four-fold differentials in deaths from accidents and suicide, and in the group as a whole, between social classes I and V. The differentials in homicide and death by accidental poisonings are both 12-fold.

In conclusion, for most diseases the ratio of morbidity and mortality between most affluent and most deprived populations ranges from about 2 to 5. Notable exceptions include some cancers where affluence is associated with greater mortality risks (breast) or where there is no socio-economic pattern (colorectal). Communicable disease deaths also show no consistent socio-economic patterns. Drug deaths are the most highly socio-economically determined, with a 22-fold difference between most affluent and most deprived populations. Socio-economic differentials in morbidity and mortality are age and sex dependent and sometimes sex specific. Because homeless populations are generally young and predominantly male, comparisons of health outcomes with the general population need to be matched to demographically comparable individuals.

2.10 Explanations for inequalities in health

In this section a review is given of the major hypotheses proposed to explain the relationship between socio-economic deprivation and health. This is relevant to two aspects of the subsequent data analysis of this thesis. The first is that it suggests what the mechanisms are for socio-economic differentials in health. The second is that it gives a rationale for understanding homelessness as a form of socio-economic deprivation rather than a unique and separate condition.

The interest in health inequalities began in the United Kingdom with Chadwick's seminal *Report on the Sanitary Condition of the Labouring Population and On the Means of Its Improvement*[1] in 1842 in which he serially documented descriptions of poor urban living conditions and inequalities in survival. Macintyre[154] described the emergence of a debate between hereditarians and environmentalists that began at the turn of the 20th Century. Hereditarians proposed that social positions were biologically determined while environmentalists believed that poor material circumstances had an independent effect on health. Eugenists suggested that better genetic endowment led to a natural stratification of societies into appropriate orders.[155] A third explanation for variations in health emerged – that of the influence of individual behaviour.[154]

Decennial Censuses began in the United Kingdom in 1801 and the first Census by the new General Register Office for Scotland, in 1851, included information on education, and occupation or employment status. A classification for social status[156] was proposed in

1887 and since 1911, mortality rates have been routinely examined in successive Censuses by both occupational social class and by occupational group alone.[2]

In 1974, *A new perspective on the health of Canadians* challenged the "traditional view of the health field,"[157] described as the assumption that all health improvements came from better medical care. Given even the brief history of perspectives on health determinants described, above, this assumption seems invalid. Lalonde proposed four health fields – human biology, environment, lifestyle and health care organisation – from which he believed health improvement might best be considered.[157]

Richard Wilkinson's open letter[158] to the Labour Secretary of State for Social Services in 1976 described the largest social class differences in death rates since accurate records began. He asked for an urgent enquiry to investigate the issues and recommend action. The Working Group on Inequalities in Health was set up the following year under the Chairmanship of Sir Douglas Black. Its aim was to review information about differences in health status between the social classes; to consider possible causes and the implications for policy; and to suggest further research.

The Black Report[159] was published in 1980. It proposed four explanations for inequalities in health: materialist/structuralist; natural and social selection; cultural/behavioural; and artefact. The materialist/structuralist argument, aside from the malapropism (materialist being used to signify lack of material factors necessary for health, rather than "interest in and desire for money, possessions, etc, rather than spiritual or ethical values"[160]) emphasised “the role of economic and associated socio-structural factors in the distribution of health and well being.” The Black Report described particular occupational hazards associated with industrialised nations, as well as the influence of social support in modulating the effects of any given pathophysiological state. The natural and social selection explanation proposed that the association between poor health and social status was the result of selection bias – that is, poor health determined social status. The corollary was that social class was not a causal factor for poor health. Natural selection suggested a Darwinian concept of a universal biological phenomenon of survival of the fittest. Social selection implied that poor health would limit particular life choices (such as education, employment, or marriageability) and that these in turn would affect social status. The working group proposed that improving opportunities for disabled people would be one practical way of dissociating health from social selection. The third “real” explanation for inequalities, the cultural/behavioural model, put individuals’ behaviour at the heart of inequalities in health, suggesting that higher social status was associated with better choices. Smoking, alcohol excess, poor diet, lack of exercise, or other risk-taking behaviour are examples of such individual health determinants. Inappropriate excessive use of health services may be another factor. The working group considered that while choices were individual, they might be significantly determined by broader cultural influences that acted at a social class level. The last explanation was that the association was artefactual. The authors described this explanation as follows

> “This approach suggests that both health and class are artificial variables thrown up by attempts to measure social phenomena and that the relationship between them may itself be an artefact of little causal significance.”[159]

They went on to suggest that while relative differences between affluent and deprived populations may have persisted, the absolute reduction in size of more deprived populations meant that the whole population had in fact become healthier and the size of the sicker, more deprived, population had shrunk over time. The artefact explanation is contentious partly because it dismisses the validity of concerns about health inequalities and partly because it is inconsistent with data.[161]

It is evident from the Black Report's conclusions that some balance of these explanations was considered to be responsible for observed inequalities in health. They therefore recommended a comprehensive anti-poverty strategy (specifically including a child anti-poverty strategy), a comprehensive disability allowance, housing policies, and preventive and educational action to encourage good health.[159]

The last major current explanation for health inequalities is the Barker hypothesis. This is a form of environmental explanation but one in which uterine and infant development programme lifelong patterns of health.[162,163,164,165,166] The hypothesis is that undernourished foetuses preserve central nervous system development at the cost of truncal development and particularly hepatic enzyme capacity. If subsequently exposed to a more affluent lifestyle – particular availability of a high calorie diet – such individuals fare particularly badly, with truncal obesity, hypertension, and dyslipidaemia. The policy and public health implications of the Barker hypothesis are that investment in maternal and infant health are of much greater potential benefit than interventions later in childhood or adulthood.

Attempts have been made to synthesise explanations for health inequalities in intergenerational and lifecourse epidemiology.[167,168] These propose that there is a cumulative effect of socioeconomic deprivation in childhood and adulthood.[169]

In conclusion, there is evidence that health inequalities arise from a mixture of genetic, environmental, and behavioural factors. Longitudinal, lifecourse analyses have begun to attempt to clarify to what extent poor health and socioeconomic deprivation are causally related. It seems reasonable to suggest that effective mitigation of health inequalities requires interventions across a range of ages and circumstances and that preventive action is more effective earlier in life.

2.11 Conclusions from the literature

Glasgow has an annual incident population of about 9000 homeless adults and a prevalent population of about 4000. Two thirds are men and the mean age is about 37 years. Cross-sectional studies show that there is a high prevalence of neurotic and psychotic symptoms, drug dependency, hazardous drinking and smoking. Surveys from North America have identified a high prevalence of HIV/AIDS in the homeless.

Most of the literature on hospitalisations in the homeless is cross-sectional and therefore unable to describe absolute risks. Data indicate higher admissions in the homeless due to skin infections, drug use, mental illness and alcohol problems.

The literature on deaths in the homeless includes 11 cohort studies. These indicate risks of death are raise by about 5-fold in the homeless in European, North American and Australian cohorts.

Socio-economic deprivation, in the absence of homelessness, is associated with increased hospitalisation and mortality. Overall, the risk ratios between affluent and deprived populations are around 2 to 5, suggesting that they may be of a similar order to those of the homeless.

The literature review identified a need for a cohort study of homeless individuals in the United Kingdom in which incidence rates could be measured accurately, rather than estimating cumulative incidence from unreliable homeless population denominators. It also indicated a need for as study in which comparisons could be made between the homeless and comparable non-homeless individuals in a range of socio-economic circumstances. This would determine whether the homeless experienced similar health risks to other deprived groups or the extent of any additional hazard.

Chapter 3. Aims and objectives

3.1 Aims

The principal aim of this thesis was to describe how the health of homeless people in Glasgow compared with that of non-homeless individuals living in deprived socio-economic circumstances. A particular question was whether patterns of mortality could be explained by differences in morbidity or whether homelessness conferred additional hazards.

The null hypothesis was that there was no difference between hospital admission and death rates between homeless and non-homeless deprived populations.

3.2 Objectives

The aim was achieved by carrying out a retrospective cohort study on homeless and non-homeless adults' hospitalisations and deaths. The common objectives to create the dataset are described first, followed by specific objectives for the analyses of deaths, hospitalisations, and morbidity-adjusted mortality.

3.2.1 Creation of a retrospective cohort study dataset

To create the dataset on which all analyses were performed, the following objectives were set:

I – To identify a closed cohort of homeless individuals by extracting demographic data on all homeless applicants to Glasgow City Council in the calendar year 2000

II – To identify a non-homeless comparison group by obtaining a closed cohort of non-homeless NHS Greater Glasgow area residents in 2000 that was age and sex matched to the homeless cohort

III – To identify and match all linked hospital admission and death records by homeless and non-homeless cohorts and to produce a dataset that included information on socio-economic circumstances of the non-homeless cohort

3.2.2 Analyses of deaths

I – To calculate time at risk of death in all subjects

II – To compare risks of death by age, sex and cause and in each case to compare the effects of homelessness with socio-economic deprivation

III – To use multivariable survival analysis to control for confounding and produce models that described the contributions of different risk factors on the hazards of death

3.2.3 Analyses of hospital admissions

I – To calculate time at risk of hospitalisation in all subjects

II - To describe hospitalisation risks by age, sex, diagnosis and type of admission (elective and emergency)

III - To describe risks of operative procedures by age, sex, diagnosis and type of admission (elective and emergency)

IV – To compare lengths of stay by age, sex and type of admission (elective and emergency)

V – In each analysis (II to IV) to compare the effects of homelessness with socio-economic deprivation

3.2.4 Analyses of morbidity-adjusted mortality

I – To identify morbidities through their appearance on any hospital record between entry into the study and death or censorship

II - To use multivariable survival analyses to describe all-cause mortality risks in homeless and deprived populations after adjustment for age, sex and morbidity

III – To describe hazards of death from specific causes and estimate the additional effect, if any, of homelessness

Chapter 4. Methods

This chapter provides a description of the methodology for a retrospective cohort study on homeless and non-homeless adults in Glasgow. Two cohorts were identified in 2000 and followed-up for 5 years. The cohorts were closed in that after no further members could join and losses could only occur by death. An exposed (homeless) cohort was identified and then a non-exposed (non-homeless) age and sex matched stratified random sample from the Glasgow population was obtained for comparison. Both cohorts' linked hospital and death records were obtained to compare health outcomes between them.

The methods used to estimate the required sample size, obtain ethics approval, identify cohorts, and match them to hospital and death records are described below. A description of the statistical methods and their assumptions concludes the chapter.

4.1 Sample size and time frame

An initial arbitrary decision was made to follow-up a cohort of a single calendar year's homeless applicants to Glasgow City Council. Sample size tests were then performed to determine whether such a cohort would be able to detect differences in hospitalisation and deaths of a similar order to that described between affluent and deprived non-homeless populations in Scotland.

When this thesis was being planned in 2005, linked hospital and deaths data were available to the end of the calendar year 2004. This meant that cohorts would need to be recruited no later than 1999 to have 5 years' follow-up. Sample size calculations were therefore based on homeless presentations to Glasgow City Council in 1999.

In order to assess whether numbers of hospitalisations in a year would have sufficient power to show differences between the homeless and non-homeless cohorts an estimate of the expected numbers was made by applying age-specific Scottish hospitalisation rates to the age structure of homeless presentations to Glasgow City Council in 1999. The Integrated Housing Management System (see Section 4.4 on page 139) did not use a reliable method to uniquely identify individuals. Therefore an estimate of the number of unique individuals who were homeless was made in the following way. A dataset of all Main Applicants' names, dates of birth and ages in the calendar year 1999 was extracted from the Integrated Housing Management System using Business Objects software. A unique person identifier was created from a concatenation of date of birth and surname. Each unique combination was counted once and duplicates removed. This method was likely to overestimate the number of individuals in a population because any differences in the spelling of a surname or in date of birth for the same individual would produce a new unique identifier – that is, generate an apparently new person on the dataset. However, for the purposes of sample size estimation, the method should provide a reasonable approximation to the true number of individuals.

It was decided to obtain a non-homeless cohort from the general population that was matched for age and sex to the homeless cohort but twice as large. The reason for age and sex matching was that the unusual demographics of homeless people – they are young and predominantly male - meant that a simple random sample of the NHS Greater Glasgow area would yield data that, when stratified by age or sex, might result in empty strata for some groups. For example, older homeless and younger non-homeless individuals might be unmatched so that comparisons could not be made between them. It was also anticipated that there would be less morbidity and mortality among the general population sample overall. So that while stratified matching would ensure adequate denominators in stratum-specific cells, there might still insufficient incident cases (hospitalisations or deaths), particularly among the younger non-homeless cohort. Again, this might lead to empty stratum-specific cells. For these reasons, a choice was made to obtain twice as large a non-homeless comparison group.

Table 6 and Table 7 show the number of hospitalisations and deaths, respectively, that might be expected if local population rates applied. Both tables show the number of individuals who were homeless in 1999. Table 6 applies age-specific Greater Glasgow Health Board general hospital admission rates to estimate the expected numbers of admissions per year in both homeless and an age-matched non-homeless cohort twice the size. Table 7 applies age-specific Scottish death rates to estimate the expected number of deaths per year in both homeless and non-homeless cohorts. The numbers of estimated hospitalisations and deaths in the non-homeless cohort is not exactly double in some cases because of rounding of estimated numbers.

Table 6. Age distribution of 1999 homeless applicants to Glasgow City Council, annual rates of all general hospitalisations and ICD-10 S00-T98 (injuries, poisonings, and certain external causes) in NHSGG area and expected numbers of admissions in homeless and non-homeless cohorts if all-Glasgow rates applied.

age	1999 homeless n (%)	NHSGG hospitalisation rate	Expected – all diagnoses		S00-T98 rates only	Expected – S00-T98 only	
			homeless	non-homeless		homeless	non-homeless
15-24	1203 (16.5%)	0.228	274	549	0.0537	65	129
25-34	2804 (38.5%)	0.313	879	1758	0.0484	136	271
35-44	1914 (26.3%)	0.362	693	1386	0.0397	76	152
45-54	755 (10.4%)	0.472	357	713	0.0338	26	51
55-64	397 (5.5%)	0.712	283	566	0.0369	15	29
>64	211 (2.9%)	1.296	273	547	0.0833	18	35
TOTAL	7284 (100%)	-	2759 (37.9%)	5518 (37.9%)	-	336 (4.6%)	667 (4.6%)

Excludes psychiatry, obstetrics and gynaecology, long stay psychiatric, and Special Care Baby Units

.

Table 7. Age distribution of 1999 homeless applicants to Glasgow City Council, annual Scottish mortality rate and expected numbers of deaths in homeless and non-homeless cohorts if all-Scotland rates applied.

age	1999 homeless n (%)	Scottish death rate	Expected number if NHSGG rates applied	
			homeless	non-homeless
15-24	1203 (16.5%)	0.228	1	1
25-34	2804 (38.5%)	0.313	3	6
35-44	1914 (26.3%)	0.362	3	7
45-54	755 (10.4%)	0.472	3	6
55-64	397 (5.5%)	0.712	5	9
>64	211 (2.9%)	1.296	15	29
TOTAL	7284 (100%)	-	29 (0.40%)	58 (0.40%)

nQuery Advisor 5.0 was used to perform power calculations using its test of two group 2-sided χ^2 test of equal proportions on samples with a 2:1 size ratio. Conventional values of α and β were chosen as 0.05 and 20% (or power of 80%), respectively. Assuming that the age-adjusted all-cause annual hospitalisation rate was 37.9%, samples of 7284 homeless and 14 568 non-homeless would be powered to detect absolute differences of 1.9% or larger between the two cohorts. This is equivalent to relative risks of 1.05 or greater between the two cohorts. Under the same assumptions, the study would have the power to detect absolute differences in injuries and poisonings (ICD-10 codes S00-T98) of 0.8% or greater, or an odds ratio of 1.2 or greater.

The study was powered to detect absolute differences in annual mortality of 0.2% or greater, or odds of 1.5. In light of a preliminary literature review, which found that mortality risks varied by at least 2.5-fold[159] between affluent and deprived populations, it was felt that the study would be sufficiently powered to detect differences in a range of common and less common diagnostic groups if they existed.

When ISD were ready to supply the final matched data, in late 2005, hospitalisation and deaths data were available to December 2004. Data were therefore extracted on all homeless presentations in the calendar year 2000. This had two advantages over using the 1999 cohort. Firstly, until February 1999 homeless applications were recorded on a variety of stand alone databases and their integration led to a mixture of double-counting and missing data: 2000 data did not suffer from these problems. Secondly, more recent data were more pertinent to current homeless conditions.

The Community Health Index (CHI) was used to obtain a sample of the non-homeless general population. This is a unique ten-digit person identifier comprising date of birth plus other numbers. The CHI is widely used in the NHS and all patients who are registered with a GP have a CHI number.[170] A significant advantage of the CHI over other population data is that it is part of the linked Scottish Morbidity Record system. Thus samples of hospital and death records could be readily identified from a CHI sampling frame without further matching. While the CHI may not include up to 10% of the population[171] this is usually because they have recently moved into an area or are temporary residents. In other words, the selection bias of the CHI will tend to favour non-homeless individuals, which reduces misclassification errors for the non-homeless cohort.

Community Health Index data were sampled on 30th June 2000. Thus, the starting point of follow-up for homeless individuals lay between 1st January and 31st December 2000 while all non-homeless individuals entered the study on 30th June 2000.

4.2 Ethics approval and funding

Ethics approval for the creation of an anonymised linked dataset, based on homeless and Community Health Index residents, was submitted and approved by the Privacy Advisory Committee of the Information and Statistics Division of NHS National Services Scotland (ISD). One member of the Committee felt that since patients had not given explicit consent for use of their data, the application should not be accepted, but the majority decision to pass the project was carried. The author was required to submit a statement to the Privacy Advisory Committee that no attempt would be made to identify individuals from the anonymised database. The Director of Public Health for Greater Glasgow approved the use of the Community Health Index for this purpose and agreed to fund ISD's work on producing the dataset.

4.3 Cohort selection and linked data matching

In this section a description is provided of how the cohorts were identified, starting with an extraction of all adults who presented to Glasgow City Council as homeless in 2000. This cleaned dataset provided the age and sex strata within which random samples of Glasgow residents on the Community Health Index were obtained.

Data on Main Applicants who presented to Glasgow City Council from 00 00 hrs on 1st January 2000 to 00 00 on 31st December 2000 were extracted using a Business Objects template designed by the author. Emergency homeless services were available 24 hours a day, hence the need to specify the times of the sample. Extracted fields comprised surname, forename, sex, address including postcode, date of birth, and National Insurance number. The file comprised 20 316 records. The recent integration of several separate databases in 2000 meant that a large number of duplicate files existed that year, and the true number of applications (not individuals) was probably closer to the 12 000 that were recorded consistently in subsequent years. However, the duplication of files should not have affected the validity or completeness of data on all homeless applicants in 2000.

ISD was provided with all 20 316 records. They formatted the dataset by creating separate fields for "surname" and "previous name" from the surname field; creating separate fields for "first forename" and "second forename" from the first name field; completing some missing "sex" values by cross-checking against first name and address fields; creating a field for "postcode" by extracting this from the address where available, or hard coding where the address contained a string mentioning the largest homeless hostels (about 35% of records were given a postcode this way); and creating a unique incremental record number plus a unique person identifier based on the exact match of full name with date of birth. These indicated that the dataset comprised 7720 individuals.

The formatted file was pre-processed by ISD to append Soundex codes and weights to the "surname" and "previous surname" fields. The Soundex system is a phonetic algorithm (see Appendix, page 316, for the algorithm) used to code similar-sounding names according to their pronunciation. It improves matching of names by removing the effects of spelling variations such as Smith and Smyth, or MacAllister and McAlistair. The pre-processed file was internally linked using probability matching on full and Soundexed surname and previous surname, first and second forename, all elements of date of birth individually, sex, and National Insurance number. The number of individuals in the file identified by this process fell from 7720 to 6898. However, given the quality of the data, this was likely to under-match the same individual, and therefore over-estimate the true number of individuals.

The internally linked file was then linked to the Scottish Morbidity Record/General Register Office for Scotland (SMR01/GRO(S)) deaths catalogue using probability matching on full and Soundexed surname and previous surname, first and second forename, all elements of date of birth individually, sex, and postcode. In total, about 87% of all records and 80% of the 6 898 homeless individuals were linked to the catalogue.

The Community Health Index sample was derived in 6 stages, as follows.

The first stage was to obtain general population data closest to the mid-point of the January-December 2000 homeless collection period. The September 2000 download of the CHI provided information on the Glasgow population at 30 June 2000.

The second step was to extract the NHS Greater Glasgow Health Board area population from the Scottish CHI at 30 June 2000 – a total population of 955 385 records.

The third step was to exclude any individuals who were part of the homeless cohort from the CHI sample. Any matching fields excluded individuals from the CHI sample. 6 449 (of the 6 898 homeless cohort) were eligible for this process: the remainder either lived outwith NHSGG catchment area or were not matched to any current registrations.

The fourth step was a further refinement of the matching process to exclude linkages with more than one possible CHI record.

The fifth step was to produce the matched non-homeless comparison group.

In the sixth and final step some refinement of the matching process was needed where exact non-homeless matches could not be obtained – for example, in the first cycle 10 dates of birth could not be matched to sex-specific CHI records. Given the size of the CHI population, this might seem an unlikely probability. Inspection of the non-matching records identified errors in the date of birth giving extreme old or young ages. These 10 cases were excluded.

The output from the CHI linkage was then checked against each corresponding stratum of homeless records. This helped to cross-validate the quality of the homeless records and led to further data cleaning and exclusion of remaining non-valid data. This left 6757 homeless and 13 514 age and sex matched non-homeless individuals. 81.5% of the 6757 homeless individuals had linked SMR/GRO(S) records whereas only 14.0% of the 141 rejected "bad links to CHI" had links.

4.4 Homelessness data collection by Glasgow City Council

Glasgow City Council administrated the largest local authority housing stock in Europe, 80 500 homes, until it was transferred to Glasgow Housing Association in March 2003. The Council's particular responsibilities to homeless people began with the 1977 Homeless Persons Act,[172] which gave legal recognition of homeless people and gave them certain rights, including priority status for local authority accommodation for certain groups (such as mothers with children).

The Council's housing stock data were managed on a variety of electronic systems before 2000. A system of stand-alone databases, designed by Kingfisher Systems (Scotland), was used to manage the housing stock including properties specially designed for homeless people. It is worth emphasising that the system was designed principally for the management of housing stock rather than being based around individuals' housing needs. This meant, for example, that if the same individual presented at a housing office several times in a few days, a new "application" would be opened each time. There was no routine linkage of individuals' records in the system.

The Kingfisher databases were merged into a single live operating system for all Glasgow City Council housing stock – the Integrated Housing Management System - in early 2001. After transfer of the Council's housing stock in 2003, the Integrated Housing Management System was split so that only the smaller remaining stock of properties for homeless people, refugees, and asylum seekers, was kept by the Council.

All individuals who present as homeless to the Council were recorded on the Integrated Housing Management System (IHMS). In the great majority of cases, one individual is the Main Applicant. The Main Applicant may be alone or accompanied by a partner, children, or other relatives. Each member of the homeless household, including unborn children, is recorded on the IHMS. In practice, there is little accommodation for couples with families and so family households are split into two applications – one for a man and one for a woman and her children. Separate accommodation is then offered for the two. As this study is concerned with the risks associated with adults who are homeless, only Main Applicant information was extracted from the IHMS. This should give a comprehensive account of the number of homeless adults who present to Glasgow City Council. The true number of individuals who experience homelessness, however, is larger when children are included.

The IHMS records demographic information (names, sex, date of birth, ethnicity, National Insurance numbers, household members, last address, etc), reasons for homelessness, accommodation offered, and details of rent payments. The strengths of the IHMS are that it captures a large number of individuals who are homeless and records demographic information that can be used to describe the epidemiology of homelessness or linked to other data sources such as the linked Scottish Morbidity Records. It also has a high specificity because legal criteria for homelessness are used to decide on eligibility for local authority assistance in each case. The main weakness of the IHMS is in its lack of sensitivity or selection bias. Only individuals who present to Glasgow City Council for assistance are recorded and therefore it excludes those who present to voluntary or charitable homeless agencies, or experience other forms of "hidden homelessness" such as rough sleepers, people staying temporarily at friends' houses, or living in shelters for victims of domestic violence.

4.5 The Scottish Morbidity Records

The principal record of the Scottish Morbidity Record is the SMR01, which records all discharges from hospital inpatient and day case episodes in general and acute specialties. The Scottish Morbidity Record system began in 1961. There are 3 main data fields on each record: identifying demographic information; administrative hospital data (such as specialty and consultant); and clinical information on up to 6 diagnoses and up to 4 procedures or operations with paired qualifying fields such as site or side of operation. An SMR01 is generated at the end of all finished consultant episodes, whether these end in discharge home, transfer to another specialty, or death. Thus, a single continuous inpatient stay by an individual may generate several SMR01 records. The records are completed by both clinical and administrative staff in hospitals either in electronic Patient Administration Systems or on paper.

An SMR01 is completed after discharge from a specialty, not on admission. Strictly, it therefore records hospital discharges. In practice, within a long-term follow-up period, the majority of patients are discharged and have an SMR01. Only those admitted at the very end of an observation period or who have extended lengths of hospital stay will not be included. A choice was made to use the more common expressions hospital admissions, or hospitalisations, throughout this thesis rather than hospital discharges. It is possible that a small number of individuals was admitted to, but not discharged from, hospital towards the end of the follow-up period and would not therefore have had an SMR01 completed.

Several other SMR specialties exist, including SMR00 (outpatient records), SMR02 (maternity), SMR04 (both psychiatric admissions and discharges), and SMR06 (cancer registrations).

4.6 The linked Scottish Morbidity Record dataset methodology

This section provides an overview of the linked Scottish Morbidity Record system. Without it, the cohort study would not have been feasible. It allowed a matched sample of non-homeless individuals to be identified; it allowed hospital admissions to be identified; and it provided a more sensitive method of identifying death records than simply obtaining exact demographic matches. It is therefore relevant to consider how the linked SMR database is constructed and how the dataset containing hospitalisation and deaths records was obtained.

Although the Scottish Morbidity Record system began in 1961, in 1968 a joint decision was made by the Scottish Health Service and Registrar General for Scotland to hold patient-identifiable information on all hospital discharge records (SMR01), cancer registrations (SMR06/SOCRATES), and death records on a central machine-readable form.[173]

Work began on the Scottish Record Linkage system in May 1989. Its aim was to group all centrally-held records by each patient. When data extraction was carried out for this thesis, linked data were available from 1st January 1981 to 30 September 2005.

Individuals are identified on the linked SMR database by 5 core items:

surname

initial

year of birth

month of birth

day of birth

Because of errors in recording the same individual's identifying details, the linkage process of bringing together all records for an individual comprises 3 stages: blocking, probability weighting, and making the linkage decision.

Blocking

The first stage of linkage comprises identifying records that do not disagree on 1 or more items from either of two blocks of information:

> Soundex/NYSIIS code,[174] first initial, and sex (Block A)
>
> or
>
> All elements of date of birth (day, month, year) (Block B)

The proportion of false negatives from this process (that is, where information from the same individual is incorrectly assumed to come from more than one person) is less than 0.5%.

Probability weighting

Internal linking of Scottish Morbidity Records is carried out using a patient's surname (plus maiden name if available), forename, sex, date of birth, and postcode of residence. Hospital-assigned reference numbers can also be used where the same system is applied to an individual's records (for example, within one hospital or sometimes within a Health Board area).

Surnames are compressed using the Soundex/NYSIIS (New York State Intelligence Information System) system. This process improves the likelihood of correctly matching the same individual by reducing the effect of misspelling. For details of the Soundex and NYSIIS algorithms, see Appendix page 316.

Next, probability matching involves calculating the likelihood that similar records come from the same individual, or come from different individuals. It comprises a mixture of calculating the amount of agreement between each of the identifying variables, and the chance that any given difference could occur.

Decision making

The degree of matching and mismatching between records is converted from odds ratios into binit weights (log odds to the base 2) because of their mathematical advantages. A threshold needs to be set above which pairs will be taken to come from the same individual, and below which they will be taken to come from different individuals. The threshold is usually determined to be at the 0.5 level – that is, above it, the balance of probabilities is that records come from the same individual.

The linked Scottish Morbidity Record/General Register Office for Scotland (SMR01/GRO(S)) dataset comprises information on all episodes of care, continuous inpatient stays for individuals, and complete histories of inpatient care and death (if it occurred) for individuals.

4.7 General Register Office for Scotland death records

Registration of births, marriages and deaths by the General Registry (now Registrar) Office began in Scotland on the 1st January 1855.[175] The GRO collates all death records for Scotland. These include information on individuals' names, dates of birth, occupation, spouse, place of death, and up to 6 causes of death. The first listed cause of death is by convention taken to be the principal or main cause.

4.8 Measuring socio-economic status: individual and ecological measures

Any scientific analysis of the effects of socio-economic status must begin with a valid measure of it. Occupational social classes infer both income and social standing, and their consistent relationship with mortality and other health outcomes (such as hospitalisation) suggests that they represent some real risk factors for health.

The Carstairs score[2] was developed to fulfil three main limitations of individual occupational social class data. Firstly, social class alone is a limited measure of socio-economic status. Secondly, and as an extension of this, numerator/denominator bias was noted (that is, classification of occupation on the death record occupational classification and in the Census denominator population do not necessarily concur). And thirdly, health records and related information, unlike death records, do not hold data on individuals' social class or occupation. The Carstairs score applied Census variables to postcode sectors, whose average size is 5000 individuals. Event rates – whether deaths or healthcare episodes – could thus be calculated for a given geographic area Census population, rather than using a social class denominator.

Carstairs produced a series of Pearson's product-moment correlations between Census variables that reflected "the access people have to material resources which allow (to quote Townsend) 'individuals to play the roles, participate in relationships and follow the customary behaviour which is expected of them by virtue of their membership in society'[176,2] and health outcomes. Four were selected:

overcrowding	persons in private households living at a density of >1 person per room as a proportion of all persons in private households
male unemployment	proportion of economically active males who are seeking work
low social class	proportion of all persons in private households with head of household in social class 4 or 5
no car	proportion of all persons in private households with no car

Box 2. Census variables used in the Carstairs score.[2]

Each indicator was considered by Carstairs to "represent or be determinant of material disadvantage."[2] Housing tenure was not included in the list because it was considered to be of lesser value in Scotland, which had a higher proportion of public sector housing stock than England and Wales. The Carstairs deprivation score is an unweighted combination of these four standardised variables, giving a summary statistic (a z-score) for an area. A further refinement, the DEPCAT, produced 7 categories of an area's socio-economic status, from 1 (most affluent) to 7 (most deprived). In order to maintain discrimination between categories, a simple septile (or quintile) was not considered appropriate. Thus, the proportion of the population in each group was as shown in Table 8.

Table 8. Population of Scotland living at differing levels of deprivation (from Carstairs and Morris)

DEPCAT	Population
1 (most affluent)	6.1%
2	13.7%
3	21.8%
4	25.5%
5	14.8%
6	11.4%
7 (most deprived)	6.8%

4.9 Definition of homelessness used in this thesis

The Homelessness Task Force[34,177] identified a range of housing situations that defined the meaning of homelessness for the purposes of their work. This definition embraced the following categories, which are not mutually exclusive, but all have been specified in the interests of clarity.

1. Persons defined in current legislation as homeless persons and persons threatened with homelessness, that is those:

    - Without any accommodation in which they can live with their families.
    - Who cannot gain access to their accommodation or would risk domestic violence by living there.
    - Whose accommodation is "unreasonable", or is overcrowded and a danger to health.
    - Whose accommodation is a caravan or boat and they have nowhere to park it.

2. Those persons experiencing one or more of the following situations, even if these situations are not covered by the legislation:

    - Roofless: those persons without shelter of any kind. This includes people who are sleeping rough, victims of fire and flood, and newly-arrived immigrants.
    - Houseless: those persons living in emergency and temporary accommodation provided for homeless people. Examples of such accommodation are night shelters, hostels and refuges.
    - Households residing in accommodation, such as Bed & Breakfast premises, which is unsuitable as long-stay accommodation because they have nowhere else to stay.
    - Those persons staying in institutions only because they have nowhere else to stay.

- Insecure accommodation: those persons in accommodation that is insecure in reality rather than simply, or necessarily, held on an impermanent tenure. This group includes:

    - Tenants or owner-occupiers likely to be evicted (whether lawfully or unlawfully).

    - Persons with no legal rights or permission to remain in accommodation, such as squatters or young people asked to leave the family home.

    - Persons with only a short-term permission to stay, such as those moving around friends' and relatives' houses with no stable base.

- Involuntary Sharing of Housing in Unreasonable Circumstances: those persons who are involuntarily sharing accommodation with another household on a long-term basis in housing circumstances deemed to be unreasonable.

4.10 Measuring morbidity for adjusted hazards models

The third set of analyses, presented in Chapter 7, used SMR01 records to infer morbidities in all subjects. In the earlier analyses of hospital admissions in Chapter 6 only the first diagnostic position of the first record in each continuous inpatient stay was used to classify the main condition. In contrast, all diagnostic positions of all SMR01 records were searched to identify the presence of major morbidities for Chapter 7. Each diagnostic group was counted once per individual whether it occurred or one or multiple SMR01 records. Any individual could have multiple morbidities.

4.11 Statistical methods

Statistical analyses were performed on SPSS version 15.0 software with some tables, graphs and summary statistics produced on Microsoft Excel software. Stata version 9.2 software was used to calculate confidence intervals for risk ratios.

Parametric methods were used on data that were normally distributed, such as age. Student's t-test of independent samples was used to compare means between unmatched groups, such as males and females or homeless and non-homeless cohorts.

Where possible, confidence intervals were calculated in favour of p-values because they give more information on the size of the spread of results about an estimate. Where a hypothesis test was the most appropriate one – for example, the logrank or Mantel-Cox test[178] in Kaplan-Meier survival curves – exact p-values were given to the third decimal place.

Kaplan-Meier survival curves[179] were produced to show overall patterns of survival between homeless and non-homeless cohorts by age and sex. The Kaplan-Meier conditional probability is calculated from the formula:[180]

$$p_k = p_{k-1} \text{ x } \frac{r_k - f_k}{r_k}$$

where p_k is the probability of surviving k days, r_k is the number of subjects still at risk (still being followed up) immediately before the kth day, and f_k is the number of observed failures (deaths) on day k. The logrank test[178] was used to compare survival times between independent groups. This is a non-parametric hypothesis test based on the χ^2 distribution. As such, it gives no direct information on the size of any difference in survival between groups. Strengths of the Kaplan-Meier are that it provides readily interpretable graphical information on survival experience and indicates whether deaths rates between groups occur constantly over time - a condition of proportional hazards models. Their main limitation is that while stratified models can be created, they cannot be used to explore the effects of several variables on survival.[180]

Multivariate models were produced using Cox proportional hazards models.[181] The Cox model is a special form of the General Linear Model, in which there are two underlying assumptions: linearity and additivity.[182] Linearity is the assumption that the relationship betweens pairs of variables can be represented by a straight line. Additivity is the assumption that as explanatory, or independent, variables are introduced to the model their predictive effects can be added to those of existing variables. Often transformations of data are required to allow a linear model to be used. The simplest linear regression equation is:

$$y = a + \beta X$$

where y is the dependent variable, a is a constant representing the value of y when X=0, and β is the coefficient representing a change in y associated with a one-unit change in X.

Multiple regression can be written as an extension of the linear equation

$$y = a + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n$$

where y is the dependent variable, a is a constant representing the value of y when X_1, X_2,…X_n = 0, and β_1, β_2, …β_n are a series of coefficients associated with unit changes in their associated variables, X_1, X_2,…X_n.

The hazard function is the instantaneous risk of death conditional on surviving to a given point in time. The hazard of death at time t, h(t) is given by

$$h(\mathrm{t}) = h_0(\mathrm{t}) \times \exp(\beta_1 X_1 + \beta_2 X_2 + ... + \beta_p X_p)$$

where $h_0(t)$ is the baseline or underlying hazard when all variables are 0 (that is, $e^0=1$), β_1 to β_p are regression coefficients, and X_1 to X_p are independent variables of interest. The proportional hazards assumption is that effect parameters multiply hazard and that this relationship is constant over time.

Cox's proportional hazards model, however, is semiparametric, in that it does not consider the hazard function. The hazard ratio for a subject with a set of predictors X^* compared to a subject with a set of predictors X is

$$hr(X^* : X) = \frac{\exp(X^* \beta)}{\exp(X\beta)} = \exp\{(X^* - X)\beta\}$$

and the point estimate for the hazard ratio is

$$\hat{hr}(X^* : X) = \frac{\exp(X^* \hat{\beta})}{\exp(X\hat{\beta})} = \exp\{(X^* - X)\hat{\beta}\}$$

Where $\hat{\beta}$ is the maximum likelihood estimate of β.

The Cox proportional hazards model assumes that the shape of the survival function over time is the same for all cases, and thus for all groups. If this condition is not satisfied, interactions will occur between groups and time, or between covariates and time. In addition to visual assessment of Kaplan-Meier curves for steadily increasing differences between curves, log-minus-log survival curves were plotted because it is easier to see whether the vertical difference between curves is constant over time rather than whether it diverges consistently. [182, 183]

Proportional hazards models are relatively resistant to the effects of correlations between covariates unless they are very high (in excess of 0.90). None of the variables in the multivariable analyses was obviously measuring the same characteristic. However, it is possible that hospitalisation for one cause (for example, drug use) was highly correlated with hospitalisation for another (for example, alcohol abuse). Because many causes of hospitalisation were entered into the survival models in Chapter 7, tests of multicollinearity were carried out using SPSS FACTOR analysis with syntax described by Tabachnik and Fiddell. [182] These models analyse correlation matrices using principal axis factoring. Initial extraction values of less than 0.90 suggest that there is no multicollinearity between variables.

4.12 Summary and conclusions on the strengths and weaknesses of available data

The retrospective cohort study used two sources of data to identify cohorts: homeless presentations to Glasgow City Council recorded on the Integrated Housing Management System and the Community Health Index to identify a non-homeless comparison population. Health outcomes were identified through linked hospitalisation and death records recorded on the SMR01/GRO(S) database.

The IHMS is probably the most comprehensive and largest single electronic database of homeless people in the world. It uses standard legal definitions to define homelessness, giving it high validity. Its weaknesses lie in its selection biases. It most accurately records incident, rather than prevalent, homelessness and captures only those people who have attended Glasgow City Council services and not other homeless services or the "hidden homeless." It does not capture data on resolution of homelessness because individuals who leave Council homeless accommodation may be moving to alternative forms of homelessness – such as rough sleeping – or may vacate a temporary furnished flat without the Council realising for some time. On balance, however, the strengths of the IHMS outweigh its limitations in identifying a large cohort of homeless people and its electronic format makes linkage to other databases, such as the SMR01/GRO(S) possible.

The Community Health Index was used to identify an age and sex matched stratified random sample from the non-homeless Greater Glasgow Health Board area. The main advantage of the CHI is that it is can readily be used to identify linked records within the

SMR01/GRO(S) database: alternative sources of population data, such as electoral rolls, are subject to greater missing data and would require separate linkage by probability matching to the SMR01/GRO(S), introducing an extra level of error. The CHI omits up to 10% of the general population because they are not registered with a GP. However, this group is more likely to contain homeless and itinerant populations and therefore the CHI is biased in favour of recording non-homeless individuals. This makes it useful as a source for the comparison group.

The linked SMR01/GRO(S) is a database that uses a range of validated methods to match all individuals' hospital and death records so that individual health risks, rather than episodes of healthcare activity, can be calculated. Its strengths include the quality of internal linkage and comprehensive Scottish national coverage. Its principal weakness is that probability matching accepts an inevitable small mismatch error between records.

Chapter 5. Deaths in homeless and deprived populations

5.1 Overview of the data and initial cleaning

The Information Services Division of NHS National Services (ISD) returned a file containing 106 720 cases, comprising index records for both homeless and Community Health Index comparators and all linked hospitalisation and death records. The linked dataset included hospitalisations from 1981 onwards but admissions before entry into the study in 2000 were removed to produce a new file comprising 59 990 records on or after entry into the cohort.

The dataset comprised records for 6757 homeless and 13 514 CHI individuals. 434 homeless and 889 non-homeless individuals (6.4% and 6.6% of each group, respectively) were aged less than 18 and were removed. Individuals under the age of 18 who present to the local authority as homeless are given different services to those aged 18 and over. Under 16-year olds who are homeless are looked after by Social Work children's services. 16 and 17 year old homeless individuals are not "looked after" as such because they are not children but they are offered special support services and accommodation, also by Social Work rather than Housing Services.

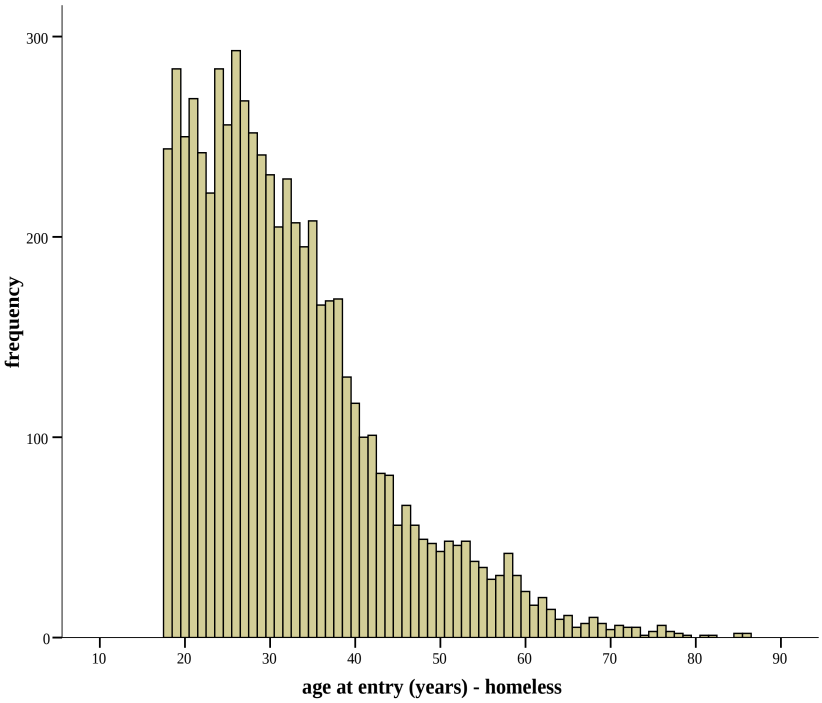
There were 18 948 eligible subjects for the study, comprising 6323 homeless and 12 625 non-homeless individuals. They generated a total of 57 021 hospital and death records. Each cohort comprised 65% men and 35% women.

The age ranges of both cohorts on entry in 2000 were 18 to 86 years. Figure 11 shows that there was a negative skew to the age distribution, so that while the mean age was 32.2 years (95% CI 32.0 to 32.3) the median was 30 years and modal age was 26. There was no significant difference in ages of the homeless and non-homeless cohorts on entry into the study (t-test of independent samples, 2-tailed, difference 0.08 years, $p=0.65$).

Men were significantly older than women. The mean ages of males and females were 33.3 and 30.0 years, respectively (t-test of independent samples, $p<0.001$).

The mean follow-up period for the homeless cohort was 5.1 years (range: 0 days to 5.7 years) and for the non-homeless cohort was 5.2 years (range: 8 days to 5.3 years). The longer maximum follow-up in the homeless cohort reflects the fact that homeless participants could join the cohort up to 6 months before (on 1st January 2000) the non-homeless cohort (30th June 2000).

Figure 11. Histograms showing age distribution on entry into study in 2000 in homeless (n=6323) and non-homeless (n=12 625) cohorts.



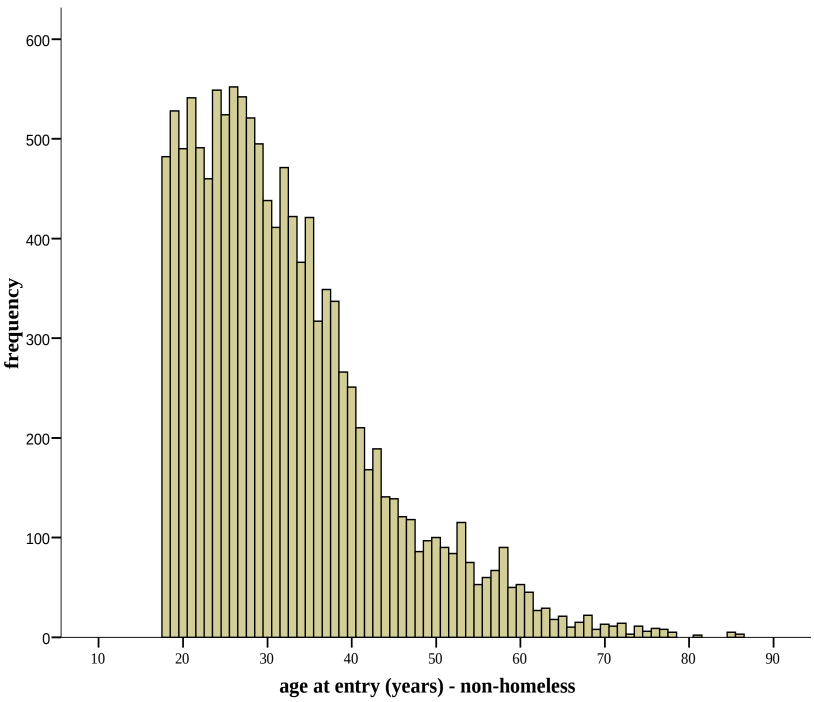
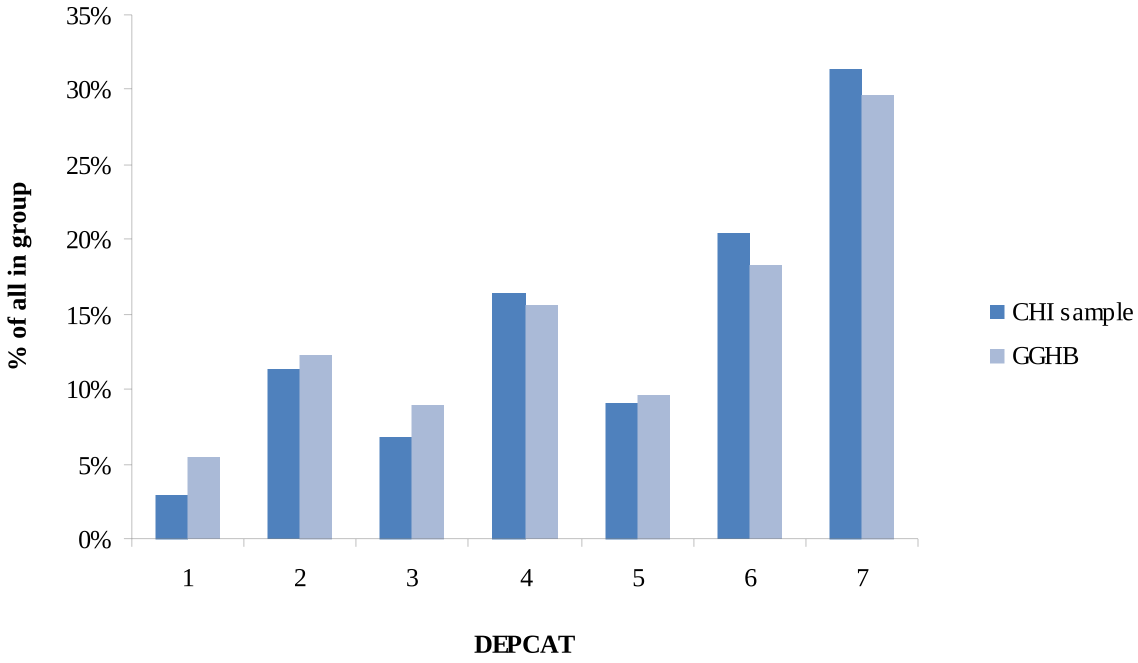


Figure 12 shows the distribution of individuals in the non-homeless cohort (CHI sample) by DEPCAT of residence on entry into the study. The pattern is typical of NHS Greater Glasgow area, with about half of all residents (51.9%) in the most deprived areas, DEPCATs 6 and 7. Numbers and percentages are provided in the Appendix, Table 21 on page 292.

Figure 12. Proportion of male and female non-homeless sample (n=12 625) in each DEPCAT with 2001 Census GGHB population distribution for comparison.



Homeless individuals died 12 years younger than non-homeless - Table 9. In both cohorts women died younger than men, a difference of 5 years and 3 years in homeless and non-homeless cohorts, respectively, although the difference was statistically significant in the homeless cohort, only. It should be noted that cohorts were the same age on entry into the study.

Table 9. Numbers of deaths and mean age at death, with 95% confidence intervals.

Cohort	sex	mean age (95% CI)	number
Non-homeless	Male	53.6 (51.2 – 56.0)	174
	Female	50.7 (44.2 – 57.2)	35
	Total	53.1 (50.8 – 55.4)	209
Homeless	Male	41.9 (40.5 – 43.4)	377
	Female	36.6 (34.5 – 38.8)	80
	Total	41.0 (39.7 – 42.3)	457
Total	Male	45.6 (44.3 – 47.0)	551
	Female	40.9 (38.2 – 43.6)	115
	Total	44.8 (43.6 – 46.0)	666

5.2 Risk of death

Four hundred and fifty seven (7.2%) of the homeless cohort and 209 (1.7%) of the non-homeless cohort died between entry into the study in 2000 and the end of follow-up in 2005. These incident proportions need to be refined to take into account the length of follow-up individuals actually contributed. This is particularly important for deaths among the homeless cohort. Because a higher proportion of the homeless cohort died, the person-time of follow-up may be significantly less than that in the non-homeless cohort. As a result, the relative risk of death between homeless and non-homeless persons may be greater than the cumulative incidence ratio of 4.2 (7.2/1.7).

The risk of death in any given cohort is given by the ratio

$$\frac{\sum \text{number of deaths}}{\sum \text{person} - \text{time at risk of death}}$$

where person-time at risk is the sum of all days from entry into the cohort until either death or censoring at the end of the follow-up period.

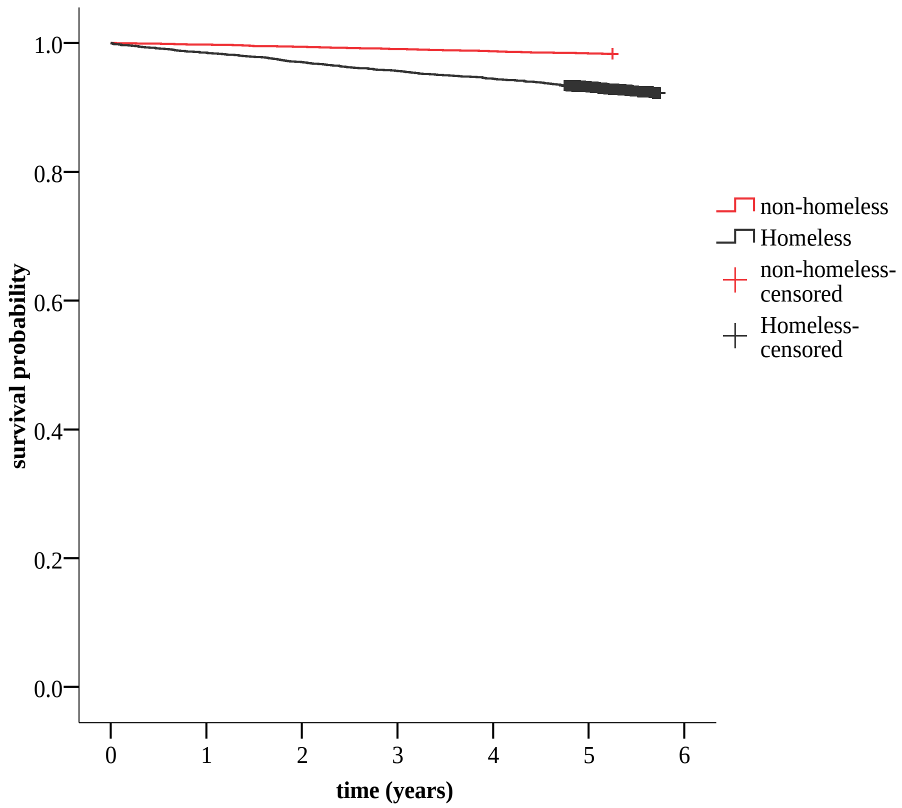
Table 10 shows the crude death risks in both homeless and non-homeless cohorts, where the cumulative number of person-days at risk until death or censoring has been divided by 365.25 to create person-years. The crude risk ratio for death in homeless people compared with non-homeless is thus 14.1/3.1 = 4.4 (95% CI 3.7 to 5.2). That is, homeless people were at four and a half times greater risk of death than non-homeless people in 5 years of follow-up.

Table 10. Numbers of deaths and crude death rates in homeless and non-homeless cohorts.

cohort	deaths	∑person-years at risk	deaths per 1000 person-years
Non-homeless	209	64 848.4	3.2
Homeless	457	32 321.8	14.1
TOTAL	666	97 170.2	6.9

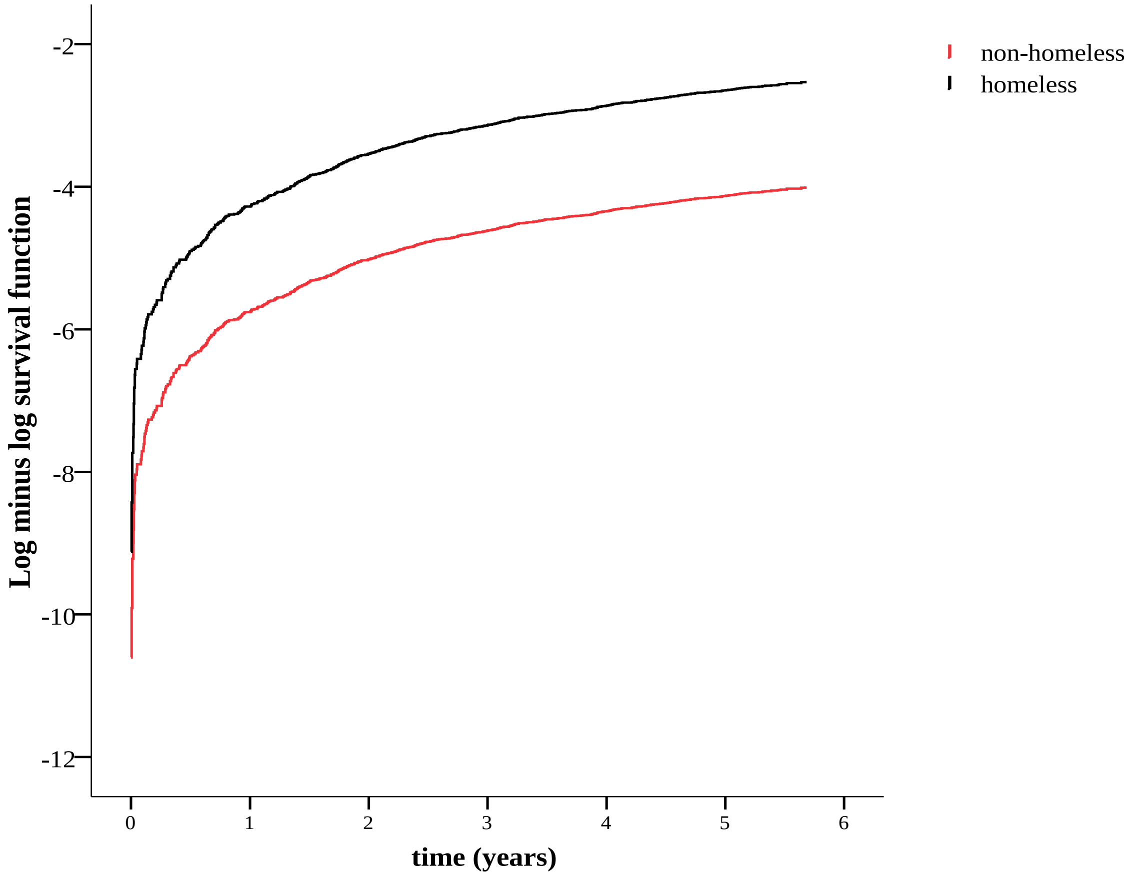
Figure 13 shows a Kaplan-Meier survival plot of the homeless and non-homeless cohorts. The event rate (death) is constant over time and significantly greater in the homeless cohort (logrank test, $p<0.001$). There is an extended section of censored data among the homeless because they were recruited over a period of a year and therefore their censor dates – when they reached the end of follow-up - also extend over a year.

Figure 13. Kaplan-Meier plot of survival over time (years) from entry into the cohort, in both homeless and non-homeless cohorts. Logrank (Mantel-Cox) test, p<0.001.



While the divergence of the two plot lines in Figure 13 suggests a constant risk over time, the log-minus-log plot in Figure 14 is more easily interpreted. It shows a constant vertical difference between homeless and non-homeless cohorts over time, indicating that the proportionality assumption has been met and therefore Cox proportional hazards models can be used to describe the data.

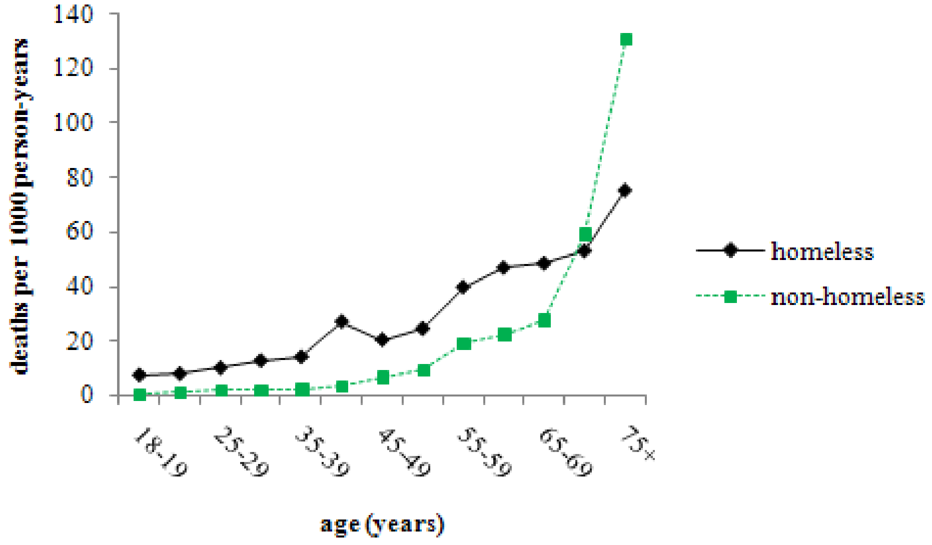
Figure 14. Log-minus-log survival plot in homeless and non-homeless cohorts.



5.3 Risk of death, by age

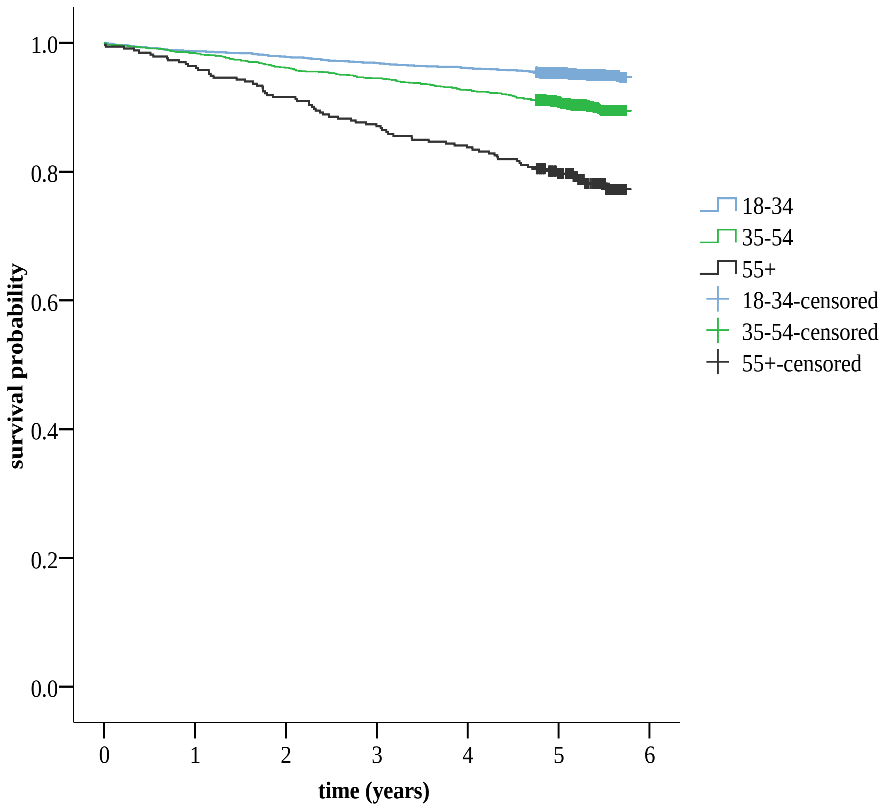
The risk of death increases with age and is higher among homeless people. Figure 15 shows that at all ages up until 65 years homelessness is associated with an increased risk of death. Above this age, risks in the non-homeless cohort increase steeply so that in the 75 and older group mortality risks are 1.7 (0.7 – 4.9) times greater than among the homeless cohort.

Figure 15. Death rates per thousand person-years by age in homeless and non-homeless cohorts.



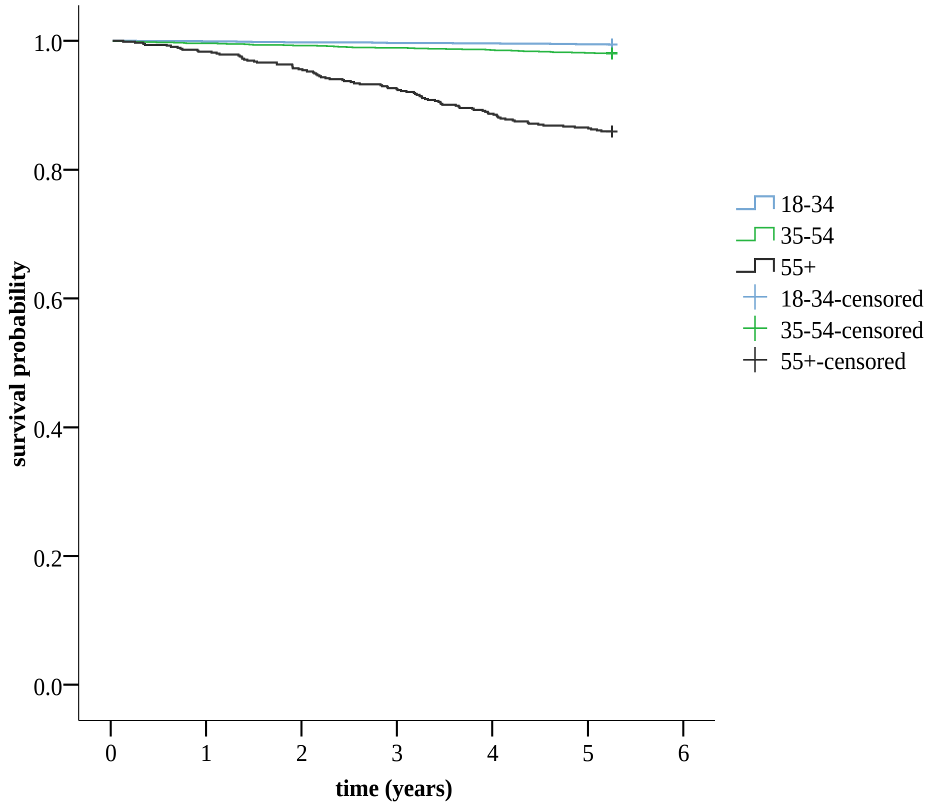
For clarity, Kaplan-Meier plots of survival by age were produced using age in three groups for homeless and non-homeless cohorts separately. Figure 16 confirms a significant increasing mortality risk with greater age with a much higher risk in the 55 and older group.

Figure 16. Kaplan-Meier plot of survival by age. Homeless cohort, n=6323. Logrank (Mantel-Cox) test, p<0.001



The difference in survival between non-homeless individuals age 18-34 and 35-54 is very small and the major effect of age on risk of survival is seen above the age of 55 - Figure 17.

Figure 17. Kaplan-Meier plot of survival by age. Non-homeless cohort, n=12 451. Logrank (Mantel-Cox) test, p<0.001



5.4 Risk of death, by sex

The risk ratio of deaths between men and women is similar in each cohort, at 2.7 in homeless and 2.6 in non-homeless cohorts. Within each sex, homelessness confers a similar risk ratio of 4.4 in males and 4.5 in females - Table 11. Thus homelessness is a greater risk factor than being male but both homelessness and male sex are risk factors.

Table 11. Numbers, rates, and ratios of deaths by sex and homeless/non-homeless status.

sex	cohort	number of deaths	∑ person-years at risk	deaths per1000 person-years	risk ratio
Male	Non-homeless	174	42 087.7	4.1	1
	Homeless	377	20 804.6	18.1	4.4 (3.7 – 5.3)
Female	Non-homeless	35	22 760.8	1.5	1
	Homeless	80	11 517.2	6.9	4.5 (3.0 – 6.9)

Figure 18 shows survival in the homeless cohort by sex. Survival was significantly lower in men compared with women throughout the follow-up period (logrank test, $p<0.001$). As in Figure 13, there is an extended period of censoring as the cohort reaches the end of follow-up.

Figure 18. Kaplan-Meier survival plot by sex, homeless cohort. N=6323. Logrank (Mantel-Cox) test, p<0.001

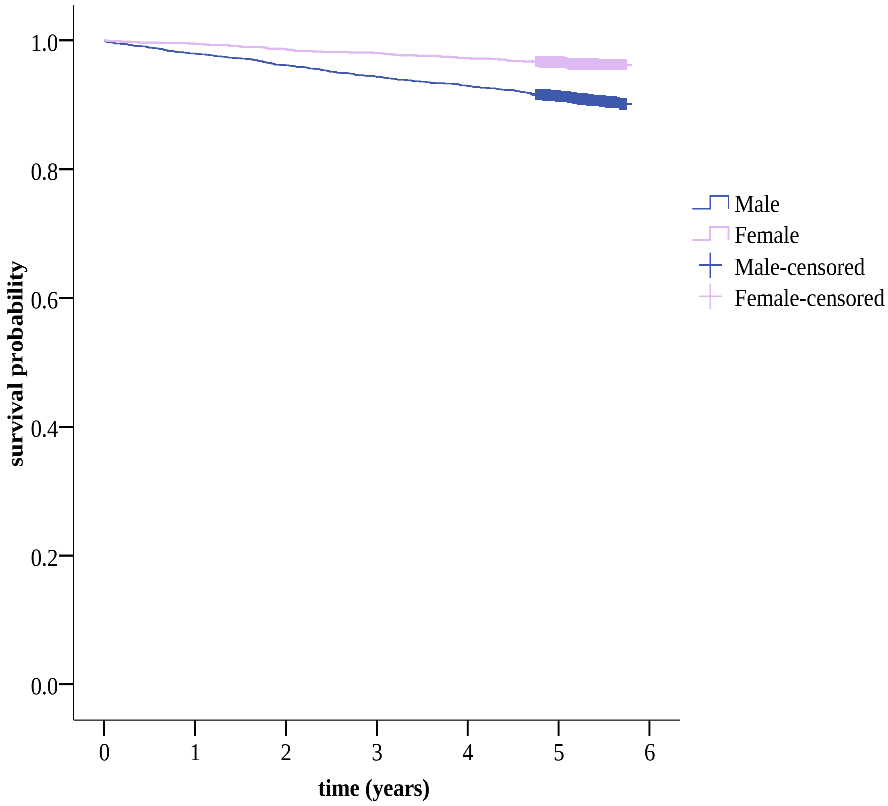
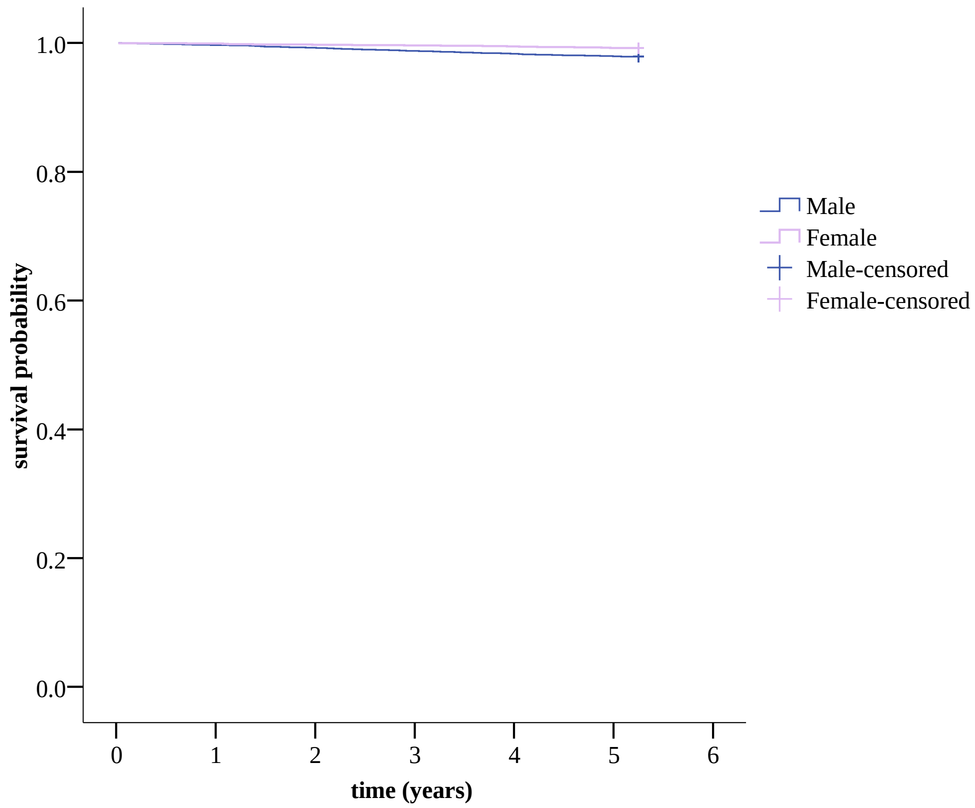


Figure 19 shows survival in the non-homeless cohort by sex. Males have statistically significantly poorer survival than females (logrank test, p<0.001) but the overall survival in both sexes is better than in homeless individuals.

Figure 19. Kaplan-Meier survival plot by sex, non-homeless cohort. N=12 451. Logrank (Mantel-Cox) test, p<0.001



5.5 Risk of death, by age and sex

The relationships between age and mortality risk differ between men and women. In men - Figure 20 – the increase in risk of death appears to be exponential in both homeless and non-homeless cohorts. In women, however, - Figure 21 – the increase with age appears to be more linear in both cohorts and the absolute risks and risk differences are smaller than in men. Small numbers of deaths introduce random error at greater ages in both men and women.

Thus sex is an effect modifier for the relationship between age and mortality risks in both homeless and non-homeless cohorts.

An alternative grouping of age is provided in the Appendix to make direct comparisons with published data from other countries.

Figure 20. Male death rates per 1000 person-years, by age, in homeless cohorts.

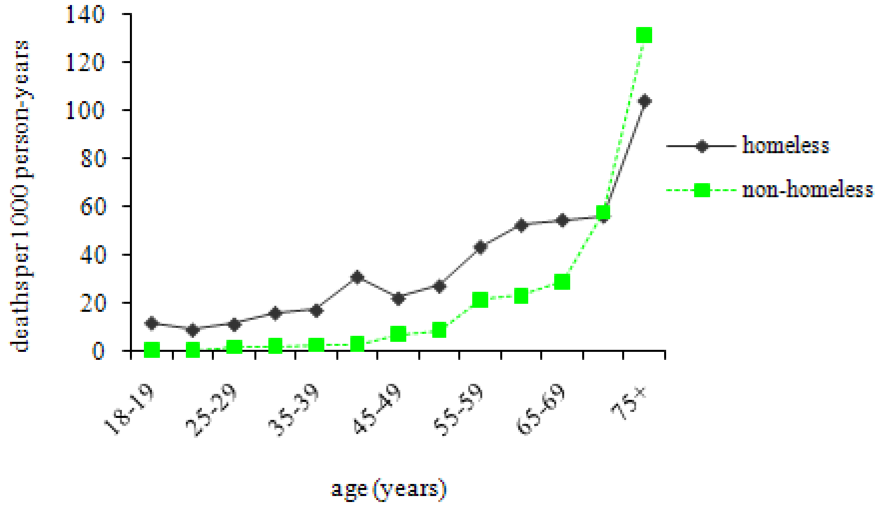
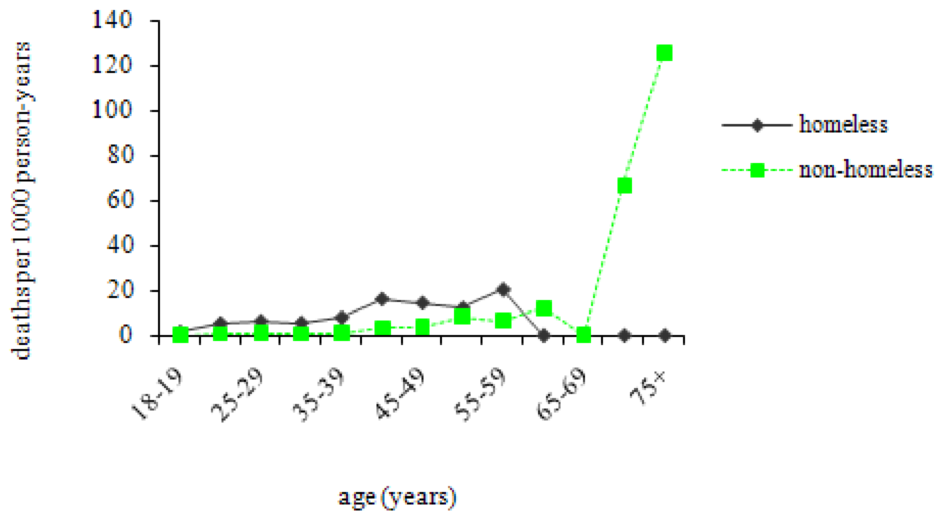


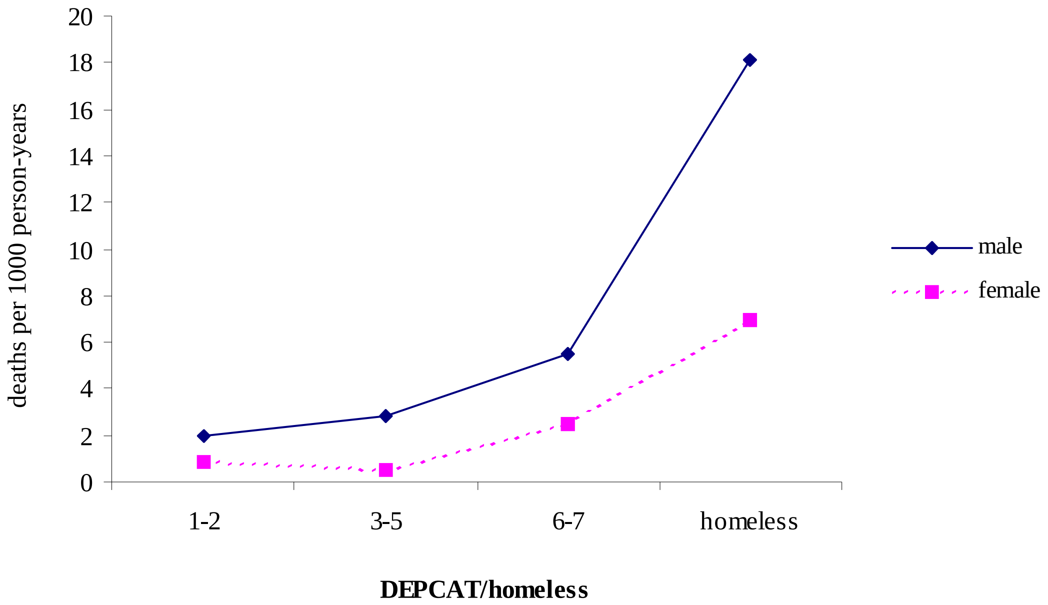
Figure 21. Female death rates per 1000 person-years, by age, in homeless and non-homeless cohorts.



5.6 Risk of death, by sex and socio-economic circumstances

The risk of death increased with greater socio-economic deprivation but was much higher among the homeless - Figure 22. In women, death rates in the intermediate group, DEPCATs 3 to 5, were slightly lower than those in DEPCATs 1 and 2 but then increased in the most deprived areas, DEPCATs 6 and 7. In men, an increase in risk of death was seen consistently with increasing deprivation. Homelessness conferred by far the greatest risk of death, a risk ratio of 9.0 (5.1 to 17.7) in men and 8.1 (2.7 to 39.9) in women compared with residents of DEPCAT 1 and 2 areas. Numbers and rates of death in each DEPCAT are provided in the Appendix, Table 22 on page 293.

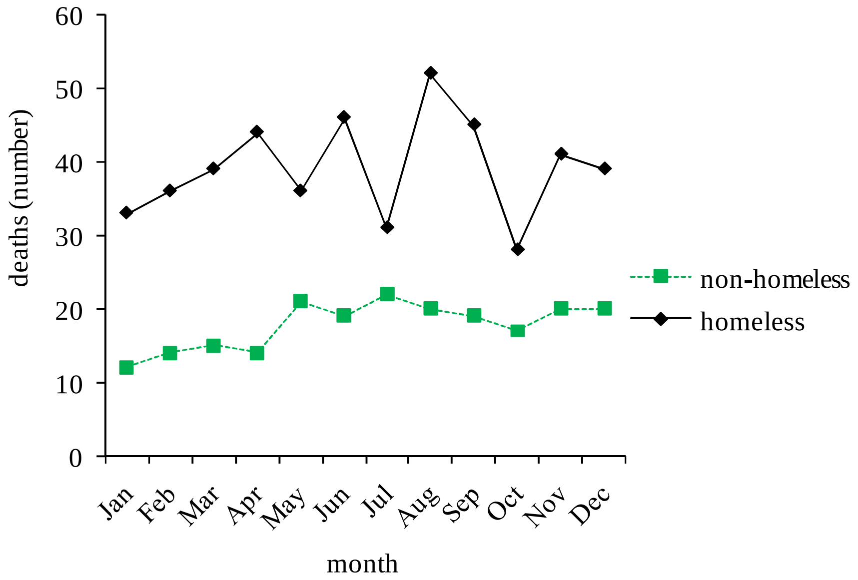
Figure 22. Death rates per 1000 person-years by DEPCAT2001 or homeless status. n=209 non-homeless and n=457 homeless deaths.



5.7 Risk of death, by month

It might be anticipated that excess winter deaths[184] would be exaggerated in homeless people because of their greater exposure to poorly heated accommodation and rough sleeping. However, excess deaths in summer months have been reported in the homeless.[113] While there are month-to-month variations in deaths there was no consistent seasonal pattern in either homeless or non-homeless cohorts - Figure 23.

Figure 23. Number of deaths in each calendar month in homeless (n=209) and non-homeless (n=457) cohorts, 2000-05.



5.8 Proportional hazards models for risks of death

Cox proportional hazards models were produced to control for the effects of age, sex, socio-economic circumstances and homelessness. Table 12 provides both univariate and multivariable models. Univariate models indicate that homelessness is associated with a hazard ratio of death 4.4 times greater than the general population. Hazards of death increased with greater deprivation but are only statistically significant in the most deprived areas compared with the most affluent. Homelessness conferred a hazard ratio 9 times greater than being a resident of the most affluent non-homeless areas. Men were at nearly 3 times greater hazard of death than women and the hazard approximately doubled with every additional decade of age.

Multivariable analysis did not include the homeless/non-homeless variable because it is included in the DEPCAT/homeless factor. Although individual risks were reduced slightly, the overall pattern was similar to the univariate models. Homelessness was associated with a nearly 9-fold increase in risk of death compared to being a resident of the most affluent areas, and the risk was almost 3 times greater than residents of the most deprived areas. Men were at twice the hazard of death than women, and increasing age remained the largest risk factor for death. The minimal effect of combining variables in a multivariable model may be because the cohorts were matched for age and sex and therefore these had minimal confounding effects on the unadjusted results.

Table 12. Proportional hazards of death in 5 years in homeless and non-homeless cohorts in Glasgow with 95% confidence interval in brackets. N= 18 774. Baseline group = 1.0 in each case.

	number	Univariate	Multivariable
non-homeless	12 451	1.0	
homeless	6323	4.4 (3.8-5.2)	not included
DEPCAT			
1 & 2 (affluent)	1811	1.0	1.0
3 – 5 (intermediate)	4087	1.2 (0.7-2.2)	1.3 (0.7-2.3)
6 & 7 (deprived)	6553	2.8 (1.7-4.8)	2.6 (1.5-4.4)
homeless	6323	8.9 (5.3-15.0)	8.7 (5.2-14.5)
sex			
female	6566	1.0	1.00
male	12 208	2.6 (2.1-3.2)	2.1 (1.7-2.3)
age			
18-24	5278	1.0	1.0
25-34	7054	1.6 (1.2-2.1)	1.5 (1.2-2.0)
35-44	3949	2.6 (2.0-3.4)	2.5 (1.9-3.3)
45-54	1507	4.2 (3.1-5.6)	3.8 (2.8-5.1)
55-64	740	9.3 (6.9-12.4)	7.9 (5.9-10.6)
65-74	187	14.7 (10.0-21.6)	12.2 (8.3-18.0)
≥75	59	37.2 (23.9-57.9)	30.6 (19.6-47.6)

5.9 Causes of death

There were marked differences in the underlying causes of death between the general population and homeless cohorts. Table 13 shows principal causes of death with age and sex adjusted hazard ratios for the homeless compared with non-homeless cohorts. As Table 11 found that sex was not an effect modifier on the risk of death associated with homelessness, separate male and female analyses were not performed.

Opioids and other psychoactive drugs together accounted for a third of deaths in homeless people. In contrast, myocardial infarction, alcoholic liver disease, and lung carcinoma (individual numbers not shown in Table 13) accounted for a quarter of deaths in the general population. As a proportion of all deaths, alcohol accounted for a similar proportion in homeless and non-homeless cohorts (16% and 15%, respectively). Among the infectious and parasitic diseases there were 4 deaths from HIV (ICD-10 B20-24) overall and the risk ratio of deaths from HIV associated with homeless was 6.0.

The overall hazard ratio of death in the homeless cohort, 4.5, was reflected in raised hazard ratios for all causes except neoplasms. Homelessness increased the hazard of death from drugs 20-fold and the hazards of suicide (intentional self-harm) and assault by 8 and 7 fold, respectively.

It must be remembered that the general population sample was age and sex matched with the homeless cohort, so it comprised a much larger proportion of young people and men than the whole population. However, matching minimised biases between the two cohorts due to these factors.

Table 13. Number, percent, and age and sex-adjusted hazard ratios for deaths over 5 years by principle cause of death. Baseline hazard ratio is non-homeless in each row.

Cause of death (ICD-10)	**n (%)**		**Hazard ratio (95% CI)**
	homeless	non-homeless	
Drugs (F11-16, F18-19, Y10-12, Y14)	153 (33.5)	15 (7.2)	20.4 (12.0-34.7)
Alcohol (Y15, F10, K70)	73 (16.0)	32 (15.3)	4.7 (3.1-7.1)
Circulatory (I00-99)	58 (12.7)	48 (23.0)	2.5 (1.7-3.7)
Intentional self-harm (X60-84)	34 (7.4)	8 (3.8)	8.4 (3.9-18.2)
Neoplasms (C00-97)	23 (5.0)	57 (27.3)	0.8 (0.5-1.4)
Respiratory (J00-99)	36 (7.9)	13 (6.2)	5.6 (3.0-10.7)
Assault (X85-Y09)	17 (3.7)	5 (2.4)	7.0 (2.6-19.0)
Infectious & parasitic (A00-B99)	8 (1.8)	3 (1.4)	5.6 (1.5-21.1)
Endocrine, nutritional & metabolic (E00-90)	6 (1.3)	3 (1.4)	4.1 (1.0-16.4)
Nervous system (G00-99)	6 (1.3)	6 (2.9)	2.1 (0.7-6.4)
All other causes	43 (9.4)	19 (9.1)	4.6 (2.7-8.0)
ALL	457 (100.0)	209 (100.0)	4.5 (3.8-5.2)

5.10 Summary of results on deaths

1.7% of the general population and 7.2% of the homeless cohort died in 5 years' follow-up. Homelessness was associated with death on average 12 years younger than the matched general population (41 versus 53 years). In both groups women died at a younger age than men. Risk of death increased with age in both cohorts but absolute risks of death were higher in the homeless at all ages except above 70 in men and 60 in women. Although risk of death increased with greater socio-economic deprivation, homelessness was associated with a greater risk than living in the most deprived areas of the general population. No seasonal pattern was observed in either homeless or non-homeless death rates. Cox's proportional hazards models yielded age and sex adjusted hazards of death of 2.6 (1.5 - 4.4) for residents of the most deprived areas and 8.7 (5.2 - 14.5) for homeless individuals compared with residents of the most affluent areas. Men were at twice the risk of death as women during the 5-year follow-up period.

A third of deaths in the homeless were caused by drugs and a further 16% by alcohol. Cancers (27%) and cardiovascular diseases (23%) were the commonest causes of death in the general population. In the homeless, adjusted hazards ratios for drug deaths, suicide, and assault were 20, 8 and 7 respectively. Alcohol deaths were 5 times more frequent in homeless individuals.

Chapter 6. Hospitalisation in homeless and deprived populations

6.1 Overview of hospitalisations

There were 18 948 eligible subjects for the study, comprising 6323 homeless and 12 625 non-homeless individuals. An overview of the demographics of participants is provided in Section 5.1 on page 157.

There were 24 844 finished consultant episodes from entry into the study until death or censor date in 2005. These comprised 21 847 continuous inpatient stays by 7108 individuals. Two records had no information on socio-economic circumstances. Table 14 shows the number of finished consultant episodes, continuous inpatient stays and risks of hospitalisation. The risk of hospitalisation is the number of continuous inpatient stays divided by the person-time alive and not in hospital between entry into the study and the censor date or date of death. Table 14 shows both the total person-years of observation and the adjusted figure after time in hospital is subtracted from it. The difference between total person-time of observation and time at risk of hospitalisation was 132.1 person-years among the homeless cohort and 61.5 person-years in the non-homeless cohort.

The hospitalisation rate ranged from 102 per 1000 person-years varies in DEPCAT 1 to the highest of 427 per 1000 person-years in the homeless cohort, a risk ratio of 4.2 between homeless and DEPCAT1 residents. Consideration of lengths of stay is given in Section 6.8 on page 221.

Table 14. Finished consultant episodes (fce), continuous inpatient stays (cis), time at risk of hospitalisation, and risk of hospitalisation in homeless and non-homeless cohorts.

cohort	n	fce	∑cis	∑los (mean)	∑ person-years observation	∑ non-inpatient person-years at risk of hospitalisation	cis/1000 person-years
DEPCAT1	383	223	204	370 (1.8)	2003.1	2002.1	101.9
DEPCAT2	1428	732	664	1629 (2.5)	7469.0	7464.6	89.0
DEPCAT3	863	494	443	872 (2.0)	4518.0	4515.6	98.1
DEPCAT4	2076	1184	1090	2197 (2.0)	10841.5	10835.5	100.6
DEPCAT5	1148	751	683	1829 (2.7)	5989.1	5984.1	114.1
DEPCAT6	2593	2102	1871	4945 (2.6)	13510.4	13496.9	138.6
DEPCAT7	3960	3652	3138	10570 (3.4)	20517.3	20488.4	153.2
Homeless	6323	15704	13752	48245 (3.5)	32321.8	32189.7	427.2
Unknown*	174		2	1 (0.5)	913.7	913.7	0
All	18948	24842	21847	70657 (3.2)	98083.9-	97890.5	223.2

***2 had no DEPCAT (each 1 fce, 1 cis, 1 day, total 2)**

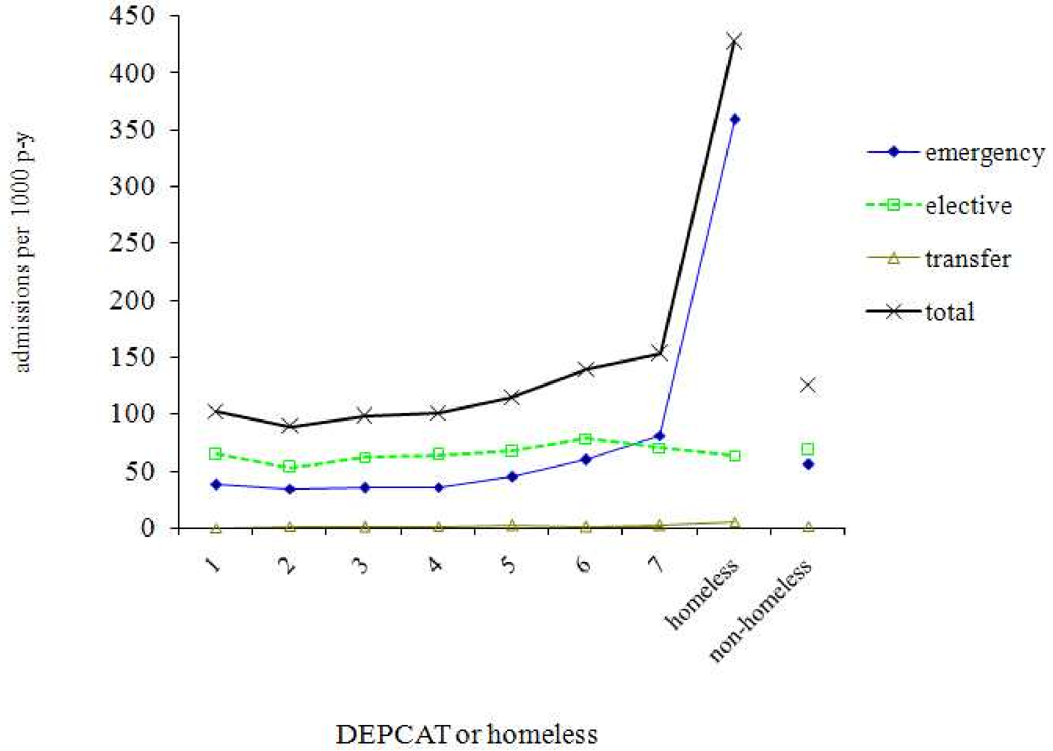
6.2 Emergency and elective admissions

The first admission type within a continuous inpatient stay was used to denote the type of admission. After a first admission (emergency or elective) it might be expected that all subsequent admission types would be transfers. In a small proportion of cases (266/21847, 1.2%) the first admission was recorded as a transfer. This may have been because a patient was transferred from outwith the Health Board area or may be recording artefact. Because of their small number and uncertain origins, transfer admissions have been omitted from some of the analyses.

Overall, hospital admission rates were higher in residents of the most deprived areas and highest among homeless individuals - Figure 24. Rates of emergency admissions increased with greater deprivation and were highest in the homeless cohort. Elective admission rates showed little association with socio-economic circumstances. These patterns are explored in further detail, below. Table 23 on page 294 provides all rates and numbers of hospital admissions.

Emergency to elective risk ratios in the homeless were 5.7. Compared with DEPCAT 1, homeless emergency and elective admission rate ratios were 9.6 and 0.98 respectively. Even compared with residents of DEPCAT 7, homeless emergency and elective admission rate ratios were 4.4 and 0.9 respectively. That is, homelessness conferred a 340% greater risk of emergency hospitalisation and 10% lower risk of elective admission than residents of the most deprived areas of Glasgow.

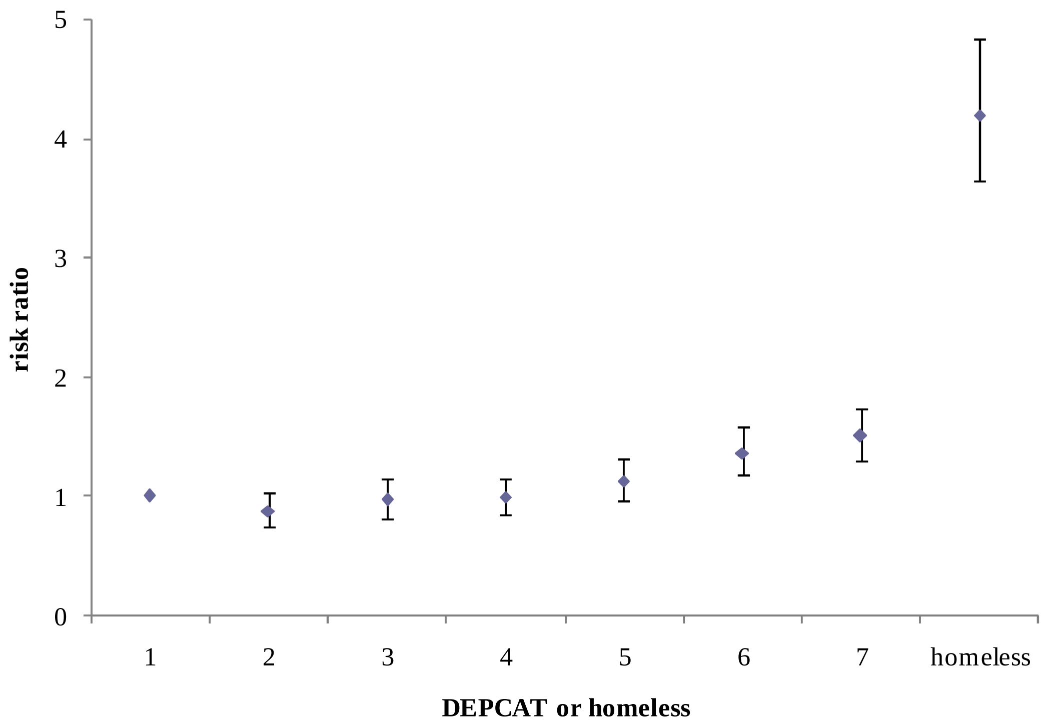
Figure 24. Hospital admissions per 1000 person-years of non-hospitalised observation, by type of admission and DEPCAT, homeless and all non-homeless combined.



While Figure 24 is useful to compare absolute rates between different types of admission, the risk ratios and confidence intervals presented below are useful in quantifying socio-economic patterns within each type of admission.

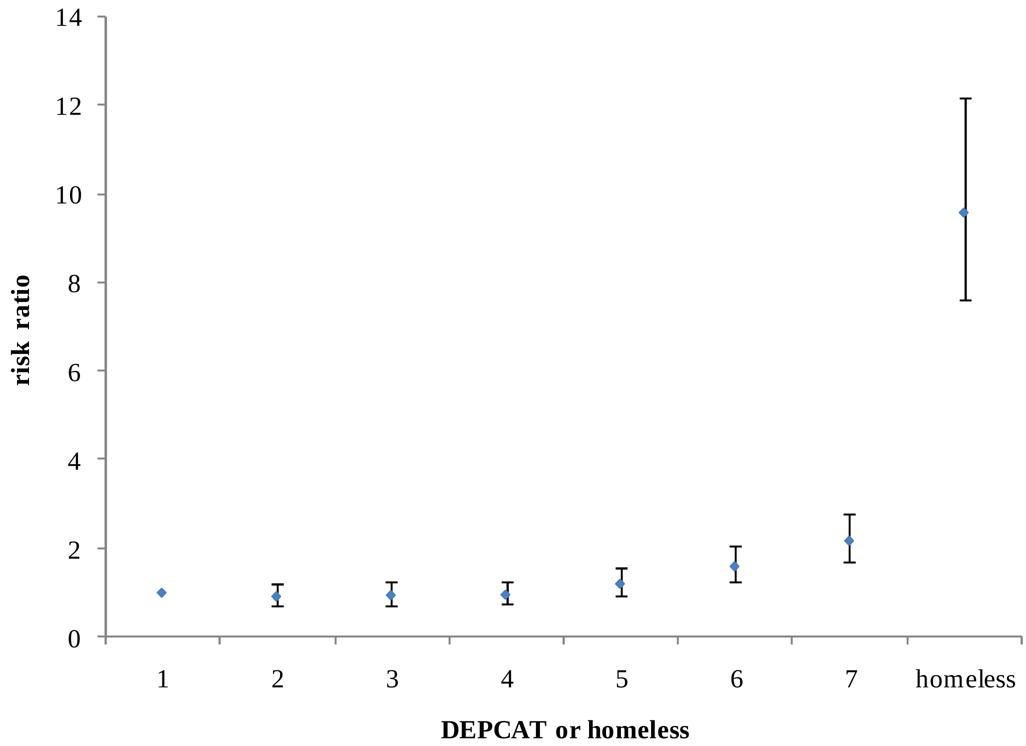
Figure 25 compares all hospitalisation risks to those of residents in DEPCAT 1 areas, who therefore have a risk ratio of 1. There is no significant difference in risks of hospitalisation between DEPCAT 1 and DEPCATs 2-5, as all confidence intervals include the null value of 1. Risk ratios in DEPCATs 6 and 7 are 1.4 (95%CI 1.2-1.6) and 1.5 (95%CI 1.3 – 1.7), respectively. Figure 25 illustrates that the risk of hospitalisation in the homeless cohort, at 4.2 (95%CI 3.7 – 4.8) was of a much greater order than that associated with deprived non-homeless circumstances.

Figure 25. Risk ratios of all hospital admissions by DEPCAT or homeless status, with 95% confidence intervals. Baseline, DEPCAT 1=1.



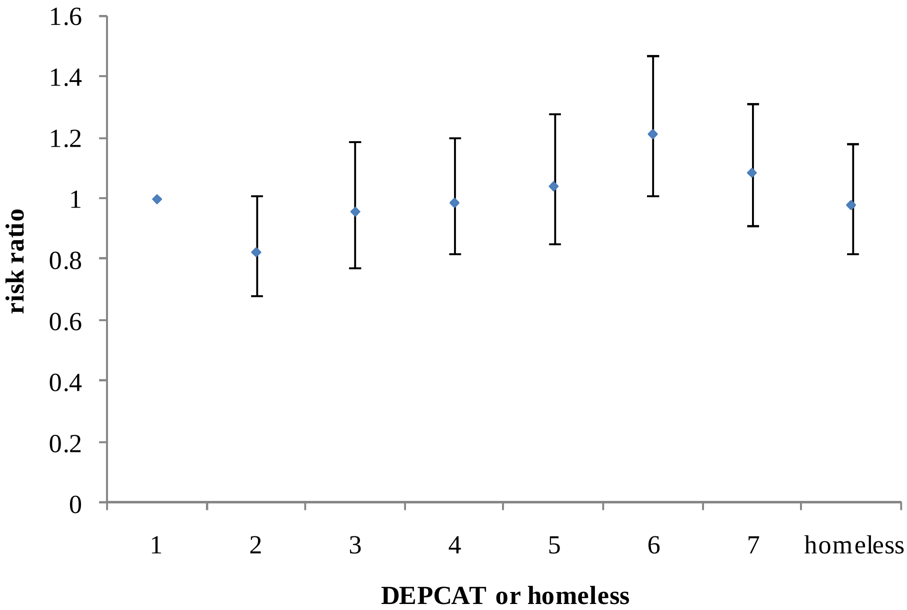
Emergency admissions show much greater deprivation effects than elective, as illustrated above in Figure 24. There were no statistically significant differences between emergency admission rates between DEPCAT 1 and DEPCATs 2-5 - Figure 26. Rates were significantly higher in the most deprived areas, DEPCATs 6 and 7, with risk ratios of 1.6 (95%CI 1.3-2.1) and 2.2 (95%CI 1.7-2.8) respectively and far greater in the homeless cohort with a risk ratio of 9.6 (95%CI 7.6 to 12.2). The ratio of admissions in the homeless compared with the most deprived areas, DEPCAT 7, was 4.4.

Figure 26. Risk ratios of emergency hospital admissions by DEPCAT or homeless status, with 95% confidence intervals. Baseline, DEPCAT 1=1.



There was no consistent socio-economic pattern to elective admissions - Figure 27. Only DEPCAT 6, with a risk ratio of 1.2 (95%CI 1.0-1.5) had a statistically significant difference to the baseline group, DEPCAT 1. Elective admission rates in the homeless were not significantly different from those in DEPCAT 1 (RR 0.98, 95%CI 0.8-1.2).

Figure 27. Risk ratio of elective hospital admissions by DEPCAT or homeless status, with 95% confidence intervals. Baseline, DEPCAT 1=1.

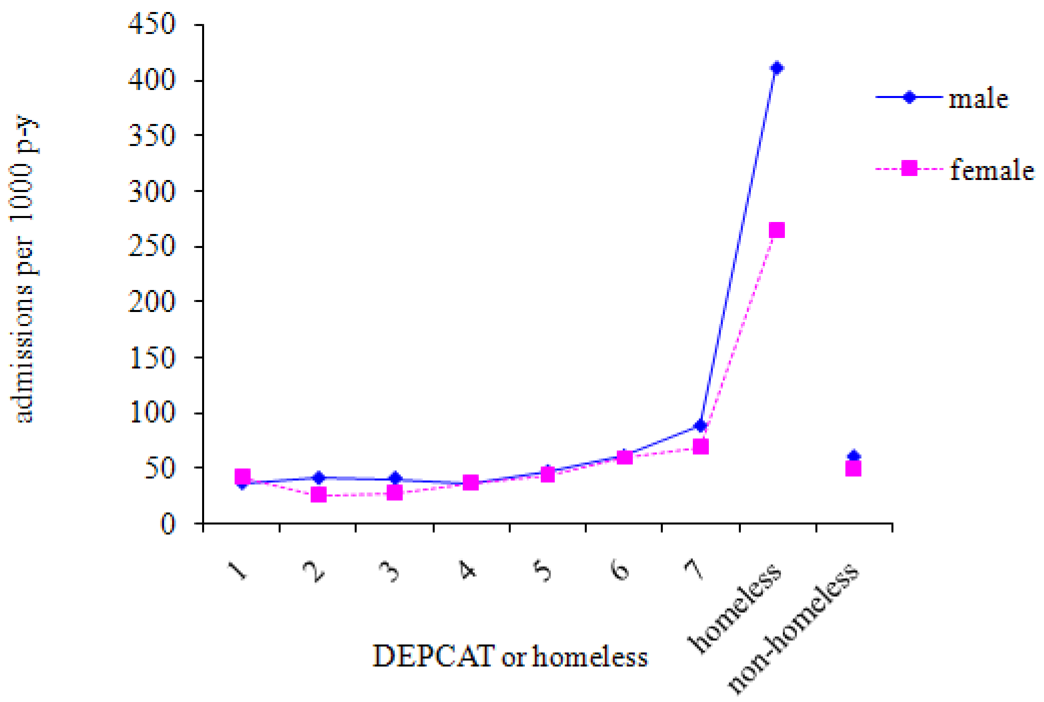


6.3 Risk of hospitalisation, by sex

Figure 28 shows rates of emergency hospitalisation by sex and socio-economic group. Exact numbers and rates are provided in the Appendix, Table 24 on page 295. Overall, the rate of emergency admissions was 1.4 times greater in men than women but socio-economic circumstances were effect modifiers on this relationship. In DEPCAT 1 female emergency admissions were about 16% higher than males (42 vs. 36 per 1000 person-years), but in all other groups, including the homeless, there was an excess of male admissions. There was no clear trend associating deprivation with emergency admissions in either men or women except for residents of the most deprived areas. These show significantly higher risk ratios of 1.7 and 2.4 in men from DEPCATs 6 and 7, respectively, and 1.7 in women from DEPCAT 7. The overall risk ratio for emergency hospitalisation in the homeless compared with residents of DEPCAT 1 of 9.6 comprised risk ratios of 11.5 (8.7-15.5) and 6.4 (4.3-9.9) in men and women, respectively.

Thus, both homeless men and women experienced significant increases in their risk of emergency hospitalisation although the risk was about a third greater in men.

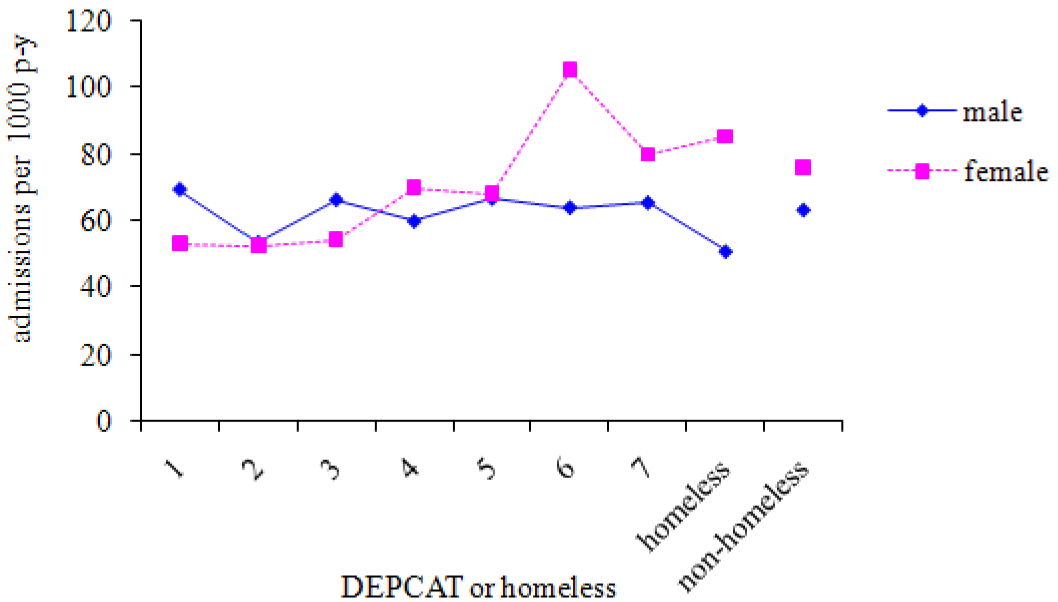
Figure 28. Risk of emergency hospitalisation. Admission rate per 1000 person-years by DEPCAT/homeless status and sex.



Elective admission rates are shown in Figure 29. Exact numbers and rates are provided in Table 25, page 296 of the Appendix. Rates in both men and women were lowest in DEPCAT 2. While no overall pattern with socio-economic circumstances was observed in Table 23, Figure 29 shows that elective hospitalisations were higher in women from more deprived areas. For example, admission rates were twice as high in women from DEPCAT 6 as those in DEPCAT 1 (RR 2.0, 1.4-2.9). There was no consistent association between male elective admission rates and socio-economic circumstances.

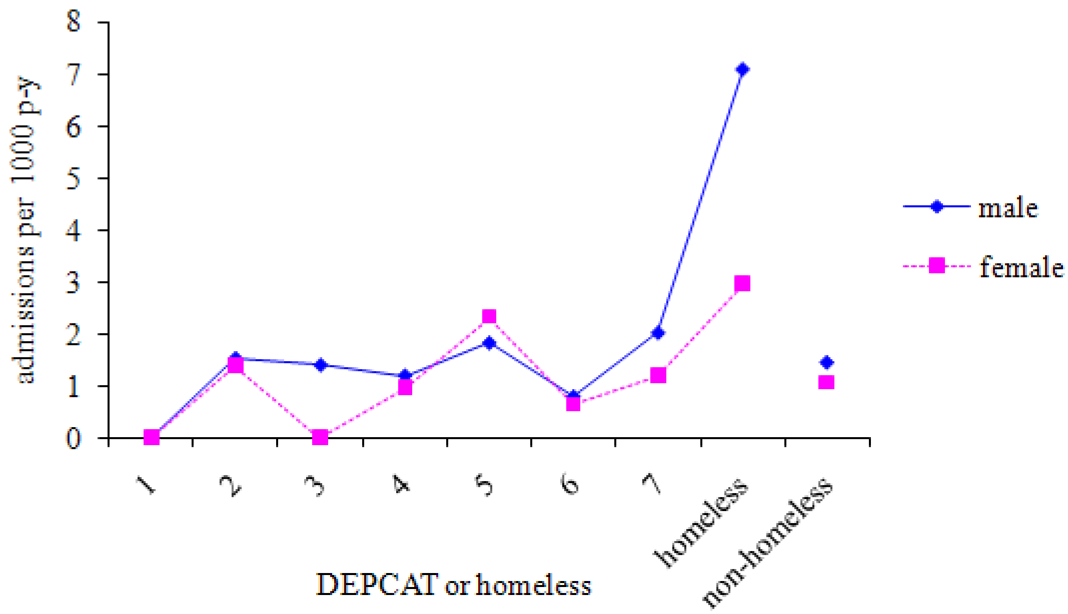
The modestly lower overall elective admission rate in homeless individuals compared with non-homeless controls is the product of two differing sex-specific trends. Female elective admissions were 60% (RR 1.6, 1.1-2.4) higher in homeless compared to non-homeless women but among men, homeless rates were 30% lower than non-homeless (RR 0.7, 0.6-0.9). The larger proportion of men in the homeless group gave greater weighting to their relatively lower elective admission rates.

Figure 29. Risk of elective hospitalisation. Admission rate per 1000 person-years by DEPCAT/homeless status and sex.



Rates of transfers were much smaller than either elective or emergency admissions, as shown in Figure 30. Exact numbers and rates are provided in Table 26 on page 297 of the Appendix. It should be noted that three cells are empty, making comparisons between sexes impossible in these strata. The overall risk ratio associated with homelessness, 4.3 (Table 23) comprised raised risks in both sexes but men's risk ratio was about twice that in women.

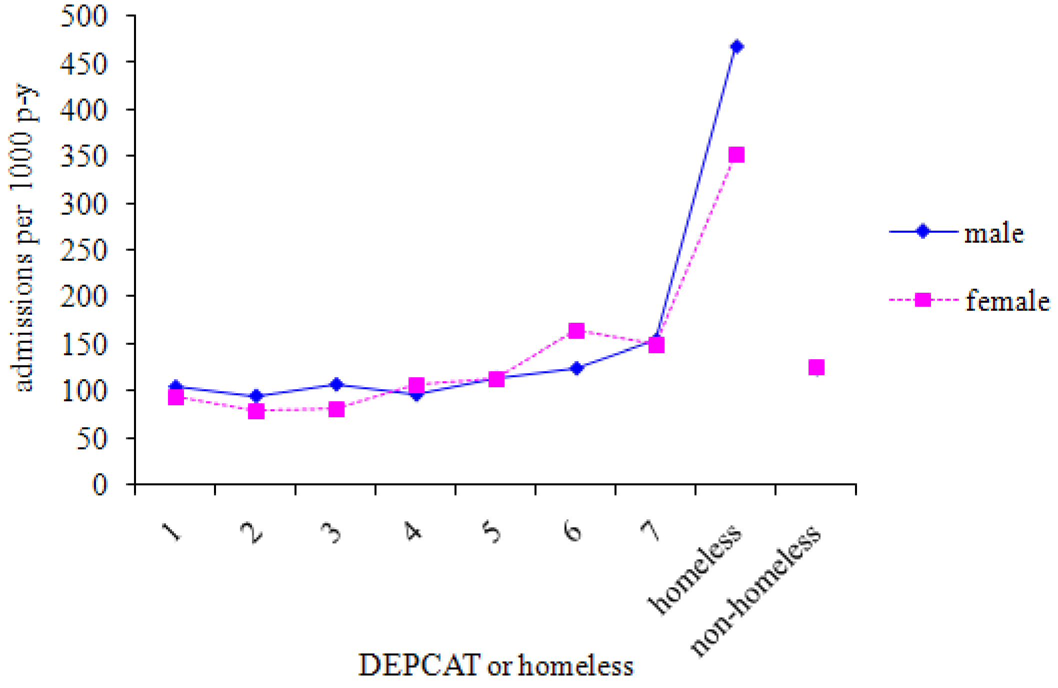
Figure 30. Risk of transfer hospitalisation. Discharge rate per 1000 person-years by DEPCAT/homeless status and sex.



Because emergency admission rates were 5.7 times higher than elective in the homeless (358 vs. 63 per 1000 person-years, respectively, see Table 23) they dominated the overall trends shown in Figure 31. In contrast, the risk ratio of emergency to elective admissions was similar in the non-homeless cohort (0.8, 56 vs. 68 per 1000 person-years respectively). Numbers and rates are provided in the Appendix, Table 27 on page 298. In non-homeless individuals the risk of any type of hospitalisation increased steeply in the most deprived areas. In men, only DEPCAT 7 residents had significantly higher risks of admission than those in DEPCAT 1 (RR 1.5, 95%CI 1.2-1.8). Women in both DEPCATs 6 and 7 had significantly increased risks of admission of 1.7 and 1.6, respectively. In the homeless, males were at 30% greater risk of any type of hospital admission compared to women. In the non-homeless population there was a small (2%) excess of hospitalisations in women.

And while both sexes of homeless individuals were at increased risk of hospitalisation, men were at a greater relative risk compared to their non-homeless age and sex matched comparison group.

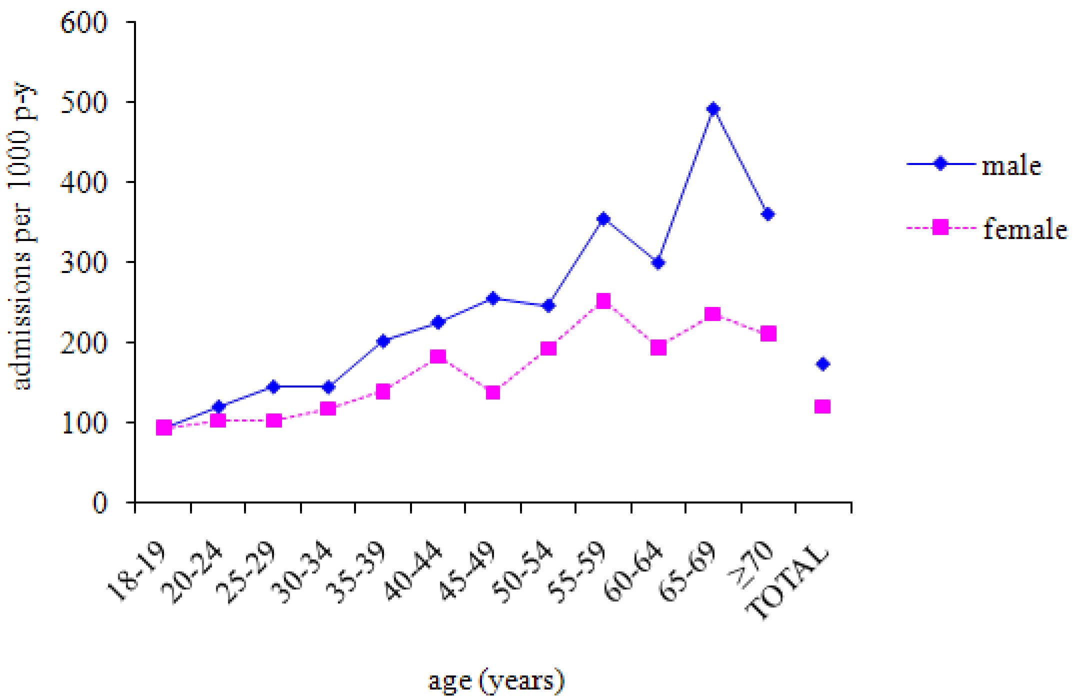
Figure 31. Risk of all hospitalisations. Admission rate per 1000 person-years by DEPCAT/homeless status and sex.



6.4 Risk of hospitalisation, by age and sex

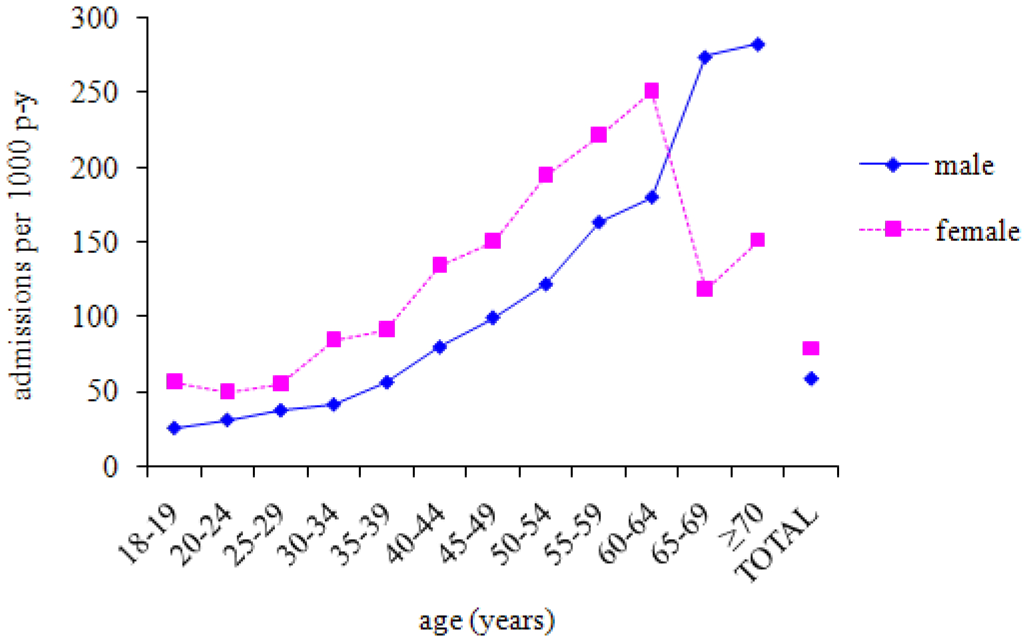
The risk of emergency admission increased with age in both sexes - Figure 32. Numbers and exact rates are provided in Table 28 in the Appendix on page 299. Overall, admission rates were 1.4 times greater in men and there was no consistent age-related pattern to this ratio. In men, emergency admission rates were highest at age 65-69 and in women rates were highest at age 55-59. In both sexes, rates were lowest at ages 18 and 19 years.

Figure 32. Emergency admission rates per 1000 person-years, by sex and age. Homeless and non-homeless cohorts combined.



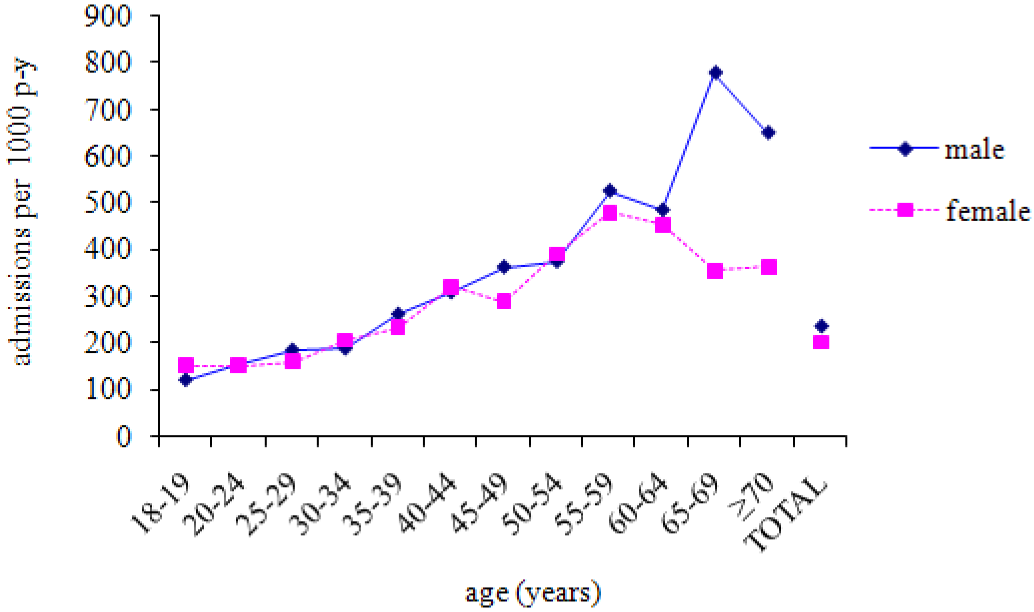
Elective admission rates also increased with age and in contrast to emergency admission were 34% higher in women compared with men - Figure 33. Table 29 on page 300 gives exact numbers and rates. There is little linear trend in the sex ratio with age except at ages 65 and over when men had up to twice as many elective admissions as women.

Figure 33. Elective admission rates per 1000 person-years, by sex and age.



The combination of all types of hospital admission is influenced by the higher rates of emergency admissions and by homeless admissions. Figure 34 shows that admissions increased with age in both sexes. Age-specific admission rates were similar up to 65-69 years but among the oldest groups men were at significantly higher risk of admission than women. Small numbers at the oldest ages may account for the lower than expected rates at ages 65 and over. Table 31 on page 302 of the Appendix provides numbers and rates.

Figure 34. All admission rates per 1000 person-years, by sex and age.



6.5 Risk of hospitalisation by age, sex and socio-economic circumstances

The risk of emergency admission increases with age and greater deprivation and is greatest among the homeless. Table 15 shows emergency admissions by age, sex and socio-economic status. It has been produced to determine whether the effects on the risk of emergency hospitalisations of either socio-economic circumstances or homelessness were modified by age. DEPCATs have been amalgamated into three conventional groups (1 and 2, affluent; 3-5, intermediate; and 6 and 7, deprived) to reduce empty strata. In men, the increase in admissions with increasing deprivation is consistently seen at most ages with the exception of 25-29 and 60-64 where rates are lower in DEPCATs 6 and 7 than in 1 and

2. In women, emergency admissions were higher in the most deprived areas at all ages, although empty stratum-specific cells make quantification of these differences difficult.

In the homeless cohort emergency admission rates were higher than in the non-homeless at all ages and in both sexes - Table 15.

Table 15. Emergency admissions by age, sex, and socio-economic circumstances. DEPCATs 1-2 (affluent), 3-5 (intermediate), 6-7 (deprived) and homeless.

	number								Rate per 1000 person-years							
	1-2		3-5		6-7		homeless		1-2		3-5		6-7		homeless	
age	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
18-19	16	7	40	18	62	53	290	265	24.0	16.1	48.2	26.4	46.8	42.4	197.9	206.2
20-24	22	14	57	62	182	82	1142	674	21.3	21.2	25.5	31.9	40.3	30.6	298.1	245.1
25-29	50	24	102	45	210	115	1573	552	48.9	29.8	31.1	25.2	46.6	52.6	355.0	238.4
30-34	30	16	68	64	226	107	1212	508	32.3	27.0	27.7	41.7	62.6	60.9	344.1	262.3
35-39	52	29	56	30	214	132	1375	487	18.2	50.8	32.6	28.3	73.4	82.2	515.5	303.4
40-44	23	5	43	31	208	92	895	267	42.1	20.3	42.0	74.6	107.0	118.5	543.8	373.7
45-49	15	0	44	19	138	40	580	108	47.7	0.0	84.3	72.8	116.7	85.1	595.9	269.1
50-54	13	0	29	7	155	40	482	91	52.3	0.0	53.1	53.4	141.8	141.3	558.0	382.1
55-59	22	0	31	9	148	40	486	65	106.5	0.0	81.6	88.7	211.3	226.9	742.2	456.6
60-64	12	0	20	3	84	12	216	9	208.6	0.0	99.4	144.6	164.7	198.3	642.7	212.5
65-69	2	0	13	1	61	2	173	7	63.7	0.0	140.3	63.6	281.5	384.6	1073.5	325.6
≥70	13	2	24	1	54	15	77	3	261.0	531.9	272.4	63.9	318.3	304.9	499.7	97.1
TOTAL	234	97	527	290	1742	730	8501	3036	39.1	27.9	39.4	36.4	76.8	64.6	410.6	264.4

Among men, elective admission rates were higher in the most deprived DEPCAT areas at all ages except 20-24 and 70 and above - Table 16. In women, elective admissions were higher in the most deprived areas at all ages. Neither the lower overall rate of elective hospitalisations in homeless men nor the higher rate in women compared to age and sex matched non-homeless groups showed effect modification by age. In the homeless cohort, male admission rates were higher than female at all ages under 70 years.

Table 16. Elective admissions by age, sex, and socio-economic circumstances. DEPCATs 1-2 (affluent), 3-5 (intermediate), 6-7 (deprived) and homeless.

	number								**Rate per 1000 person-years**							
	1-2		**3-5**		**6-7**		**homeless**		**1-2**		**3-5**		**6-7**		**homeless**	
age	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
18-19	15	12	23	22	35	62	38	112	22.5	27.5	27.7	32.2	26.4	49.6	25.9	87.2
20-24	51	21	52	87	111	136	147	160	49.3	31.7	23.3	44.8	24.6	50.7	38.4	58.2
25-29	28	35	160	66	150	135	160	156	27.4	43.5	48.7	37.0	33.3	61.8	36.1	67.4
30-34	43	29	89	127	180	172	126	173	46.3	48.9	36.3	82.8	49.8	97.9	35.8	89.3
35-39	36	45	103	86	170	165	153	148	40.9	78.8	60.0	81.1	58.3	102.8	57.4	92.2
40-44	30	28	90	50	165	125	128	87	55.0	113.5	88.0	120.3	84.9	161.0	77.8	121.8
45-49	18	6	40	34	162	85	83	58	57.2	81.6	76.7	130.2	137.0	180.9	85.3	144.5
50-54	34	2	105	38	127	69	70	30	136.7	31.7	192.3	290.0	116.1	243.8	81.0	126.0
55-59	24	5	87	10	129	54	77	31	116.2	190.4	229.1	98.5	184.1	306.3	117.6	217.8
60-64	8	0	35	0	116	12	41	19	139.1	0.0	173.9	0.0	227.5	198.3	122.0	448.6
65-69	37	0	22	0	69	1	11	4	1178.7	0.0	237.5	0.0	318.4	192.3	68.3	186.0
≥70	19	0	38	7	55	6	20	2	381.5	0.0	431.3	447.6	324.2	122.0	129.8	64.7
TOTAL	343	183	844	527	1469	1022	1054	980	57.3	52.6	63.1	66.2	64.8	90.4	50.9	85.3

The overall results of all types of admission, by age, sex and socio-economic circumstances are shown in Table 17. As noted above in Table 27 and Table 31, the combined figures reflect a balance of elective and emergency admissions in the non-homeless cohort, but the higher emergency admission rate in the homeless cohort gives its effects greater weight. In men, individuals living in the most deprived areas were at greatest risk of hospitalisation at all ages except 20-24 and 65 and over. In women, hospitalisation rates were higher in the most deprived areas at all ages. Homelessness was associated with higher hospitalisation rates at all ages in women, and at all ages except 65 and over in men.

Table 17. All admissions by age, sex, and socio-economic circumstances. DEPCATs 1-2 (affluent), 3-5 (intermediate), 6-7 (deprived) and homeless.

	number								Rate per 1000 person-years							
	1-2		3-5		6-7		homeless		1-2		3-5		6-7		homeless	
age	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
18-19	32	19	64	40	100	117	331	379	48.0	43.6	77.2	58.6	75.5	93.6	225.9	294.9
20-24	73	35	110	150	298	220	1311	838	70.6	52.9	49.2	77.2	66.0	82.0	342.2	304.7
25-29	81	61	271	113	360	252	1753	716	79.2	75.9	82.6	63.3	80.0	115.3	395.7	309.2
30-34	73	46	158	193	413	280	1355	688	78.6	77.5	64.4	125.8	114.3	159.4	384.7	355.2
35-39	52	75	162	118	388	299	1548	641	59.1	131.3	94.3	111.3	133.1	186.3	580.3	399.3
40-44	53	33	133	81	375	218	1038	358	97.1	133.7	130.0	194.9	192.9	280.8	630.7	501.1
45-49	33	6	85	54	304	125	682	166	104.8	81.6	162.9	206.8	257.1	266.0	700.7	413.7
50-54	49	2	136	45	287	110	561	122	197.0	31.7	249.1	343.4	262.5	388.7	649.4	512.3
55-59	47	5	119	19	278	94	575	98	227.5	190.4	313.3	187.2	396.8	533.2	878.1	688.4
60-64	20	0	55	4	201	24	261	28	347.7	0.0	273.3	192.8	394.1	396.7	776.6	661.2
65-69	39	0	35	1	131	3	189	11	1242.4	0.0	377.8	63.6	604.6	576.9	1172.8	511.6
≥70	32	2	62	8	111	21	98	5	642.6	531.9	703.7	511.5	654.3	426.8	636.0	161.9
TOTAL	584	284	1390	826	3246	1763	9702	4050	95.9	81.6	104.0	103.7	143.1	156.0	468.6	352.7

6.6 Reasons for hospitalisation: diagnoses by elective and emergency admissions

The principal diagnosis was determined as the first diagnosis of up to six on an SMR01 record for the first finished consultant episode in a continuous inpatient stay, which might comprise several finished consultant episodes.

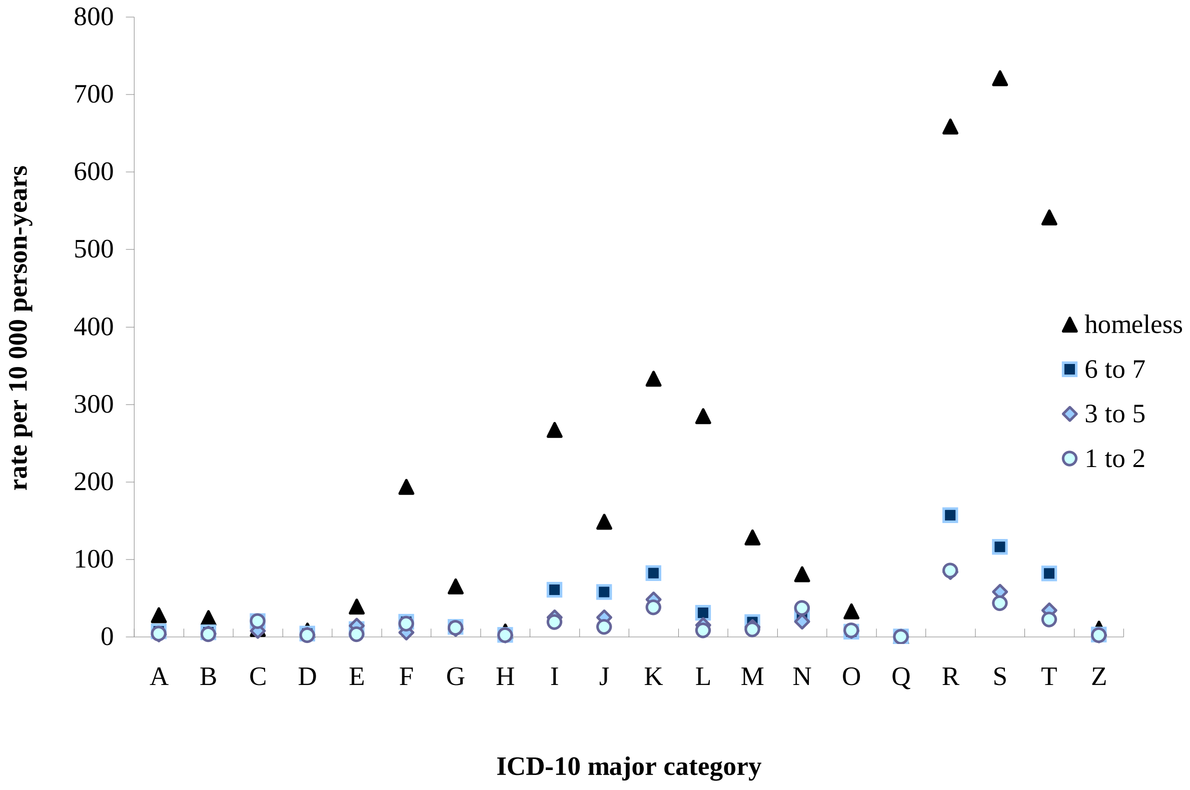
Figure 35 shows emergency admission rates by major ICD-10 diagnostic categories. Table 32 on page 303 of the Appendix provides all numbers and rates and Table 33 on page 304 provides rate ratios and confidence intervals. For each diagnostic category in Figure 35, rates are shown for homeless, affluent (DEPCATs 1-2), intermediate (DEPCATs 3-5) and deprived (DEPCATs 6-7) populations.

The overall hospital admission rate increased with greater socio-economic deprivation and was highest among the homeless for all diagnoses except neoplasms - Figure 35. The most common diagnostic categories – external causes (including injuries and poisonings) – were also those for which the differential between homeless and non-homeless were among the greatest with risk ratios between 17 and 24. Although there was a significant increase in risk of emergency admission for this group in residents of the most deprived areas, the risk ratio was between 3 and 4, so that homelessness had a much greater effect than socio-economic deprivation alone. The only higher differential between homeless and non-homeless cohorts was for emergency admission for diseases of the skin and subcutaneous tissues, for which the risk ratio is 34. Again, there was a significant association between admissions for these conditions and socio-economic deprivation but by a smaller order of magnitude, with a risk ratio of 4 in DEPCATs 6 and 7.

Neoplastic diseases were the only group for which the admission rate in the homeless was lower than in the non-homeless cohort but the risk ratio of 0.5 was not significant at the 95% level. This may be because no difference existed or because of relatively small numbers in this group. No relationship was observed between emergency hospital admission for neoplastic conditions and socio-economic circumstances in the non-homeless cohort.

Respiratory diseases had the highest risk ratio associated with deprivation among the non-homeless of 5 in DEPCATs 6 and 7.

Figure 35. First diagnosis in first finished consultant episode of all continuous inpatient stays where type of admission is emergency, by DEPCAT (1 to 2 affluent, 3 to 5 intermediate, 6 to 7 deprived) and homelessness. Rates per 10 000 person-years.



Index for Figure 35:

A, B – infectious & parasitic

C – neoplasms

D – endocrine, nutritional and metabolic

E – mental & behavioural

F – nervous system

G – eye and adnexa

H – ear and mastoid process

I – circulatory system

J – respiratory system

K – digestive system

L – skin & subcutaneous tissue

M – musculoskeletal system and connective tissue

N – genitourinary system

P – perinatal period

Q – congenital

R – symptoms and signs

S, T – injury, poisoning and external causes

Z – factors influencing health and contact with health services

In order to understand emergency casemix more fully, the commonest individual diagnoses are displayed in Figure 36. All numbers and rates are provided in Table 34 on page 305 and rate ratios with confidence intervals in Table 35 on page 306 of the Appendix.

The overall picture in Figure 36 is of consistently much greater admission rates in homeless compared to residents of even the most deprived areas.

Diagnoses are ordered by overall frequency in Figure 36, although injuries to the head, S00-09, have been grouped and therefore become the largest single diagnosis. Within this group ICD-10 S09, "other and unspecified injuries to the head" was the third most frequent single diagnosis, with admission rates of 77.4 per 10 000 person-years for the entire sample. Head injury admission rates increased with socio-economic deprivation, such that rates in DEPCATs 6-7 were 4 times higher than those in DEPCATs 1-2. Homeless rates of emergency admissions for head injuries were just over 30 times higher than those in residents of DEPCATs 1-2.

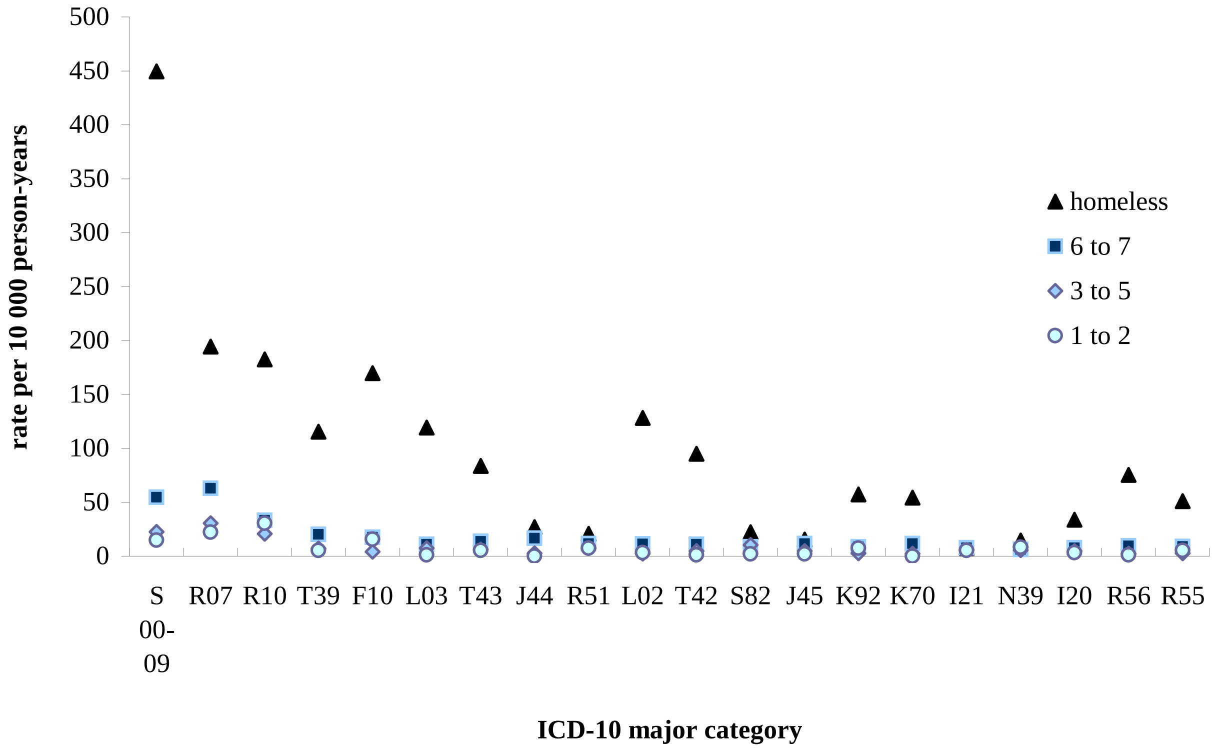
Of the ill-defined symptoms and signs categories, pain in the throat, chest, abdomen or pelvis were the commonest. Throat and chest pain admissions increased with deprivation, while admissions with abdominal and pelvic pain are not significantly different in the affluent and deprived non-homeless populations. Throat and chest pain admissions were nearly 9 times more common in the homeless, and abdominal and pelvic pain admissions were 6 times more common than residents of the most affluent areas. Poisonings by nonopioid analgesics and psychotropic drugs (ICD-10 T39 and T43, respectively) were 4 and 3 times greater, respectively, in residents of the most deprived areas but 22 and 16 times greater, respectively, in the homeless cohort compared with the most affluent residents.

Emergency admissions due to mental and behavioural effects of alcohol were not significantly higher in the most deprived compared to the most affluent groups (RR 1.1, 95%CI 0.6-2.1). Rates in the homeless, at 170 per 10 000 person-years, were 11 times greater than the most affluent non-homeless and the difference was statistically significant. No emergency admissions with alcoholic liver disease were recorded from residents of the most affluent areas making comparisons across socio-economic groups more difficult. However, other diseases of the digestive system, ICD-10 K92, probably also reflects alcoholic illnesses. They were not significantly higher in the most deprived groups but 8 times greater amongst the homeless. Convulsions, not elsewhere classified, and syncope and collapse (ICD-10 R56 and R55, respectively) were increasingly common with greater deprivation. Hospital admissions for convulsions and syncope were 9 times greater in the most deprived and 72 times greater in the homeless. They are not classified as epilepsy (ICD-10 G40) and may therefore reflect alcohol and drug-induced seizures.

Skin infections and cellulitis were common in the homeless and deprived. Compared with the most affluent areas, emergency admissions for cellulitis were 10 and 113 times more common in DEPCATs 6 and 7 and the homeless, respectively. For skin infections, risk ratios were 4 and 41 times more common in the deprived and homeless, respectively.

Emergency admissions for acute myocardial infarction (ICD-10 I21) were not raised in either the most deprived non-homeless or homeless groups, with non-significant risk ratios of 1.4 in both. In contrast, admissions with angina were 2.4 times more common in the most deprived non-homeless group and 11 times greater in the homeless, although only the latter result was statistically significant.

Figure 36. Admissions per 10 000 person-years of 20 overall commonest diagnoses among emergency admissions by DEPCAT (1 to 2 affluent, 3 to 5 intermediate, 6 to 7 deprived) and homelessness.



Key to Figure 36:

S00-09 – Injuries to the head

R07 – Pain in throat and chest

R10 – Abdominal and pelvic pain

T39 – Poisoning by nonopioid analgesics, antipyretics and antirheumatics

F10 – Mental and behavioural disorders due to use of alcohol

L03 – Cellulitis

T43 – Poisoning by psychotropic drugs, not elsewhere classified

J44 – Other chronic obstructive pulmonary disease

R51 - Headache

L02 –Cutaneous abscess, furuncle and carbuncle

T42 – Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs

S82 - Fracture of lower leg, including ankle

J45 - Asthma

K92 – Other diseases of digestive system [includes haematemesis, melaena, unspec. Gastrointestinal haemorrhage]

K70 – Alcoholic liver disease

I21 - Acute myocardial infarction

N39 - Other disorders of urinary system

I20 - Angina pectoris

R56 - Convulsions, not elsewhere classified

R55 – Syncope and collapse

Figure 37 shows elective admission rates by major ICD-10 diagnostic categories. Table 36 on page 306 of the Appendix provides exact numbers and rates and Table 37 on page 308 gives rate ratios and their 95% confidence intervals. As in Table 32, the principal diagnosis of the first finished consultant episode in any given continuous inpatient stay has been chosen. Arguably, this should provide a valid description of the reasons for an elective admission as it should represent the main diagnosis for which the admission was arranged. The validity of using the principal diagnosis of the first finished consultant episode in emergency admissions might be weaker if the initial diagnosis is changed or a subsequent illness emerges.

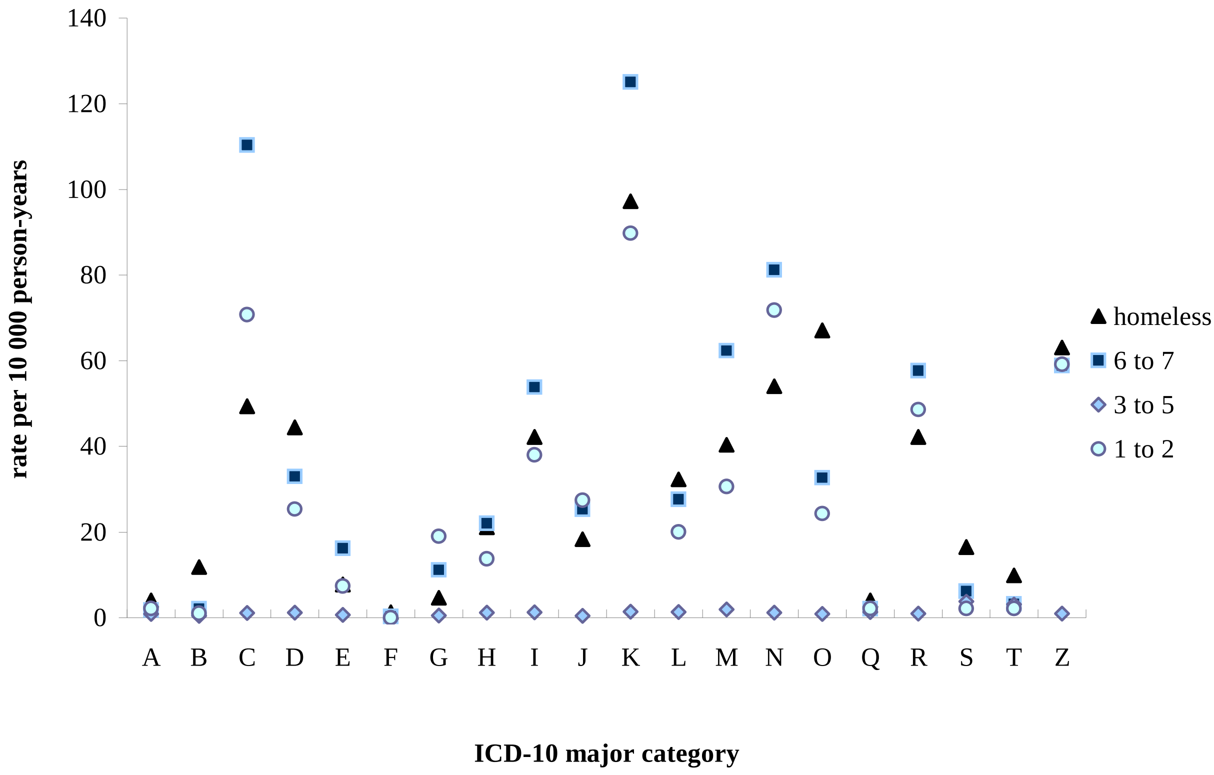
Homelessness is not associated with a significantly different overall elective admission rate compared to most other non-homeless areas as shown in Figure 27 on page 187. Figure 37 therefore presents a more complex picture than that for emergency admissions.

Overall, the commonest diagnostic group for elective hospital admissions was for diseases of the digestive system, which alone accounted for nearly 1 in 6 elective admissions in both homeless and non-homeless cohorts. Rates in both intermediate and deprived were 40% greater than in the most affluent areas and the difference was statistically significant. There was no significant difference between elective admissions for digestive diseases in the most affluent and homeless groups. Admissions for neoplasms were the second commonest diagnostic group in the non-homeless, while pregnancy, childbirth and puerperium were the second commonest homeless diagnosis. Elective admission rates for neoplasms increased with greater deprivation but were only significantly raised in

DEPCATs 6 and 7 (RR 2.6, 95%CI 1.2-2.1). They were significantly lower among the homeless cohort (RR 0.7). Admissions for pregnancy and childbirth were 3 times more common among the homeless cohort than residents of the most affluent areas.

Infectious and parasitic diseases were relatively uncommon reasons for elective admissions in non-homeless individuals although they increased with deprivation, while homelessness increases the risk by up to 11-fold compared with residents of the most affluent areas - Figure 37. There were no admissions for mental and behavioural disorders in residents of DEPCATs 1 and 2, making comparison with this group not possible. Not all diagnostic groups were more common in homeless people, as expected from the overall risk ratio of 0.9. Elective admissions for the treatment of neoplasms were 60% greater in the most deprived areas but 30% lower in the homeless cohort compared to the most affluent areas. Diseases of the nervous system were 80% lower among the homeless compared to DEPCATs 1 and 2, and again the difference was statistically significant. As with emergency admissions, elective admissions for the treatment of injuries, poisonings and other external causes were significantly raised in the homeless cohort, with risk ratios of 5 to 8. Risks were also raised among intermediate and deprived non-homeless groups but did not achieve statistical significance.

Figure 37. First diagnosis in first finished consultant episode of all continuous inpatient stays where type of admission is elective, by DEPCAT (1 to 2 affluent, 3 to 5 intermediate, 6 to 7 deprived) and homelessness. Rates per 10 000 person-years out-of-hospital risk time



Index for Figure 37:

A, B – infectious & parasitic

C – neoplasms

D – endocrine, nutritional and metabolic

E – mental & behavioural

F – nervous system

G – eye and adnexa

H – ear and mastoid process

I – circulatory system

J – respiratory system

K – digestive system

L – skin & subcutaneous tissue

M – musculoskeletal system and connective tissue

N – genitourinary system

P – perinatal period

Q – congenital

R – symptoms and signs

S, T – injury, poisoning and external causes

Z – factors influencing health and contact with health services

Figure 38 shows the 20 commonest principal diagnoses in elective admissions, ranked in order of diminishing frequency. Table 38 on page 309 provides rates and Table 39 on page 310 provides risk ratios and confidence intervals. Medical abortion was the commonest reason for elective admission in both homeless and non-homeless cohorts. The risk was not associated with increasing deprivation but was 3 times greater in the homeless compared with residents of the most affluent areas and this was statistically significant. As the cohorts were age and sex matched, comparison of female-only rates would yield higher absolute risks but risk ratios would be little changed. Elective admissions for contraceptive management showed no clear association with deprivation or homelessness. Admission for a procedure that was not carried out was the second commonest code overall. This category, ICD-10 Z53, includes contraindication, patient's decision and unspecified reasons for not carrying out a procedure but excludes failure to immunize. It has implications for wasted NHS resources. Risks were non-significantly raised in both deprived and homeless groups by 30% and 50% respectively. Small numbers become an increasing problem in analyzing specific diagnoses within socio-economic strata. For ICD-10 Z53, the numbers were 15, 68 and 76 in the most affluent, most deprived and homeless groups, respectively.

Elective admissions for treatment of cancer were noted to be higher in the most deprived groups but half as common in the homeless - Figure 37, above. There were no cases of elective breast cancer treatment in residents of DEPCATs 1 and 2 but the rate in DEPCATs 3-5 and 6-7 and the homeless were 14, 17 and 12 per 10 000 person-years, respectively.

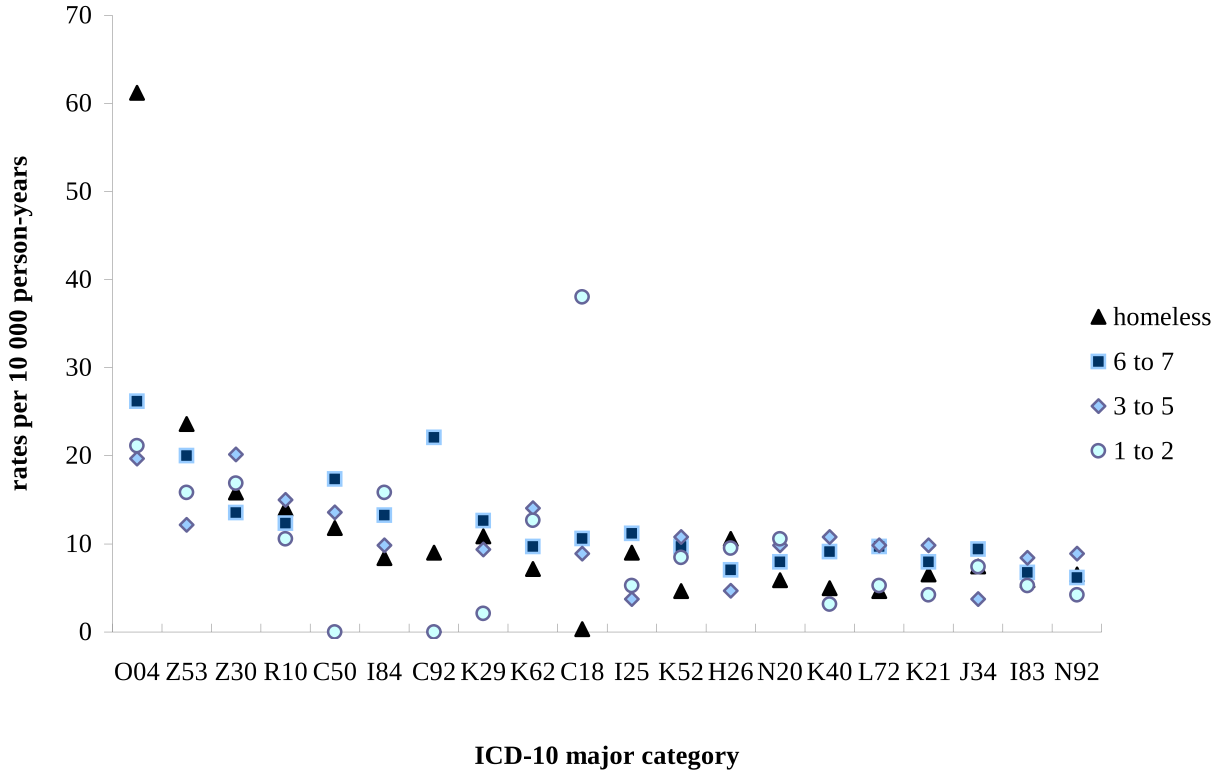
That is, the increase in breast cancer treatment found with greater deprivation was not found in the homeless.

Elective admissions for gastritis and duodenitis – principally for endoscopic investigations – showed a consistent increase with deprivation but homeless rates were between those of intermediate and deprived non-homeless areas. The risk ratios in intermediate, deprived and homeless groups were 4, 6 and 5, respectively, compared with residents of the most affluent areas.

Elective admissions for malignant neoplasm of the colon, ICD-10 C18, showed unusual patterns. Incidence of colonic carcinoma is similar in all socio-economic groups but admission risk ratios fell to 0.2 and 0.5 in intermediate and deprived areas compared with the most affluent and were significant at the 95% level. Homeless elective admission rates for colonic carcinoma were very low because only a single case occurred. This produced a homeless rate of 0.3 admissions per 10 000 person-years compared with a mean non-homeless rate of 14.0 per 10 000 person-years. Homelessness therefore was associated with a statistically significant risk ratio of 0.008 compared with the most affluent areas.

Risk ratios for elective admissions among the homeless for other diagnoses in Figure 38 (and Table 39) are around the overall mean value of 0.9. None of the other risk ratios in the homeless was statistically significantly different from those of DEPCATs 1 and 2.

Figure 38. Admissions per 10 000 person-years of 20 overall commonest diagnoses among elective admissions by DEPCAT (1 to 2 affluent, 3 to 5 intermediate, 6 to 7 deprived) and homelessness.



Key to Figure 38:

O04 – Medical abortion

Z53 – Persons encountering health services for specific procedures, not carried out

Z30 – Contraceptive management

R10 – Abdominal and pelvic pain

C50 – Malignant neoplasm of breast

I84 - Haemorrhoids

C92 – Myeloid leukaemia

K29 – Gastritis and duodenitis

K62 – Other diseases of anus and rectum [incl. polyp, prolapse, haemorrhage, ulcer]

C18 – Malignant neoplasm of colon

I25 – Chronic ischaemic heart disease

K52 – Other noninfective gastroenteritis and colitis

H26 – Other cataract

N20 – Calculus of kidney and ureter

K40 – Inguinal hernia

L72 – Follicular cysts of skin and subcutaneous tissue

K21 – Gastro-oesophageal reflux disease

J34 – Other disorders of nose and nasal sinuses

I83 – Varicose veins of lower extremities

N92 – Excessive, frequent and irregular menstruation

6.7 Operative interventions

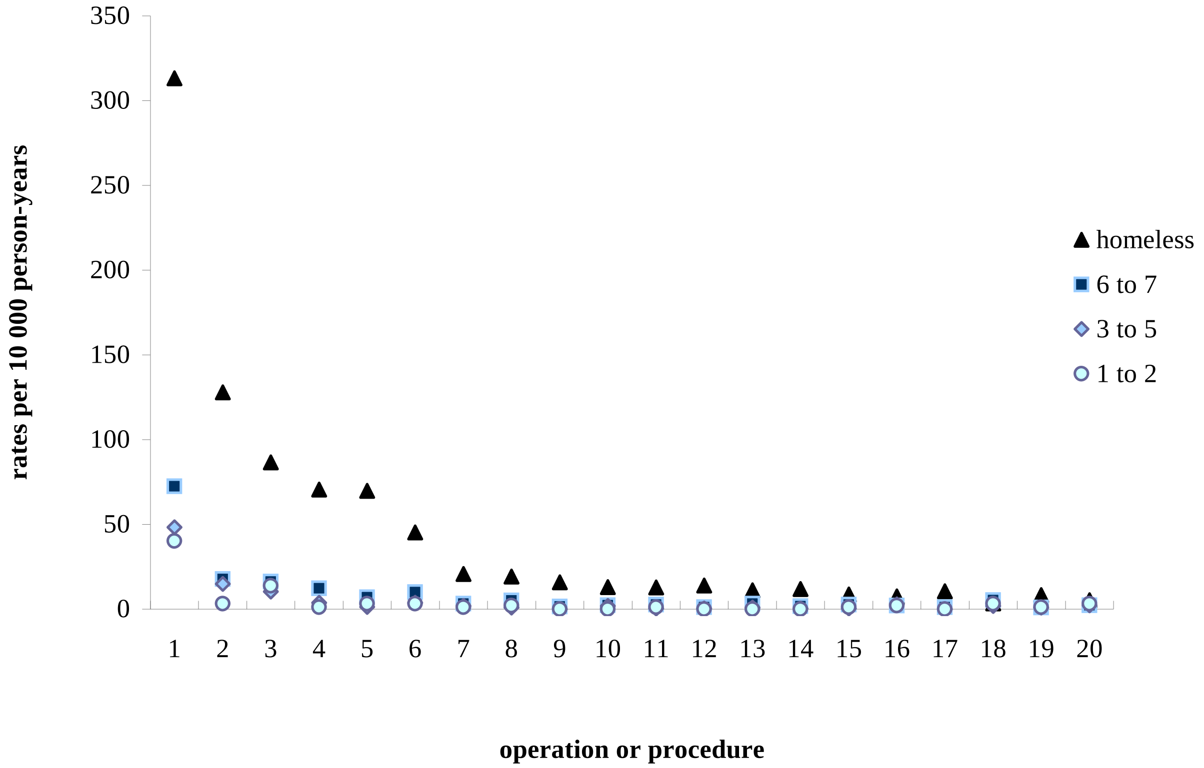
Each SMR01 can record up to 4 operations or procedures. They are coded using the Office for Population Censuses and Surveys' OPCS-4 system. Each procedure has a paired item that gives further detail, for example, on the exact site of an operation. As with other analyses in this thesis, information was taken from the first finished consultant episode of each continuous inpatient stay. The first of the four positions is deemed the Principle Operation and it was used in favour of the other three fields.

Figure 39 shows rates for the 20 most common operations performed on emergency admissions. Table 40 on page 311 provides rates and Table 41 on page 312 of the Appendix provides rate ratios and confidence intervals.

The largest single group in each socio-economic category is the general non-specific "other specified operations on unspecified organ." Cross-tabulation of principal diagnoses within this operative group, X558, produced a diverse range of conditions from all categories of the ICD-10. The most common diagnoses associated with X558 were ICD-10 I80 (Phlebitis and thrombophlebitis) and R10 (Abdominal and pelvic pain), which comprised 173 (12.4% of all emergency admissions) and 166 (11.9% of all emergency admissions), respectively. The third largest group within X558 was cellulitis, ICD-10 L03 (75, 5.4%) but most other diagnoses within this operative group belonged to 1 or 2 individuals only. Rates of "other specified operations" increased significantly with deprivation. They were twice as high in DEPCATs 6 and 7, and 8 times higher in the homeless, compared with DEPCATs 1 and 2.

Intravenous chemotherapy was the second most common intervention. There was a strong socio-economic trend and homelessness was associated with a risk ratio of 9. Rates of drainage of skin lesions in the homeless were 15 times greater than the general population, corresponding to the high rates of cellulitis in this population. Homelessness was also associated with high risk ratios for insertion of a central venous catheter (RR 21) and paracentesis for ascites (RR 18). Among these 20 commonest operative interventions, only drainage of a perianal abscess was lower, by 10%, in the homeless.

Figure 39. 20 most common operations, position 1, by DEPCAT (1 to 2 affluent, 3 to 5 intermediate, 6 to 7 deprived) and homelessness, for emergency admissions only. Rate per 10 000 person-years for each socio-economic group.



Key for Figure 39:

1 Other specified operations on unspecified organ

2 Intravenous chemotherapy

3 Other specified continuous infusion of therapeutic substance

4 Other specified intravenous injection

5 Drainage of lesion of skin – not elsewhere classified

6 Unspecified continuous infusion of therapeutic substance

7 Primary simple repair of tendon

8 Debridement of skin – not elsewhere classified

9 Insertion of central venous catheter – not elsewhere classified

10 Unspecified diagnostic fibreoptic endoscopic examination of upper gastrointestinal tract

11 Primary suture of skin – not elsewhere classified

12 Paracentesis abdominis for ascites

13 Insertion of tube drain into pleural cavity

14 Primary suture of skin of head or neck – not elsewhere classified.

15 Fibreoptic endoscopic examination of upper gastrointestinal tract and biopsy of lesion of upper gastrointestinal tract

16 Continuous subcutaneous infusion of insulin

17 Other specified subcutaneous injection

18 Drainage of perianal abscess

19 Unspecified exploration of skin of other site

20 Manipulation of fracture of bone – not elsewhere classified

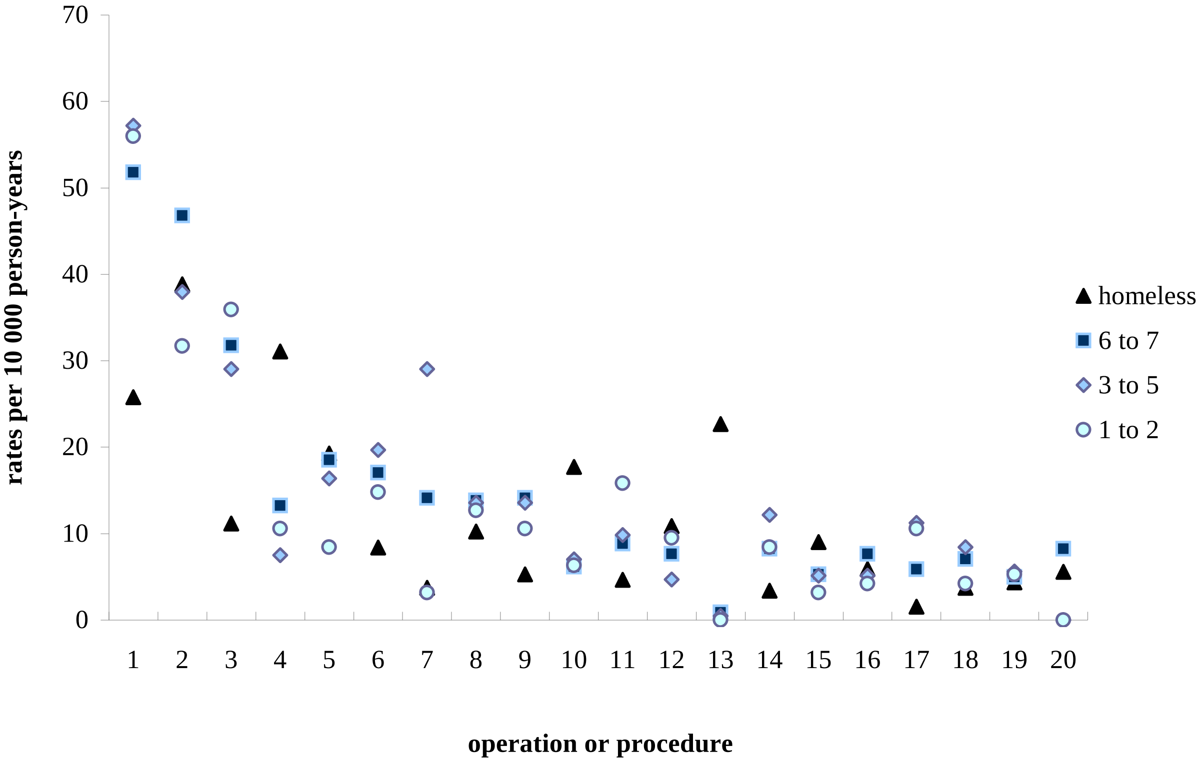
The 20 overall commonest operations in elective admissions are shown in Figure 40. Exact rates are provided in Table 42 on page 313 and rate ratios with confidence intervals in Table 43 on page 314 of the Appendix.

The commonest intervention in non-homeless individuals was intravenous chemotherapy. Among the homeless, this is the second commonest category and rates are half as great as the general population. Within this category (OPCS-4 X352) the great majority (420/434, 97%) were associated with principal diagnoses of cancer. The lower rate among the homeless corresponds with their lower elective admission rate for cancers. Although emergency admissions were more common than elective in all groups, intervention rates were higher in elective non-homeless individuals. Intravenous chemotherapy rates were half as great in the homeless compared with the most affluent non-homeless individuals.

Upper gastrointestinal tract flexible endoscopy, the second commonest elective operative procedure, showed non-significant increases of up to 50% with greater deprivation but no significant increase in the homeless compared to the most affluent non-homeless (RR 1.2, 95%CI 0.8-1.9). Diagnostic endoscopy of the bladder showed no consistent relationship with deprivation but rates were 70% lower in the homeless (RR 0.3, 95%CI 0.2-0.5).

Within the rest of the 20 commonest elective operative procedures shown in Figure 40, the homeless experienced statistically significant three-fold increases in both medical and surgical abortion rates. Rates of elective transfusions of coagulation factors in affluent, intermediate, and deprived patients were 0, 0.5 and 0.9 per 10 000 person-years respectively while there were 22.7 in the homeless cohort. This gave homelessness a very high relative risk compared with non-homeless individuals. In contrast, homelessness was associated with a 90% lower risk of vasectomy compared with residents of the most affluent areas. Although numbers were small, the difference was significant at the 95% level.

Figure 40. 20 commonest operations on elective inpatient admissions, by DEPCAT (1 to 2 affluent, 3 to 5 intermediate, 6 to 7 deprived) and homelessness. Rates per 10 000 person-years.



Key for Figure 40:

1. Intravenous chemotherapy
2. Fibreoptic endoscopic. examination upper gastrointestinal tract & biopsy lesion
3. Unspecified diagnostic endoscopic examination of bladder
4. Dilation of cervix uteri and vacuum asp. Products of conception from uterus
5. Unspecified diagnostic fibreoptic endoscopic examination of upper g.i. tract
6. Unspecified diagnostic endoscopic exam. of large bowel using fibreoptic sigmoidoscope
7. Other specified continuous infusion of therapeutic substance
8. Unspecified diagnostic endoscopic examination of colon
9. Diag. fibreoptic endoscopic exam. of colon & biopsy of lesion of colon
10. Insertion of prostaglandin pessary
11. Unspecified excision of lesion of skin
12. Insertion of prosthetic replacement for lens
13. Transfusion of coagulation factor
14. Diagnostic endoscopic exam & biopsy lesion lower bowel using fibreoptic sigmoidoscope
15. Insertion of abortifacient pessary - not elsewhere classified
16. Other specified operations on unspecified organ
17. Bilateral vasectomy
18. Excision of lesion of skin of head or neck – not elsewhere classified.
19. Septoplasty of nose - not elsewhere classified
20. Attention to central venous catheter

6.8 Lengths of stay

Total lengths of stay are a useful proxy measure for health service resource use in different populations. Variations in mean lengths of stay may suggest differences in case complexity between groups.

Figure 41 shows mean lengths of stay for emergency admissions, by socio-economic circumstances and sex. Lengths of stay in men were longer than in women. Lengths of stay increased in women from the most affluent to the most deprived areas, with homelessness lying between intermediate and deprived values. The difference between mean lengths of stay was small. For example, affluent and homeless mean lengths of stay were 2.8 and 3.5 days, respectively, and one-way ANOVA was non-significant ($p=0.784$). In contrast, male lengths of stay for emergency admissions were highest in the most affluent areas (5.6 days) and although there was not a consistent trend with increasing deprivation, homeless lengths of stay were shortest (3.8 days). The differences between groups were also larger in men and ANOVA was significant ($p<0.001$). Differences in male and female lengths of stay are thus greatest in the most affluent areas (2.8 days) and smallest in the homeless (0.3 days). This may reflect differences in diagnostic casemix between socio-economic groups described in Sections 6.6 and 6.7.

Figure 41. Mean lengths of stay (days) for emergency admissions, by socio-economic circumstances and sex.

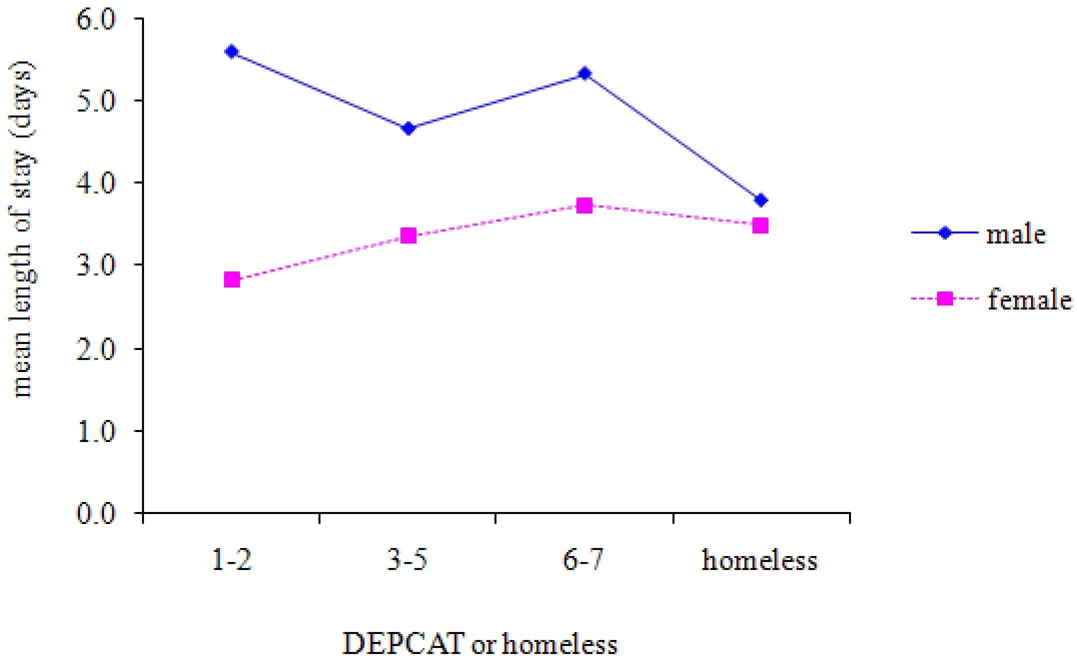
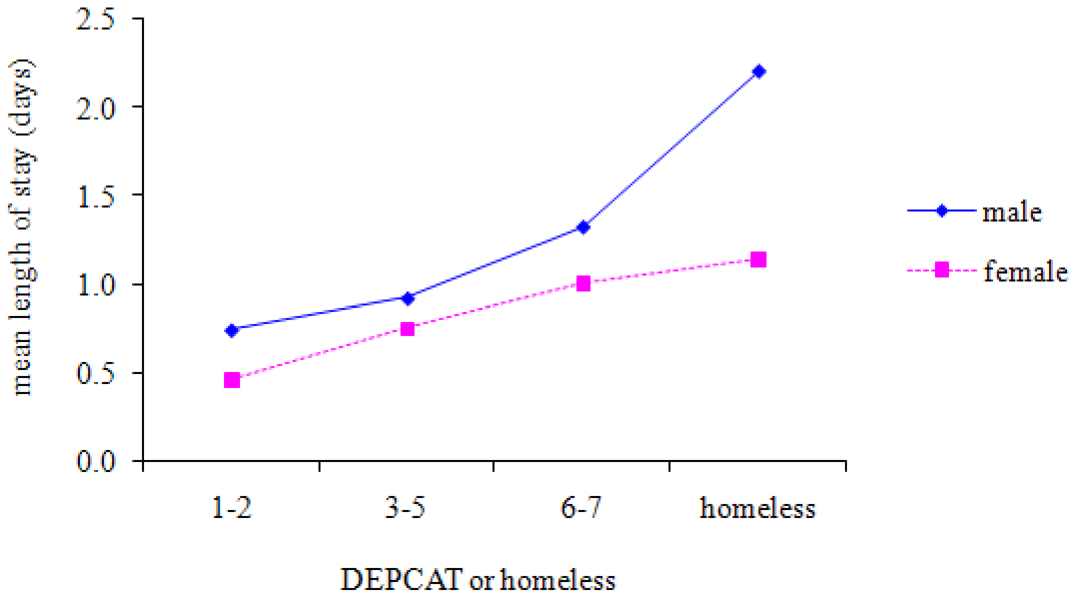


Figure 42 shows mean lengths of stay for elective admissions in affluent, intermediate, and deprived groups and the homeless, by sex. In both sexes, lengths of stay increased with deprivation and were longest in the homeless. The differences are statistically significant. In men, mean length of stay increased from 0.7 days in the most affluent areas to 2.2 days in the homeless (ANOVA, p=0.002). In women, mean lengths of stay increased from 0.5 days in the most affluent to 1.1 days in the homeless (ANOVA, p=0.027). In each socio-economic group male lengths of stay exceeded female. The difference between male and female rates in the general population was about a third of a day. In the homeless it was 1 day. Together, these may suggest greater case complexity of elective admissions in deprived and homeless populations and in men more than women.

Figure 42. Mean lengths of stay (days) for elective admissions, by socio-economic circumstances and sex.



6.9 Summary of results – emergency hospitalisations

Emergency hospital admission rates showed relatively little association with socio-economic circumstances between affluent and intermediate populations but rose in more deprived areas. Homelessness was associated with considerably higher emergency admission rates than those in the most deprived non-homeless areas. The risk ratio for emergency hospitalisation in the homeless was 6.4 compared with non-homeless overall; it was 4.4 times greater than residents of the most deprived areas and 9.6 times greater than those in the most affluent areas. Men were at greater risk of emergency hospitalisation but the risk was greater in the homeless (RR 1.6) than the general population (RR 1.2). The risk of emergency hospitalisation increased with age in both sexes and male rates were higher at all ages.

Emergency admissions for both mental and behavioural disorders and disorders of the skin and subcutaneous tissues were 13 times more common in the homeless compared to the general population. Admissions for cancers were the only group in which the admission rate in the homeless was lower than in non-homeless individuals. Emergency admissions for mental and behavioural effects of alcohol were 13 times higher in the homeless. Head injuries were 12 times more common and poisonings by drugs 9 times more common in the homeless than in the general population.

Intravenous chemotherapy was the commonest specific intervention for emergency admissions. There was a strong relationship with increasing deprivation and homelessness was associated with a risk ratio of 9. Risk ratios in the homeless for central venous catheter insertion and drainage of ascites were 21 and 18, respectively.

Mean lengths of inpatient stay were longer in men than women but their relationship with socio-economic status differed between the sexes. Male lengths of stay were longest in the most affluent areas and homeless lengths of stay were shortest. In women, lengths of stay increased with greater socio-economic deprivation but homeless women had stays that were between the intermediate and deprived averages.

6.10 Summary of results – elective hospitalisations

There was little difference in elective admission rates across different socio-economic strata. Homelessness was associated with a small reduction in risk of elective hospitalisation compared with the general population. Elective admission rates were higher than emergency rates in all but the most deprived areas of the general population. Principally because of their very high emergency admission rates and partly because of slightly lower elective rates, the differential between emergency and elective admissions in the homeless exhibited an extreme of this inversion, with emergency rates nearly 6 times elective rates. Although there was little overall relationship between elective admission rates and deprivation, this was a feature in men, only. Women from more deprived areas had significantly higher elective admission rates. In the homeless, elective female admission rates were 10% higher than the general population while male rates were 20% lower. Overall, elective admissions were 34% higher in women than men and increased with age in both sexes.

The commonest diagnostic groups for elective admissions were diseases of the digestive system and neoplasms. Admissions for treatment of infectious and parasitic disease were 9 times more common in the homeless. Admissions for injuries, poisonings, mental and behavioural disorders, and maternity related diagnoses were around 2-3 more common in the homeless. Admissions for treatment of neoplasms were half as common in the homeless as the general population. Medical abortion was the commonest reason for elective hospitalisation in both homeless and non-homeless cohorts, although absolute rates were 3 times greater in the homeless. Admissions for procedures that were cancelled were 40% more common in the homeless. Homeless admissions for treatment of colonic carcinoma were very low.

The commonest elective intervention was intravenous chemotherapy although among the homeless rates were half as great. This reflected lower rates of admissions for cancer. The second commonest elective intervention was for upper gastrointestinal endoscopy. Rates increased with greater deprivation but were lower in the homeless. A similar pattern was seen with endoscopic bladder investigations. Homelessness was associated with almost 3-fold increases in elective admissions for abortions but an 80% lower risk of vasectomy.

Lengths of stay for elective admissions increased with deprivation and were longest in the homeless. Male lengths of stay exceeded female. The difference between male and female mean inpatient stays in the general population was about a third of a day: in the homeless it was 1 day.

Chapter 7. Homelessness as an independent risk factor for mortality

7.1 Hazards of all cause mortality adjusted for morbidity

Morbidities were identified by their presence in any diagnostic position of all SMR01 records for each individual. Table 18 repeats the Cox proportional hazards analysis of Table 12 but adds hospital admissions in the same major groups of diseases responsible for deaths. After controlling for previous admissions for a variety of causes, homelessness remained a significant risk factor for death with an adjusted hazard ratio of 2.4 compared with residents of the most affluent non-homeless areas. Deprivation ceased to be significantly associated with hazard of death in the multivariable model. The risk of mortality associated with being male fell from 2.6 to 1.6 in this extended multivariable model. The hazard associated with being aged 35-54 years did not change in the multivariable model but the hazard of being 55 or over fell from 8.7 to 3.6.

Hospitalisation was itself a significant risk factor for death. Previous admission for cancer treatment was associated with the greatest risk of subsequent death (HR 7.2 in the adjusted model) within the 5-year follow-up period. Admissions for drug use doubled the risk of death, and admissions for alcohol trebled it. Admissions for assault were associated with a small but significant reduction in risk of death. Notably, previous admission for self-harm did not raise the risk of death.

Table 18. Proportional hazards models for all-cause mortality by socio-economic circumstances, age, sex, and cause-specific hospitalisation up to 5 years prior to death. Number of deaths/number in stratum in brackets.

	All cause mortality	
	univariate	multivariable
Socio-economic circumstances		
Affluent (15/1811)	1	1
Intermediate (42/4087)	1.2 (0.7, 2.2)*	1.1 (0.6, 2.2)*
Deprived (152/6553)	2.8 (1.7, 4.8)	1.7 (0.9, 3.1)*
Homeless (457/6323)	8.9 (5.2, 15.0)	2.4 (1.3, 4.3)
Age (years)		
18-34 (253/12332)	1	1.0
35-54 (250/5456)	2.3 (1.9, 2.7)	2.0 (1.6, 2.5)
≥ 55 (163/986)	8.7 (7.1, 10.6)	3.6 (2.7, 4.8)
Sex		
Female (115/6566)	1	1.0
Male (551/12208)	2.6 (2.1, 3.2)	1.6 (1.3, 2.0)
Hospitalisation†		
Drug (F11-16, F18-19, Y10-12, Y14) (168/1083)	1.6 (1.3, 2.0)	1.9 (1.4, 2.5)
Alcohol (Y15, F10, K70) (105/1189)	4.7 (4.0, 5.6)	2.8 (2.3, 3.5)
Circulatory (I00-99) (106/1331)	2.8 (2.3, 3.3)	1.2 (1.0, 1.5)
Respiratory (J00-99) (49/1084)	2.8 (2.3, 3.4)	1.4 (1.2, 1.7)
Intentional self-harm (X60-84) (42/774)	1.4 (1.1, 1.8)	1.0 (0.8, 1.3)*
Neoplasms (C00-97) (80/166)	10.3 (8.1, 13.1)	7.2 (5.5, 9.3)
Assault (X85-Y09) (22/841)	1.2 (0.9, 1.5)*	0.7 (0.5, 0.9)
Infectious, parasitic (A00-B99) (11/879)	2.2 (1.8, 2.7)	1.2 (1.0, 1.5)*
Endocrine (E00-90) (9/407)	2.7 (2.1, 3.5)	1.3 (1.0, 1.8)
Nervous (G00-99) (12/471)	2.6 (2.1, 3.3)	1.2 (1.0, 1.6)*

* - **not** significant at the 95% level

† - excludes 62 smaller other diagnostic groups

It is possible that hospitalisations for one condition may be associated with hospitalisations for another. To detect multicollinearity – that is, very high correlations between variables – squared multiple correlations were produced through SPSS FACTOR analysis. Table 19 indicates that none of the variables entered into the model in Table 18 had squared multiple correlations ("Initial" Communalities) in excess of 0.90, which would indicate multicollinearity.[182]

Table 19. Test of multicollinearity by SPSS FACTOR analysis. Extraction Method: Principal Axis Factoring.

Factor	Initial	Extraction
DEPCAT/homeless group	0.239	0.347
Agegroup (18-34, 35-54 and 55+)	0.215	0.424
Sex	0.082	0.326
Alcohol admission	0.216	0.540
Drug admission	0.310	0.662
Cardiovascular disease admission	0.168	0.313
Respiratory admission	0.066	0.106
Neoplastic admission	0.041	0.048
Endocrine admission	0.068	0.119
Infectious disease admission	0.183	0.264
Nervous system admission	0.046	0.070
Self-harm admission	0.088	0.148
Assault admission	0.145	0.247

7.2 Hazards of cause-specific mortality adjusted for morbidity

Table 20 gives the cause-specific hazard ratios of death after adjustment for age, sex, homeless or non-homeless status and previous hospital admission for the same condition that caused death. Non-homeless socio-economic strata were not entered for two reasons. The first was that Table 18 indicated that socio-economic deprivation was not a significant independent risk factor for death after morbidity had been included in the model. The second was that stratification by both hospitalisation and three groups of socio-economic circumstances led to many empty cells. Even the simplified model resulted in two conditions (neoplasms and endocrine diseases) being excluded because all homeless patients who died from neoplasms had been previously hospitalised for neoplastic disease and all patients who died from endocrine causes had been previously hospitalised for endocrine diseases.

Each row of Table 20 represents a different model in which age, sex, homeless or non-homeless status and previous hospitalisation for the same condition that caused death were entered. It shows the hazard ratios associated with hospitalisation and homelessness in each model. In general, previous admission for a given condition raised the risk of subsequent death from it. Previous admission for an alcohol-related condition was associated with the second greatest hazard of death from alcoholic causes. In this model, homelessness added no further risk. That is, individuals who had been inpatients for alcohol related conditions were at no greater risk of death from alcohol if they were homeless. Admissions for drug related conditions raised the hazard of death by about four-fold but among this group homelessness conferred an even greater hazard of 7-fold. That is, homeless drug users were at considerably greater risk of death from drugs than non-homeless drug users. Homelessness doubled the risk of cause-specific mortality among patients with circulatory diseases, and trebled it among respiratory patients. Compared with the overall model in which hospitalisation was not included (HR=4.4), these suggest that some but not all of the excess risk associated with homelessness can be explained by the general risks of morbidity. Squared multiple correlations tests for each of the separate models described in Table 20 did not identify evidence of multicollinearity between variables.

Table 20. Age and sex adjusted cause-specific hazards of death by previous hospitalisation for the principle cause of death. Adjusted homeless to non-homeless hazard ratio also shown.

Cause of death (ICD-10)	**Hazard ratios (95% confidence intervals)**	
	Hospitalised for cause of death	**homeless**
Drugs (F11-16, F18-19, Y10-12, Y14)	3.9 (2.6 - 5.9)*	7.2 (3.4 - 15.2)*
Alcohol (Y15, F10, K70)	42.0 (20.8 - 84.5)*	0.7 (0.4 - 1.1)
Circulatory (I00-99)	6.0 (3.6 - 10.3)*	1.8 (1.1 - 2.9)*
Intentional self-harm (X60-84)	7.0 (2.8 - 17.4)*	3.3 (0.9 - 11.7)
Respiratory (J00-99)	5.9 (3.1 - 11.2)*	2.9 (1.4 - 5.9)*
Assault (X85-Y09)	3.5 (0.9 - 13.8)	3.4 (0.7 - 17.1)
Infectious & parasitic (A00-B99)	73.0 (8.9 - 598.0)*	1.2 (0.3 - 4.7)
Nervous system (G00-99)	28.5 (6.8 - 118.8)*	0.7 (0.2 - 2.6)

* significant at the 95% level

7.3 Summary of results for morbidity-adjusted mortality rates

Morbidities recorded on hospital discharge records (SMR01) were used to infer morbidity among both homeless and non-homeless cohorts. Cox proportional hazards models were then constructed for both all-cause mortality adjusted for all morbidities and separately for cause-specific deaths where individuals had been previously been hospitalised for the same condition.

Adjustment for morbidity reduced but did not eliminate the hazard associated with homelessness, from 8.9 to 2.4. The hazard associated with deprivation was reduced and no longer significant after adjustment for morbidity. Adjustment for morbidity also reduced the effects of age and sex on hazard of all-cause mortality.

Homelessness increased the hazards of some causes of death but had no independent effects on others after adjustment for morbidity. Homeless drug users were 7 times more likely to die from drugs than the non-homeless. Homelessness trebled the risk of respiratory deaths among those with respiratory disease and doubled the risk of circulatory death among those with circulatory diseases. Homelessness had no independent additional risk on deaths from alcohol among those with alcohol-related conditions.

Chapter 8. Discussion

8.1 Deaths

The risk of death in the Glasgow homeless cohort was 14.1 per 1000 person-years with a risk ratio of 4.4 compared with the age and sex matched local population. One limitation in making comparisons with published literature is that few of the studies identified reported absolute death rates, preferring to use cumulative incidence (often with an imprecise denominator) or Standardised Mortality Ratios (SMRs). Another is that standard populations, such as European or World standard populations, were not used and thus mortality ratios depended on local general population rates. This is illustrated in Barrow's[114] report on a cohort of 1260 homeless shelter user in New York City. Standardised mortality ratios in men and women were 3.9 and 4.7 respectively using USA populations but 2.2 and 3.7 when New York City rates were used. The other consideration in comparing standardised mortality ratios between studies is that different follow-up periods may yield significantly different results. If SMRs can be considered similar to risk ratios for matched cohorts (see Section 8.4, Validity of hospital and deaths data, page 252), then Barrow's USA-referenced figures are of a similar order to the risk ratios comparing homeless to non-homeless Glasgow populations, which were 4.4 and 4.5 for men and women, respectively. However, because Glasgow has high levels of socio-economic deprivation, it is likely that these risk ratios will be lower than if the typical Scottish population rates were used.

Nordentoft's 10-year prospective cohort of hostel residents found SMRs in men and women of 5.6 and 2.8. Rates of suicide and accidents were particularly high. These were higher than the general population in men but lower in women in the Glasgow homeless cohort. The study took place over twice as long as that described in this thesis and hostel residents were older than the Glasgow homeless incident population. Longer follow-up time does not necessarily affect SMRs but it may do so if there is an excess of early deaths among the homeless introducing a significant competing risk against deaths from chronic diseases in the general population. For example, the high death rates found in 15-34 year old hostel dwellers[111] would remove them from being at risk of deaths from cardiovascular disease and cancers in middle age.

Hwang's analysis of adults who had used a Boston homeless health service[121] could not calculate death rates but proportions of deaths due to specific causes. It found that about a fifth of deaths were each due to HIV/AIDS and heart disease. This thesis found that in absolute proportions of numbers of deaths, 0.66% of homeless deaths (3/457) and 0.48% (1/209) non-homeless deaths were due to HIV with a risk ratio of 6.0 for homelessness. While the two estimates cannot be compared directly, it is not surprising that HIV deaths form a smaller proportion of deaths in the Glasgow population from 2000 to 2005 than in a Boston homeless population between 1988 and 1993. HIV prevalence in Scotland, particularly in injecting drug users, never reached similar proportions to that in North America.[185] Also, highly active anti-retroviral therapy (HAART) was introduced in Scotland as part of the universal provision of NHS care in 1996 and deaths from HIV fell steeply thereafter. Access to HAART by homeless individuals in the United States was likely to be much poorer because universal healthcare is not provided.

As Table 13 shows, 13% of deaths in the homeless cohort were due to cardiovascular diseases. This is lower than the 17% reported by Hwang[121] for heart disease, only. Hwang's cohort analysis of the Boston homeless[115] indicated that the mean age was 47, some 15 years older than that of the Glasgow homeless cohort, may partly account for its higher prevalence of heart disease. Comparing crude mortality rates in Boston[115] and Glasgow, these are 1114 and 1414 per 100 000 person-years, respectively, giving Glasgow a rate ratio of 1.3, or 30% higher death rates. In his cohort analysis, Hwang[115] found that AIDS was the leading cause of death in 25 to 44 year olds but risks were considerably higher in black men and women. Mortality rates for AIDS in the Glasgow cohort were 9.3 per 100 000 person-years while in the Boston cohort they were around 500 per 100 000 person years, with variations in age and sex. The second commonest cause of death in Boston in 18-24 year olds was by homicide. Rates were 243 and 84 per 100 000 person-years in men and women aged 18-24. The methodology for determining homicide was not provided in Hwang's paper but for comparison ICD-10 codes X85 to Y09 (assault) were calculated for Glasgow. The overall death rate by assault in the Glasgow homeless population was 53 per 100 000 person-years. This is considerably lower than the 18-24 year old rates in Boston but higher than those for 25 to 44 year olds, which were 43 and 45 per 100 000 person-years in men and women respectively.

Hwang's retrospective cohorts of Toronto shelter users in 1995[118,117] are considered next. Crude mortality in men was 876 per 100 000 person-years, compared with 1812 per 100 000 person-years in Glasgow homeless males. Hwang's age-specific rates are also race-adjusted, making direct comparison with Glasgow rates imprecise. However, comparing

Toronto and Glasgow males (see Table 44on page 315 of the Appendix for numbers and rates), rates were 421 vs. 1018 at ages 18-24, 669 vs. 1696 in 25-44 year olds, and 1680 vs. 3254 at ages 45-64 years. That is, all age-specific death rates were about twice as great in the Glasgow homeless population.

In Cheung and Hwang's parallel study of female Toronto shelter users,[117] the crude death rate of 498 per 100 000 person-years was lower than Glasgow's 695 although their mean age was 39 years compared with Glasgow's 30 years. Cheung and Hwang found that the highest risk ratios of death were in their youngest group, 14-25 year olds and not significantly raised in the older age groups (45-64 years). This contrasts with the experience in Glasgow, in which risk of death is lowest in 18 year olds and increase progressively with age. In common with North American literature, HIV/AIDS deaths were among the most common, contrasting with 0.65% of all Glasgow homeless deaths.

Shaw and Dorling's[109] analysis of rough sleepers might be interpreted as deaths per 1000 person-years although strictly they are presented as cumulative risks – that is, proportions of deaths in a fixed time interval (1995/6 may refer to two years or one). Comparing death rates in 16-29 year olds with those in 18-24 year olds in Glasgow, rates were 41 and 7.6 per 1000 person-years; in 30-44 year old London rough sleepers, death rates were 72 per 1000 compared with 14 per 1000 person-years in Glasgow; and in 45-64 year olds they were 158 per 1000 in London compared with 28 per 1000 in the same age group in Glasgow. In short, the rates calculated in London rough sleepers appear to be 5 to 6 times greater than those in the wider cohort of homeless individuals in Glasgow. Shaw and

Dorling concede that “there are undoubtedly many difficulties with the reliability of these data.”[109] The most critical is their use of Census estimates of rough sleepers.

Shaw’s[110] analysis of Oxford hostel residents reported death rates of 13 and 52 per 100 000 for 16-44 and 45-64 year old men, respectively. These compare with rates in Glasgow homeless males of 15 and 33 per 100 00 person-years (the first figure is for 18 – 44 year olds, not 16-44 year olds). Thus rates in Glasgow were very similar for younger men but are only two thirds the Oxford rates in 45-64 year olds.

Shaw’s analysis of Brighton homeless bed-and-breakfast and bedsit residents yielded risks of death in 16-44 year olds of 4.5 per 10^5 and 2.7 per 10^5 in 16-44 year old men and women, respectively, and 51.1 per 10^5 and 2.6 per 10^5 in 45-64 year old men and women, respectively. Comparing these to Glasgow, and noting that the lower limit for inclusion in this thesis was 18 years, Glasgow rates in 18-44 year olds were just over 3 times higher in younger men, and 30% lower in older men. In women, the Glasgow homeless cohort had death risks just over twice that in the younger Brighton bed-sit population and 11 times that in the older group. Overall, therefore, death risks were considerably lower in the Brighton sample. This may partly be because misclassification bias resulted in the inclusion of many non-homeless individuals in the Brighton sample, or because those who are in some form of accommodation, even if it is not secure, are at a lower risk than those who present to the local authority without anywhere suitable to stay.

Roy’s analysis of Montreal street youth[116] was based on a sample whose mean ages of 20 years was 10 years younger than the Glasgow cohort and ceased to follow-up individuals after the age of 30 years. SMRs of 11 and 14 in males and females, respectively, compared with Glasgow risk ratios of 4.4 and 4.5 in males and females. Suicide and drug use were the commonest causes of death in the Montreal street youth although rates were not calculated.

Hibbs[113] prospective cohort study in Philadelphia had similar age and sex demographics to the Glasgow cohort and found crude mortality rates in white individuals of 9 and 5 per 1000 person-years in white men and women, respectively. These compare to Glasgow homeless death rates of 18 and 7 per 1000 person-years in men and women, respectively. That is, male death rates are twice as high in Glasgow as the Philadelphia cohort while female death rates in Glasgow are a third greater. However, when compared with the general population of Philadelphia, risk ratios of death were 4.9 and 4.5 in white men and women, respectively. The female risk ratio was identical to Glasgow's 4.5 while the male death risk ratio was only marginally raised compared with Glasgow's 4.4. By inference, death rates in males in the general population of Philadelphia must be considerably lower – nearly half - than that in Glasgow and deaths in females around a third lower than Glasgow. Hibbs found that injuries and heart disease were the two most common causes of death, together accounting for 40% of all deaths. Direct comparisons with Glasgow are not possible because ICD-10 or other more detailed descriptions of these diagnostic groups are not given. However, deaths from all ischaemic heart diseases (ICD-10 I20 to I25) accounted for only 7% of homeless deaths in Glasgow and ICD-10 S and T codes (injury, poisoning and certain other consequences of external causes) were not among the principal causes of death in any cases. External causes of morbidity and mortality (ICD-10 V01-Y98), however, accounted for 22% of Glasgow homeless deaths. In contrast to Glasgow, Hibbs found that death rates were highest at younger ages (15 to 34 years) and diminished with increasing age.

Babidge's cohort[120] of Australian homeless psychiatric patients was perhaps less like the Glasgow homeless cohort because it comprised individuals who had already developed and were being treated for psychiatric illness. Follow-up of 9.5 years was nearly twice the length of this study. Assuming approximately constant death rates over time, 5-year death rate of 6.6% occurred, which is similar to the 7.2% in the Glasgow cohort. The commonest causes of death were cardiovascular disease (32%), suicide (26%) and accidents (14%). These compare to Glasgow's proportions of cardiovascular disease of 13%, suicide 7%, and external causes of 22%. Given that all causes compete with eachother to produce these percentages, it can be said that the relatively low rates of death from cardiovascular disease and suicide in the Glasgow homeless population must be due to higher rates of other causes. Notably, no deaths in the New South Wales population were attributed to alcohol, while in Glasgow this was the second commonest cause of death, accounting for 16% of deaths and respiratory causes accounted for 1% of Australian and 8% of Glasgow deaths. SMRs in Babidge's paper[120] of 3 and 4 in men and women, respectively, were lower than the Glasgow risk ratios of 4.4 and 4.5 in men and women, respectively.

Lamont[46] estimated cancer incidence in 10 large male homeless hostels in Glasgow. Direct comparisons with death rates cannot be made but some observations are worth noting. In Lamont's analysis, 49% of all cancers were of the lung; in the Glasgow cohort, 26% of deaths from cancer (6 of 23) were lung cancers. Comparing Lamont's incidence proportions with cancer death proportions in the Glasgow homeless cohort, oral cavity and pharynx (ICD-10 C10) were 5% and 9% (2 of 23), stomach (ICD-10 C16) were 5% and none, and colorectal (ICD-10 C18-C20) 5% and 9% (2 of 23). Although the figures do not measure the same event, they both reflect high prevalences of smoking and hazardous drinking reported by Kershaw[44] resulting in lung and oro-pharyngeal cancers.

In conclusion, socio-economic deprivations effects in the non-homeless were of similar orders to those reported elsewhere. The unusually young and male demographics of the non-homeless sample resulted in lower absolute death rates for most causes. The overall mortality ratio in the UK general population between social classes I and V at comparable ages to the Glasgow sample was 4.5.[121] The mortality rate ratio between residents of DEPCATs 1 and 7 in this thesis was lower, at 2.7.

The risks of death in the Glasgow homeless cohort were greater than those described in most previously published studies and, in contrast to several published reports, increased with age.

8.2 Hospitalisations

In Glasgow, the risk of hospital admission increased with greater deprivation but the effect was only statistically significant in residents of the most deprived areas. Homelessness conferred a much greater risk of hospitalisation than being in non-homeless deprived circumstances. The overall pattern of hospitalisations was shaped by two different patterns. The risk of emergency admission showed a clear association with deprivation but rates were lower than elective admissions in all but the most deprived and homeless groups. Elective admissions were more common than emergency in DEPCATs 1 to 6 and showed no overall relationship with socio-economic circumstances or homelessness.

In this discussion it has generally been assumed that published literature described emergency admissions, unless it stated otherwise, and thus comparisons are made with emergency admissions in Glasgow. For most of the North American, Canadian, Australian and some European countries, the provision of elective health care for individuals with limited or no health insurance is restricted. In addition, provision of universal primary care services cannot be assumed. This thesis did not explore the use of either emergency departments or psychiatric hospitals although both emergency admissions following attendance at Accident and Emergency departments and mental and behavioural disorders treated in general hospitals were included. Most literature described homeless populations with very similar age and sex structures to that in Glasgow although North American populations have important racial differences with high proportions of black and Hispanic groups. Analyses of Veterans Administration[80] health care in the United States tended to describe much older groups.

Emergency admissions in Glasgow were twice as high in the most deprived populations compared to the most affluent. The risk ratio of homeless to non-homeless emergency admissions was 6.4 (see Table 23). This is similar to Martell's Hawaiian cohort[61] in which the homeless to non-homeless ratio was 5.6, about 50% higher than the London bed and breakfast residents' odds ratio of 4.5.[81] Among emergency admissions, relative risks of injuries and poisonings were particularly high in both deprived and homeless groups. The association between injuries and poisonings and lower socioeconomic status has been described elsewhere.[186] Injuries and poisoning by illicit drugs appear among the most common diagnoses in other analyses of homeless hospitalisations.[74,80,90] No previously published study was identified that quantified the risks associated with hospitalisation for specific diagnoses. However, the magnitude of risk associated with homelessness was of a different order to that experienced by residents of deprived areas, with risks of around ten times greater. Emergency hospitalisations for convulsions were also nearly ten times greater in the homeless compared with the most deprived areas.

It is unfortunate that among the few cohort studies on homeless people,[61,62] which have the potential to describe diagnosis-specific hospitalisation rates, this information was not provided.

The risk ratio for emergency hospitalisations between deprived and affluent was found to be 3.2 for circulatory disease while the Scottish national figure was 1.8 for myocardial infarction and stroke.[137,138] This may be because the unusual demographics of the sample (socio-economic differentials are greatest at younger ages[118]) or because of a true difference in Glasgow. The risk ratio between affluent and homeless for circulatory disease hospitalisations was 14.1. Risk ratios between deprived and affluent of 4.6 for respiratory diseases and between homeless and affluent of 11.7 are consistent with high prevalences of smoking in deprived[141] and homeless[52,44] populations.

Cirrhosis deaths were around six times greater in residents of the most deprived areas of Glasgow,[187] but no significant relationship was found between deprivation and admissions for mental and behavioural disorders due to the use of alcohol and there were insufficient data to make a comparison of admissions for alcoholic liver disease. However, the risk of "other diseases of the digestive system" was increased by 8-fold in the homeless. This category, which includes haematemesis, melaena and other non-specific gastrointestinal haemorrhages, may be a measure of the effects of excessive alcohol consumption. This finding is consistent with the high prevalence of hazardous drinking in the homeless.[44,52,57,45]

There was no significant relationship between acute hospital admission for mental and behavioural disorders overall and socioeconomic circumstances but the risk of admission in the homeless was 12 times greater than residents of the most affluent areas of Glasgow. This is consistent with high levels of self-reported psychiatric morbidity[52,58,60] although none of these studies quantified the relative risk between homeless and non-homeless populations. Data on psychiatric hospital activity were not obtained and therefore patients with severe and enduring mental illnesses would not necessarily be identified. Thus direct comparisons with high rates of admissions to psychiatric hospitals for psychoses[76] or other psychiatric admissions[87] should not be made.

The literature on homeless hospitalisations identified both tuberculosis and HIV/AIDS as particularly foci for research. Marks's analysis[104] of hospitalisations among patients being treated in the community for tuberculosis did not indicate the relative risk of contracting the infection but found that the odds of hospitalisation among homeless tuberculosis patients was 40% higher than the non-homeless. Hospitalisation rates for HIV/AIDS in deprived or homeless populations have not been described, although the prevalence of infection ranges from 2% in urban homeless women[69] to 12-16% in homeless adolescents[66,67] and 23% among female sex workers.[68] Taylor[105] found in a prospective cohort study of tuberculosis patients that homelessness increased the risk of hospitalisation by 2.5-fold. In Glasgow, there were 2 emergency admissions for HIV-related conditions in the non-homeless cohort and 22 admissions among the homeless, giving homelessness a risk ratio of 22.1. Both of the non-homeless admissions came from residents of DEPCAT areas 6 and 7. Similarly, there were 4 emergency admissions for treatment of tuberculosis in non-homeless individuals, all of which came from DEPCAT 6 and 7 residents, and 22 admissions in the homeless, giving homelessness a risk ratio of 11.1. Thus the absolute risks of hospitalisation for both HIV/AIDS and tuberculosis were low in all populations in Glasgow although homelessness was associated with a high relative risk.

The Honolulu cohort[61] described mean lengths of stay of 10 days in the homeless compared with 8 days in the general population. In the New York City public hospital analysis[74] lengths of stay were 3 to 5 days longer in homeless compared with non-homeless patients. Among patients with tuberculosis[104] lengths of stay were also longer in the homeless, with a median difference of 6 days. Lengths of inpatient stay for emergency admissions in Glasgow were found to increase with greater deprivation in women but were not significantly higher in the homeless. Lengths of emergency stays were lower in homeless compared to non-homeless men. For elective admissions, lengths of stay in both sexes increased with deprivation and were longest in the homeless. Longer lengths of stay may be due to a mixture of more complex conditions and delayed discharge because suitable accommodation cannot be found.

The literature on socio-economic differentials in operations and procedures is limited and no published research was identified on intervention rates in the homeless. Angiography rates after a first acute myocardial infarction are higher and waiting times shorter for patients from more affluent areas.[137,139] Operative intervention rates tended to follow overall trends for elective and emergency admissions, so that they were more common for most emergency operations in the deprived and homeless, but less common for elective admissions. Given that the homeless suffer from much poorer health, it seems reasonable to assume that elective hospital care is under-provided for them. The exception to this finding was the excess of admissions for surgical and medical abortions among the homeless, which can be contrasted with the low rates of vasectomy. This may suggest that contraception is an unmet health need in the homeless.

8.3 Validity of definitions

This section considers whether risk factors were valid at the point of entry into the study and remained valid over the period of observation. Risk factors for both deaths and hospitalisations were determined at the point at which patients entered the cohort in 2000. The question of whether homeless individuals at the point of entry into the study remained homeless for some or all of the follow-up period is a specific example of a more general question of whether cohorts were fixed – that is, whether individuals moved between exposure groups during follow-up.[188]

The principal aim of a cohort study is to identify disease-free populations with different levels of exposure and observe the effects of exposure on incidence of an outcome of interest. The exposures of interest in this study were age, sex and socio-economic circumstances - of which homelessness was one form - and the outcomes hospitalisation and death. Although age is often a strong determinant of risk for a variety of health outcomes, it inevitably advances with every year of observation. Thus the 5-year risk of death in a cohort of 60 year olds describes events that occur in individuals between the ages of 60 and 65. It might be argued that all comparator groups age at the same rate – so that the 5-year risk in 20 year-olds describes events in 20 to 25 year olds. While this is true, the difference between death rates in 20 and 25 year olds is much smaller than that between 60 and 65 year olds. This results in 5-year (or longer) death risks for a given age being confounded by age itself. Aside from the approximation of age at entry into the cohort, rates of change of sex – for example due to gender reassignment surgery - are likely to be very small to nil.

To what extent do socio-economic circumstances at one point in time continue to be valid over 5 years? DEPCATs and other ecological measures do not identify individuals but the circumstances in which they live, and thus they are only capable of measuring changes in an area's characteristics and not changes in an individuals' socio-economic status. If either an individual moves to an area with a different DEPCAT or there are changes in the Census components that result in a change in an area's DEPCAT over time the same individual will be considered to have changed socio-economic circumstances while not necessarily experiencing any personal change in affluence or poverty. It seems reasonable to assume, however, that within a relatively short period of time, such as 5 years, the proportion of individuals who experience significant shifts in their financial, occupational or social circumstances is small enough not to invalidate their initial socio-economic description.

Homelessness as such may be a transient condition but reliable data quantifying its typical duration are lacking. Before considering this further, it is important to be clear that homelessness is used in this thesis to identify individuals in extreme poverty who are likely to have lifelong exposures to a series of traumatic and disadvantageous experiences. Whether or not they "resolve" their legal status as homeless by obtaining secure accommodation, their mental and physical health and health-related behaviours are likely to be poor. The question of whether homeless participants remained homeless for any or all of the follow-up period does not invalidate their identification as individuals who are likely to be in extreme socio-economic deprivation. The results of this thesis confirmed that the major characteristics of deprived populations, such as high mortality and emergency hospitalisation rates – were found in extreme ways among individuals who were homeless at some point in 2000.

Returning to the question of whether homelessness is a persistent or transient condition. Homelessness is defined by its incidence but resolution of homelessness does not have a similar marker. Thus persistent homelessness is defined as repeat presentations, or incidence, in the same individuals. These probably do not really represent repeated episodes of homelessness but failure to properly resolve a number of personal, social and health-related problems in the first place. An analysis of repeat homeless presentations[35] found in a one-year 2001-2 cohort of homeless presentations in Glasgow (the closest to that used in this thesis) 47% of individuals re-presented as homeless within a 4 year period of their initial presentation. The majority of these presentations were within 3 years of their first but 3% presented again only after an absence of 3 years. This suggests that around half of homeless individuals identified in one year experienced persistent homelessness or risk of homelessness. Beijer's analysis of homeless adults in Stockholm[112] found that three quarters remained homeless after 5 years.

One potential response to the question of whether homeless people remained homeless throughout the study would have been to have obtained place of death information. Another would have been to also have obtained address information from SMR01 records. This would have identified individuals who died or were admitted to hospital while residents of large scale homeless hostels and a smaller number whose usual residence would be "no fixed abode." However, this method is subject to significant selection biases, some of which can be inferred from an analysis of deaths and notifiable diseases in hostel residents that was carried out for a needs assessment.[11] The major problem is that neither death records nor hospital records adequately identify homelessness. This was a reason for having designed the study using local authority data to identify homeless individuals. Both hospital and death records do not identify people staying at smaller homeless services – particularly the increasing majority of homeless accommodation that is temporary furnished flats within buildings that are largely occupied by non-homeless residents. Temporary furnished flats do not have unique postcodes to differentiate them from non-homeless accommodation. They are also a constantly changing housing stock, with new properties being added and other properties being either offered to the homeless as permanent accommodation or re-entering the mainstream stock again. By assuming that only individuals who could be identified as residents of named or postcode-specific accommodation were still homeless at the point of hospitalisation or death, a potentially large proportion of truly homeless individuals would be misclassified as being no longer homeless.

The issue of whether risk factors change over time is perhaps less important than whether they provide meaningful measures to assess risks of future events. The findings of this thesis were that age, sex, DEPCAT and homelessness at the point of entry into the cohorts in 2000 were all strongly associated with differences in incidence and casemix of hospitalisation and risk of death. While it may still be argued that they are imperfect measures and no longer describe an individual some time after their entry into the study, they do appear to provide consistent measures of subsequent health outcomes.

Errors in applying valid categorisations to risk factors may result in misclassification biases. To what extent are age, sex, homelessness or DEPCAT valid in the first instance? Date of birth and sex were used as matching fields from Glasgow City Council's homeless data and general population age and sex data came from the Community Health Index. Significant errors in date of birth might result in both incorrect age calculations and reduce the likelihood of matching hospital and death records. However, the matching process employed by ISD used several methods to resolve small differences in demographic data between homeless and SMR01/GRO(S) databases.

This thesis used two types of measure of socio-economic circumstances – DEPCAT and homelessness. The DEPCAT describes the characteristics of a postcode sector using four Census variables. It requires the populations of postcode sectors to have proportions of unemployed males, overcrowded houses, car ownership and residents in occupational social classes IV and V that are within given parameters that define each of the seven DEPCATs. However, populations are heterogeneous and not all individuals will share the characteristics of the whole area. The assumption that an individual's social and economic status is the same as the average in their area is an ecological fallacy. (Homelessness is also a heterogeneous grouping that includes some individuals who are, for example, fleeing a domestic fire or flood but who are not socio-economically deprived.) Area-based measures provide a practical solution to the problem of determining individual socio-economic status when it would be impractical or impossible to obtain actual individual data.[189] There have been questions, however, on the validity of area-based measures as indicators of individual socio-economic status.[190,191] Area-based measures tend to be least valid in the intermediate DEPCATs, 3-5, because these are more heterogeneous, comprising individuals who are truly in intermediate circumstances as well as affluent and deprived, whose scores contribute to an intermediate value.[192] Thus DEPCATs are most useful in comparing and contrasting affluent and deprived populations, which require to be relatively homogeneous to obtain high or low scores. Fortunately, the poorer validity of the DEPCAT in intermediate populations was less important in this analysis. The objective of this thesis was to quantify differences in health between deprived and affluent populations and compare the experience of homeless individuals to those in deprived areas.

A second consideration in the use of socio-economic labels is whether the mixture of individual and ecological measures was appropriate. As noted above, DEPCATs may be considered proxy measures of individual socio-economic status, albeit with some imprecision. Homelessness in this thesis was defined at an individual level. While these are measures that were gathered and defined in different terms, it can be argued that they share many similarities. Homelessness, at one level, is a shorthand measure of a variety of deprived and hazardous circumstances, including insecure or unsuitable accommodation, that an individual experiences; DEPCAT is also an area-based measure of social and material circumstances. The alternative perspective is to consider homelessness as a measure of an individual's personal social status and DEPCAT a proxy measure for individual social class. Thus homelessness and DEPCAT are both proxy measures of individual socio-economic status, with homeless people often being absent from conventional Census-based measures because of they do not have an area of residence to which they belong.

In conclusion, all measures of socio-economic status and age are liable to change from the point at which they are initially defined. DEPCAT is derived from area-based information and homelessness from individual data but both indicate the circumstances in which an individual lives and are proxy measures for the socio-economic status of the individual. The findings of this thesis were that DEPCAT, homelessness, age and sex provided consistent measures of the risks of hospitalisation and death in different populations.

8.4 Validity of hospital and deaths data

This section considers the validity of diagnostic information in hospital and deaths records as well as the precision of data linkage. The validity of using hospital admission data to determine morbidity is also discussed.

All hospital records and death certificates are subject to errors in diagnostic classification. ISD has produced several quality assurance assessments of the SMR01 data. In the most recent report, it estimated that 3-digit diagnostic codes for the Main Condition on SMR01 were accurate in 88% of cases and for Main Operation codes were accurate in 93% of cases.[193] The accuracy of admission and discharge dates was between 95 and 100%.[193] It has been estimated that the probability matching methods used by ISD to link a patient's records correctly to General Register Office death records is around 3%.[194,173] That is, about 3% of patients are either incorrectly matched to a death record when they are alive or incorrectly not matched to a death record when they have died. Validation of Scottish Morbidity Record maternity linkage suggests mismatching occurs in a higher proportion although it is still considered to have a high level of accuracy.[195] These errors may introduce a small amount of non-differential misclassification and therefore bias any finding towards the null.[196] There is no reason to suggest that any risk group will differentially be more likely to be linked to death records and therefore experience artefactual increases in death risks.

The use of the first underlying cause of death, rather than the immediate cause, is standard practice in reporting the principal cause of death. It has the advantage of reporting only one cause of death per person and emphasises the major morbidity contributing to death rather than the mechanism of death itself. It might be argued that this approach underestimates the presence of some risk factors. For example, in Crisis's first report, *Sick To Death of Homelessness*, they found that alcohol was the main cause of death in 5% of coroner's reports but a contributory factor in 14%.[107] An alternative approach would be to sum the presence of all causes of death and order them by frequency. A limitation of this approach is that it emphasises conditions that are frequently cited but not necessarily of high importance.

Hospital admissions were used to indicate morbidities in the last of the three major analyses in this thesis. To what extent do hospitalisations represent prevalent morbidity? Previous hospitalisations may be useful indicators of chronic, non-fatal conditions that require hospital treatment.[197] The corollary is that they underestimate the occurrence of transitory, including fatal, conditions and those that do not require inpatient care. Among this latter group may be included many patients with addictions problems, diabetes mellitus, and psychiatric disorders. The methodology used in this thesis was to record any occurrence of a major diagnostic group as evidence of morbidity. This may have over-represented some less significant morbidities that were entered particularly in the third to sixth diagnostic positions of the SMR01 form. However, any one diagnostic group was only counted once per person, so multiple occurrences in either the same or different hospitalisations would not increase its weighting.

Individuals with higher hospitalisation rates were more likely to have morbidities recorded in the analysis of morbidity-adjusted mortality. Thus, among a group of patients who shared the same casemix, some were more likely to be admitted to hospital, they would also appear to have a higher prevalence of morbidity. This is an example of Berkson's bias,[198] in which case ascertainment is conditional on hospitalisation, although the original paper describes the phenomenon in case-control studies only. The effect of controlling for morbidity in the multivariable analysis of deaths may therefore have been to confound associations between risk groups and probability of death. Without triangulating morbidity information from some other sources, it was not possible to know in which direction this confounding may have operated. For example, if, for the same level of alcohol-related morbidity, homeless individuals were less likely to obtain inpatient hospital treatment, the relationship between homelessness and death from alcohol-related conditions will not apparently be explained by the prevalence of alcohol-related morbidity. It will remain an "independent" risk factor of homelessness. This interpretation may explain the findings for alcohol in Table 18 on page 228. However, it may be that compared with non-homeless individuals, homelessness is either associated with a similar or greater likelihood of hospital admission for a given level of alcohol morbidity. In these two scenarios, the observed findings of the multivariable analysis would be a valid estimate, or an underestimate, respectively, of the independent effect of homelessness.

In summary, the diagnostic precision of SMR01 records is high and where errors occur, they are unlikely to be systematically biased towards any given risk group. Errors in linkage to death records are small and also unlikely to be biased towards any given group. Differential hospitalisation rates may confound apparent associations between morbidities and deaths but without additional data to validate morbidity estimates, the effects of confounding may increase or decrease the independent effects of homelessness described in the multivariable analyses in Chapter 7.

8.5 Implications for a "Glasgow effect"

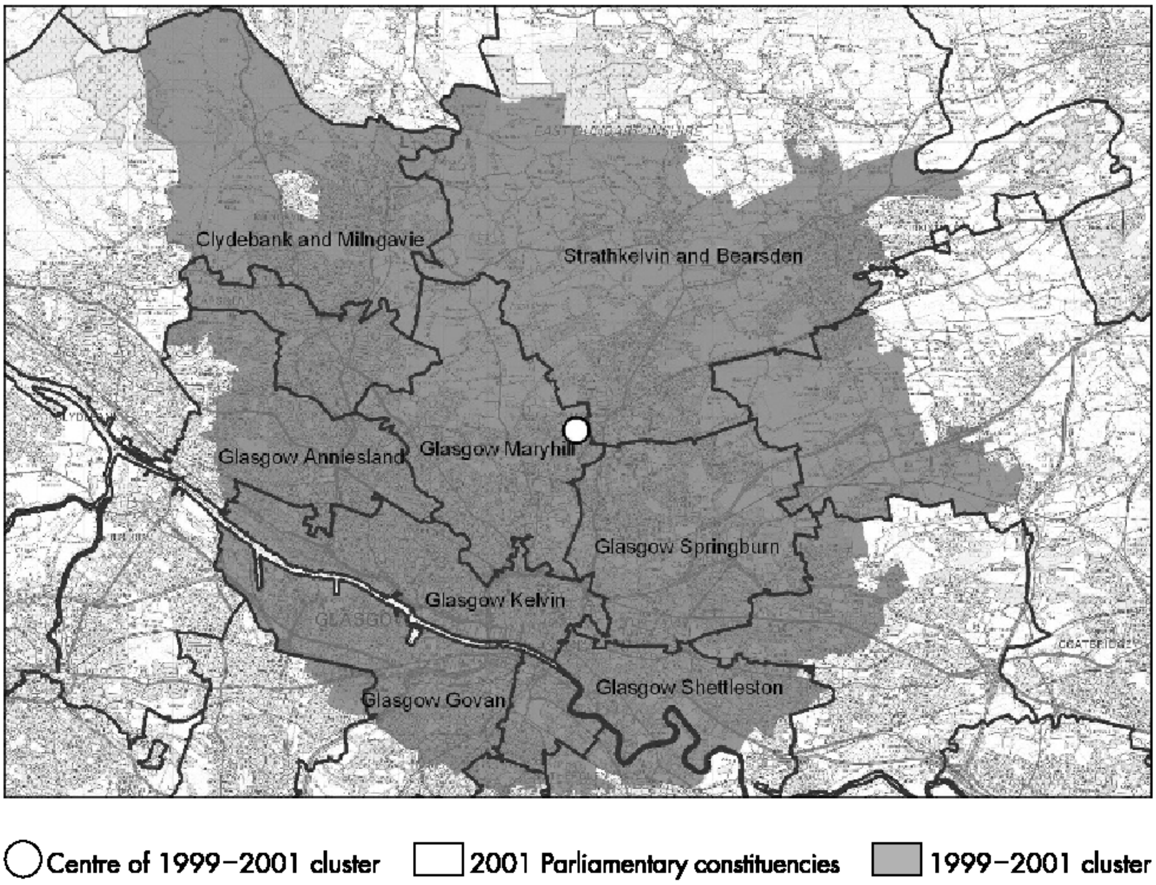
Chadwick's observation over 160 years ago that the health of residents of Scottish cities was worse than any in England[1] has remained valid through time, albeit using more objective quantitative methods. Mortality rates are both higher and improving more slowly over time in Glasgow compared with similar post-industrial areas in the United Kingdom and Europe.[10] Carstairs and Morris suggested that differences in mortality between Scotland and England and Wales could be largely explained by their eponymous four-component deprivation score.[199] However, later analyses by Hanlon suggested that there was an additional "Scottish effect" that could not be explained by the Carstairs variables.[6,200,5] It was suggested that higher levels of individual risk factors, such as excessive alcohol consumption and smoking, within comparably deprived Scottish and English populations might be responsible.[5] The psycho-social impacts of deindustrialisation were also hypothesised as explanations. The debate has continued. An analysis of individual self-reported health in 25 to 64 year olds concluded in 2006 that poorer health in Scotland compared with England could largely be explained by socio-economic position alone, defined by housing tenure, housing conditions and car ownership.[4] An analysis of cause-specific mortality in 2008, however, proposed that the higher prevalence of drug use in Scotland compared with England contributed 32% of its overall excess mortality.[201]

Watt's analyses focussed specifically on understanding the higher mortality rates in Glasgow compared with Edinburgh. A novel perspective was gained by comparing age-specific mortality rates between the cities, concluding that in 1979-83 men and women in Glasgow had mortality rates comparable to men and women in Edinburgh their elders by 3.9 and 3.6 years, respectively. It was predicted that these differences would continue to increase over time.[202] Subsequent analyses confirmed that differences in age-specific mortality rates in both men and women had increased by 1989-93, despite larger than expected absolute falls in cause-specific mortality in Glasgow.[203] A number of explanations was suggested for Glasgow-Edinburgh mortality differences but the sense that life was being lived at a faster rate in more deprived populations[204] led to the conclusion that primary preventive lifecourse perspectives were needed rather than more secondary preventive medical interventions. In particular, Watt suggested that childhood deprivation needed to be reduced and socio-economic differences in life expectancy should both be routinely reported and be the subject of Government remediation.[204]

Further insights into a specific “Glasgow effect” have been obtained from a recent comparison between health behaviours in Glasgow and other European areas.[7] This found that while socio-economic deprivation was not significantly worse in Glasgow compared with other European countries, excessive weekly alcohol consumption and binge drinking, and obesity were higher in Glasgow than some equivalent areas of Northern Ireland and England. Self-reported health was also poorer in Glasgow than in comparable areas of Eastern Northern Ireland, Sweden, Belgium, Spain and Germany.[7]

It is not possible to say whether Glasgow has a greater prevalence of homelessness than other cities because case ascertainment methods are not comparable. No comparable universal database to the Integrated Housing Management System has been identified in other United Kingdom areas. However, the presence of a population of homeless individuals who experience extremely poor health may be one dimension to the excessive morbidity and mortality observed in Glasgow. It may provide an explanation for observed clusters of suicides in deprived areas of Glasgow.[205] The cluster moved north from the Glasgow Springburn area in 1980-2 and 1990-2 to Glasgow Maryhill in 1999 to 2001 (see Figure 43). The similarity between this cluster and the high prevalence of homeless accommodation illustrated particularly in Figure 2 and 4, on pages 42 and 44, respectively, is striking and suggests that the 8.4 fold hazard ratio for intentional self-harm in the homeless described in Table 13 on page 179 may offer an explanation.

Figure 43. The significant cluster of suicides in Glasgow in the 1999 to 2001 period. From Exeter DJ, Boyle PJ.



Homelessness might therefore be seen as a sensitive index of the extreme socio-economic deprivation experienced in Glasgow, an "eighth DEPCAT" beyond conventional measures of poverty, which record only whether accommodation is overcrowded[2] (the Carstairs score) or owner-occupied[206] (the Townsend score), not if it is wholly absent.

8.6 Implications for health improvement

There are several perspectives on how best to improve the poor health of homeless and deprived people. One is to focus on the determinants of specific causes of morbidity and mortality. This high-risk strategy is appealing at an individual level[207] but as a public health strategy is paradoxically ineffective.[208] Moreover, it is simplistic to consider that the poor health of homeless and deprived populations is the result of their identifiable health risk behaviours and that reducing smoking, alcohol consumption and drug use would eliminate health inequalities. The evidence from this thesis is that homelessness raises the risk of death from all causes except cancers and even this may be an artefact of studying a young population with high competing risks. Homeless people die 12 years younger than their non-homeless counterparts, displaying an extreme form of the accelerated aging in deprived communities described by Watt.[204] The morbidity-adjusted mortality hazards described in this thesis suggest that homelessness confers an additional hazard of death in patients with similar morbidities. Given their high levels of morbidity, rates of elective hospital care appear inappropriately low in the homeless, while high emergency admission rates suggest under provision of primary care. In short, public health strategies that attempt to deal with the health and health care manifestations of deprivation avoid dealing with the primary pathology, deprivation itself.

The policy response to homelessness in Glasgow has been principally directed at tertiary prevention, that is, making improvements to homeless services and statutory accommodation. Glasgow Homelessness Partnership's *Strategy for the Prevention and Alleviation of Homelessness*[209] outlined the closure of all local authority homeless hostels, their "re-provisioning" by temporary furnished flats, the creation of new accommodation for older men with ongoing alcohol problems, and improvements in assessment of health and social problems when people present to the Council's homeless services. A substantial investment in specialist health services was also made. To some extent this approach treats homelessness as mainly being a problem of lack of suitable accommodation, while acknowledging high prevalences of addictions and other health problems. It would be unfair to suggest that the professionals who work in homeless services are naïve about the complexity of problems their clients and patients have. Nevertheless, much of the investment in homelessness in Glasgow has been about improving the aesthetics of the homeless temporary accommodation rather than on preventing homelessness occurring in the first place. Hwang's systematic review of health interventions for the homeless[210] found evidence that active outreach improved psychiatric symptoms and hospitalisations and reduced substance use amongst drug users. Monetary incentives improved adherence to tuberculosis testing and treatment.[98,97] However, these remain tertiary preventive approaches and it seems reasonable to suggest that resolution of homelessness would effect the greatest improvement in health and a greater ability to benefit from efficacious health care interventions.

When homelessness is seen as part of the spectrum of socio-economic inequalities, rather than an accommodation problem, the appropriate solutions for primary prevention become more far-reaching, radical and therefore difficult to realise. Wilkinson proposed that reductions in relative wealth within societies were important[211] and variations in the quality of social relations were the mechanism by which inequalities affected health.[212] Despite a consistent body of evidence of their harms, income inequalities have increased in the

United Kingdom since comparable records began in 1961.[213] Between 1996-7 and 2006-7, income growth was smallest at the bottom of the income distribution and greatest at the top. The Gini coefficient of income inequality (in which 0 describes complete equality and 1 describes complete inequality) rose from about 0.25 in 1979 to about 0.35 in 1997 and has remained more or less constant to date.[213] The overall rise in income and increase in inequality is reflected in mortality rates. Although overall mortality rates fell, socio-economic inequalities in mortality increased in Scotland between 1980 and 2000.[214] The greatest increases occurred among younger adults' deaths by suicide and alcohol and drug-related causes.

It is beyond the scope of this thesis to propose a manifesto for reducing socio-economic inequalities in the United Kingdom but it would be remiss not to conclude that the most effective way of reducing the hazards of homelessness would be to reduce overall inequalities throughout society. At the point of becoming homeless, many individuals have experienced a lifetime of disadvantage – they may have been born into a homeless family[215] and therefore experienced disrupted and incomplete education,[44] a third have been raised in local authority care or have been in prison,[44] experienced long-term unemployment,[44] or had mental health or addictions problems. While there is a responsibility to improve early detection and resolution of homelessness, to provide safe and secure accommodation for those who remain homeless, and to provide effective and appropriate health services, the potential to reverse the psychological and physical effects that have led to homelessness may be limited.

8.7 Further analyses

The dataset that was created for this thesis comprises all hospital admissions and death records. There is potential for extensive analysis of specific diagnostic groups, comparing the relative effects of deprivation and homelessness. It would be possible to contrast conditions for which there is evidence that deprivation worsens mortality, such as cardiovascular diseases,[216] with those where the reverse is found, such as breast cancer.[217] For patients with similar casemix variables, comparisons might be made of numbers of hospitalisations, lengths of stay, treatment modalities and death rates. The sample size is not necessarily powered to detect true effects in smaller sub-groups, however. Poisson regression could be used to model admission counts within risk groups, as an alternative to the methods used in this thesis. Poisson regression might complement information on lengths of stay by indicating not just whether the overall admission rates were higher among some groups, but also whether multiple admissions were more common. However, this methodology assumes that each count – that is, hospital admission – occurs independently of others. In practice, multiple admissions for treatment of a chronic illness are associated within individuals. Further statistical consideration would therefore be required before applying Poisson regression.

The dataset includes link numbers that uniquely identify individuals on ISD's linked databases. It would be relatively straightforward, therefore, to obtain updated hospitalisation and deaths records in the future so that longer-term risks could be calculated, particularly for chronic diseases of middle age such as cardiovascular diseases and cancers.

One question that remains is on the extent to which homelessness is a causal factor for, or a consequence of, ill health. Prospective cohort studies have the potential to answer this question by identifying non-homeless cohorts with various illnesses and determining the subsequent risk of becoming homeless compared with matched controls without these illnesses. Hwang reported lifetime prevalence of traumatic brain injury of 53% in a cross-sectional study of homeless adults in Toronto[218] and suggested that it may be possible to link data from patients in Glasgow with traumatic brain injury[219,220] to homeless records in the Integrated Housing Management System [personal communication]. Other groups of patients, for example those with alcohol and drug problems, might similarly be identified in prospective homeless data.

Prospective cohort methods also offer the potential to measure individual, rather than ecological, socio-economic status and to determine whether it remains valid throughout the follow-up period. As with other studies of "hard to reach" populations, however, a great deal of effort is needed to identify individuals who have no fixed address and may deliberately attempt to avoid being traced because of debt or fear of violence. All but one prospective cohort study of deaths was identified in which data on homeless status were available from those who had not died, a small study in which patients were identified by community psychiatric outreach teams.[112]

Between 2003 and 2008 Glasgow City Council closed all of its large homeless hostels for men and it will close its single female hostel thereafter. There has been a concomitant increase in alternative accommodation, principally temporary furnished flats. A substantial investment has also been made in specialist health services for the homeless. A repeat study is needed to determine whether these changes have been associated with improvements in the health and mortality of homeless people in Glasgow. A lifecourse perspective would suggest, as noted in Section 8.6, above, that the potential for making significant differences at the point an individual has become homeless is much less than if preventive interventions had been made earlier.

However, there is an opportunity to evaluate the effectiveness of specialist health services for the homeless in Glasgow, both in terms of their effectiveness in providing high quality services – particularly accessible and acceptable dimensions[221] – and their impacts on subsequent homelessness.

Chapter 9. Conclusions

This thesis contributes the largest published cohort study of the health of homeless adults in the United Kingdom and is among the largest and most comprehensive homeless studies published internationally. It is unique in using hospital data to infer morbidity, allowing the effects of homelessness and prevalent morbidity to be distinguished. The use of closed cohorts avoids the limitations of estimating cumulative incidence using denominators that may be imprecise, particularly for those of the prevalent homeless population. Absolute risks of hospitalisation and death have been reported in favour of standardised ratios used in most previously published work on the homeless. This allows more direct comparisons to be made with risks in other populations. The use of a matched cohort allowed for comparisons to be made with socio-economically deprived populations and any local area effects – such as particular hospital admission policies or death coding preferences – should be common to both homeless and non-homeless cohorts.

The health of homeless people, measured through hospital care and deaths, was consistently poorer than that of the most deprived non-homeless local populations. This could be partly explained by poorer health at the point of becoming homeless but an estimate has also been made of the additional hazard of homelessness itself.

Homeless people continue to be characterised by their lack of suitable accommodation. While accommodation may be one of their most urgent needs when they present to a local authority, it is important that the homeless population is seen as a manifestation of the most severe socio-economic deprivation within the whole of an unequal and inequitable society. A response that deals only, or mainly, with managing homelessness when it occurs will make little difference to the incidence of homelessness and has limited potential to reverse the cumulative effects of deprivation over a lifecourse.

Glasgow probably has the most comprehensive database of homeless individuals that exists. This provides a unique opportunity to be able to describe the incidence of homelessness. The linked Scottish Morbidity Record system also provides an opportunity to follow individuals' hospital care and identify death records. Together, these routine data are able to describe the relationships between health and complex social conditions. It is important that the Integrated Housing Management System is maintained and used to evaluate whether major changes in homeless service provision have had an impact on the city's most vulnerable citizens.

Chapter 10. Bibliography

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Chapter 11. Appendices

Table 21. DEPCAT of residence on entry to study in 2000, non-homeless cohort, by sex with Greater Glasgow Health Board (GGHB) area 2001 Census population for comparison.

N=12 625.

	DEPCAT								
group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**not available**	**all**
male	268	879	546	1284	737	1700	2687	108	8209
	3.3%	10.7%	6.7%	15.6%	9.0%	20.7%	32.7%	1.3%	100.0%
female	115	549	317	792	411	893	1273	66	4416
	2.6%	12.4%	7.2%	17.9%	9.3%	20.2%	28.8%	1.5%	100.0%
TOTAL	383	1428	863	2076	1148	2593	3960	174	12625
	3.0%	11.3%	6.8%	16.4%	9.1%	20.5%	31.4%	1.4%	100.0%
GGHB 2001	5.5%	12.3%	9.0%	15.6%	9.6%	18.3%	29.7%		

Table 22. Numbers of deaths and death rate per 1000 person-years by DEPCAT in non-homeless cohort. n=209

DEPCAT 2001	deaths	rate
1	4	1.75
2	12	1.50
3	8	1.63
4	21	1.86
5	15	2.39
6	44	3.07
7	105	4.79
TOTAL	209	-

Table 23. First admission type in each continuous inpatient stay by elective (EL), emergency (EM), transfer (TR) and all hospital admissions by DEPCAT and homeless status. Rate per 1000 person-years of non-hospitalised observation (and number in brackets).

cohort	n persons	∑ non-inpatient person-years at risk of hospitalisation	∑ EM per 1000 person-yrs	∑ EL per 1000 person-yrs	∑ TR per 1000 person-yrs	∑ cis per 1000 person-yrs
DEPCAT1	108	2002.1	37.5 (75)	64.4 (129)	0 (0)	101.9 (204)
DEPCAT2	313	7464.6	34.3 (256)	53.2 (397)	1.5 (11)	89.0 (664)
DEPCAT3	223	4515.6	35.4 (160)	61.8 (279)	0.9 (4)	98.1 (443)
DEPCAT4	533	10835.5	35.8 (388)	63.7 (690)	1.1 (12)	100.6 (1090)
DEPCAT5	332	5984.1	45.0 (269)	67.2 (402)	2.0 (12)	114.1 (683)
DEPCAT6	788	13496.9	59.6 (805)	78.2 (1056)	0.7 (10)	138.6 (1871)
DEPCAT7	1273	20488.4	81.4 (1667)	70.0 (1435)	1.8 (36)	153.2 (3138)
Non-homeless	3570	64787.2	55.9 (3620)	67.7 (4388)	1.3 (85)	124.9 (8093)
Homeless	3536	32189.7	358.4 (11537)	63.2 (2034)	5.6 (181)	427.2 (13752)
Homeless/non-homeless risk ratio			6.4	0.9	4.3	3.4
unknown	2	913.7	1.1 (1)	1.1 (1)	0 (0)	2.2 (2)
All	7106	97890.5	154.8 (15157)	65.6 (6422)	2.7 (266)	223.2 (21845)

Table 24. Risk of emergency hospitalisation. Number of continuous inpatient stays, non-hospitalised observation time and rate per 1000 person-years by DEPCAT/homeless status and sex.

cohort	∑ EM		∑ person-yrs		Rate per 1000 person-yrs		Risk ratio	
	M	F	M	F	M	F	M	F
DEPCAT1	50	25	1399.8	602.3	35.7	41.5	1	1
DEPCAT2	184	72	4587.3	2877.2	40.1	25.0	1.1 (0.8-1.6)	0.6 (0.4-0.9)
DEPCAT3	114	46	2854.7	1660.8	39.9	27.7	1.1 (0.8-1.6)	0.7 (0.4-1.1)
DEPCAT4	237	151	6683.3	4152.2	35.5	36.4	1.0 (0.7-1.4)	0.9 (0.6-1.4)
DEPCAT5	176	93	3832.2	2151.9	45.9	43.2	1.3 (0.9-1.8)	1.0 (0.7-1.7)
DEPCAT6	530	275	8830.5	4666.4	60.0	58.9	1.7 (1.3-2.3)	1.4 (0.9-2.2)
DEPCAT7	1212	455	13854.3	6634.1	87.5	68.6	2.4 (1.8-3.3)	1.7 (1.1-2.6)
Non-homeless	2503	1117	42042.1	22745.0	59.5	49.1		
Homeless	8501	3036	20705.4	11484.3	410.6	264.4	11.5 (8.7-15.5)	6.4 (4.3-9.9)
unknown	1	0	567.1	346.6	1.8	0	-	
All	11004	4153	63314.6	34575.9	173.8	120.1	1.4	

Table 25. Risk of elective hospitalisation. Number of continuous inpatient stays and rate per 1000 person-years by DEPCAT/homeless status and sex.

cohort	**∑ EL**		**∑ person-yrs**		**Rate per 1000 person-yrs**		**Risk ratio**	
	M	F	M	F	M	F	M	F
DEPCAT1	97	32	1399.8	602.3	69.3	53.1	1	1
DEPCAT2	246	151	4587.3	2877.2	53.6	52.5	0.8 (0.6-0.9)	1.0 (0.7-1.5)
DEPCAT3	189	90	2854.7	1660.8	66.2	54.2	1.0 (0.7-1.2)	1.0 (0.7-1.6)
DEPCAT4	400	290	6683.3	4152.2	59.9	69.8	0.9 (0.7-1.1)	1.3 (0.9-2.0)
DEPCAT5	255	147	3832.2	2151.9	66.5	68.3	1.0 (0.8-1.2)	1.3 (0.9-2.0)
DEPCAT6	564	492	8830.5	4666.4	63.9	105.4	0.9 (0.7-1.2)	2.0 (1.4-2.9)
DEPCAT7	905	530	13854.3	6634.1	65.3	79.9	0.9 (0.8-1.2)	1.5 (1.1-2.2)
Non-homeless	2656	1732	42042.1	22745.0	63.2	76.1		
Homeless	1054	980	20705.4	11484.3	50.9	85.3	0.7 (0.6-0.9)	1.6 (1.1-2.4)
unknown	1	0	567.1	346.6	1.8	0		
All	3710	2712	63314.6	34575.9	58.6	78.4		

Table 26. Risk of transfer hospitalisation. Number of continuous inpatient stays and rate per 1000 person-years by DEPCAT/homeless status and sex.

cohort	∑ TR		∑ cis per 1000 person-yrs		Rate per 1000 person-yrs		Risk ratio, M:F
	M	F	M	F	M	F	
DEPCAT1	0	0	1399.8	602.3	0.0	0.0	-
DEPCAT2	7	4	4587.3	2877.2	1.5	1.4	1.1
DEPCAT3	4	0	2854.7	1660.8	1.4	0.0	-
DEPCAT4	8	4	6683.3	4152.2	1.2	1.0	1.2
DEPCAT5	7	5	3832.2	2151.9	1.8	2.3	0.8
DEPCAT6	7	3	8830.5	4666.4	0.8	0.6	1.2
DEPCAT7	28	8	13854.3	6634.1	2.0	1.2	1.7
Non-homeless	61	24	42042.1	22745.0	1.5	1.1	1.4
Homeless	147	34	20705.4	11484.3	7.1	3.0	2.4
RR					4.9	2.8	
unknown	0	0	567.1	346.6	0	0	-
All	208	58	63314.6	34575.9	3.3	1.7	2.1

Table 27. Risk of all hospitalisations. Number of continuous inpatient stays and rate per 1000 person-years by DEPCAT/homeless status and sex.

cohort	∑ admissions		∑ cis per 1000 person-yrs		Rate per 1000 person-yrs		Risk ratio	
	M	F	M	F	M	F	M	F
DEPCAT1	147	57	1399.8	602.3	105.0	94.6	1	1
DEPCAT2	437	227	4587.3	2877.2	95.3	78.9	0.9 (0.8 –1.1)	0.8 (0.6-1.1)
DEPCAT3	307	136	2854.7	1660.8	107.5	81.9	1.0 (0.8-1.3)	0.9 (0.6-1.2)
DEPCAT4	645	445	6683.3	4152.2	96.5	107.2	0.9 (0.8-1.1)	1.1 (0.9-1.5)
DEPCAT5	438	245	3832.2	2151.9	114.3	113.9	1.1 (0.9-1.3)	1.2 (0.9-1.6)
DEPCAT6	1101	770	8830.5	4666.4	124.7	165.0	1.2 (<1.0-1.4)	1.7 (1.3-2.3)
DEPCAT7	2145	993	13854.3	6634.1	154.8	149.7	1.5 (1.2-1.8)	1.6 (1.2-2.1)
Non-homeless	5220	2873	42042.1	22745.0	124.2	126.3		
RR					3.8	2.8		
Homeless	9702	4050	20705.4	11484.3	468.6	352.7	4.5 (3.8-5.3)	3.7 (2.9-4.9)
unknown	2	0	567.1	346.6	3.5	0		
All	14922	6923	63314.6	34575.9	235.7	200.2		

Table 28. Number and rate of emergency hospital admissions by age and sex. Baseline 18-19 years in each sex. Male:female rate ratio.

	EM		Risk time		Rate per 1000 person-years		Rate ratio
Age (years)	M	F	M	F	M	F	
18-19	408	343	4364.5	3683.9	93.5	93.1	1.0
20-24	1403	832	11697.8	8146.9	119.9	102.1	1.2
25-29	1935	736	13358.4	7159.1	144.9	102.8	1.4
30-34	1537	695	10637.2	5905.0	144.5	117.7	1.2
35-39	1661	678	8228.4	4868.5	201.9	139.3	1.4
40-44	1169	395	5190.3	2163.8	225.2	182.6	1.2
45-49	777	167	3049.7	1216.3	254.8	137.3	1.9
50-54	679	138	2762.6	715.2	245.8	192.9	1.3
55-59	687	114	1941.8	451.6	353.8	252.4	1.4
60-64	332	24	1110.0	123.6	299.1	194.2	1.5
65-69	249	10	507.1	42.4	491.0	235.7	2.1
≥70	168	21	466.9	99.5	359.8	211.1	1.7
TOTAL	11005	4153	63314.6	34575.9	173.5	120.1	1.4

Table 29. Number and rate of elective hospital admissions by age and sex. Male:female rate ratio.

	Number		Rate per 1000 person-years		Rate ratio
Age (years)	M	F	M	F	
18-19	111	208	25.4	56.5	0.5
20-24	361	404	30.9	49.6	0.6
25-29	498	392	37.3	54.8	0.7
30-34	438	501	41.2	84.8	0.5
35-39	462	444	56.1	91.2	0.6
40-44	414	290	79.8	134.0	0.6
45-49	303	183	99.4	150.5	0.7
50-54	336	139	121.6	194.3	0.6
55-59	317	100	163.3	221.4	0.7
60-64	200	31	180.2	250.8	0.7
65-69	139	5	274.1	117.8	2.3
≥70	132	15	282.7	150.8	1.9
TOTAL	3711	2712	58.5	78.4	0.7

Table 30. Number and rate of transfer hospital admissions by age and sex. Male:female rate ratio.

	number		**Rate per 1000 person-years**		**Rate ratio**
Age (years)	M	F	M	F	
18-19	8	4	1.8	1.1	1.7
20-24	28	7	2.4	0.9	2.8
25-29	32	14	2.4	2.0	1.2
30-34	25	11	2.4	1.9	1.3
35-39	27	11	3.3	2.3	1.5
40-44	17	5	3.3	2.3	1.4
45-49	24	1	7.9	0.8	9.6
50-54	18	2	6.5	2.8	2.3
55-59	15	2	7.7	4.4	1.7
60-64	5	1	4.5	8.1	0.6
65-69	6	0	11.8	0.0	-
≥70	3	0	6.4	0.0	-
TOTAL	208	58	3.3	1.7	2.0

Table 31. Number and rate of all types of hospital admissions by age and sex. Male:female rate ratio

	all		**Rate per 1000 person-years**		**Rate ratio**
Age (years)	M	F	M	F	
18-19	527	555	120.7	150.7	0.8
20-24	1792	1243	153.2	152.6	1.0
25-29	2465	1142	184.5	159.5	1.2
30-34	2000	1207	188.0	204.4	0.9
35-39	2150	1133	261.3	232.7	1.1
40-44	1600	690	308.3	318.9	1.0
45-49	1104	351	362.0	288.6	1.3
50-54	1033	279	373.9	390.1	1.0
55-59	1019	216	524.8	478.3	1.1
60-64	537	56	483.8	453.1	1.1
65-69	394	15	776.9	353.5	2.2
≥70	303	36	649.0	361.8	1.8
TOTAL	14924	6923	235.3	200.2	1.2

Table 32. First diagnosis in first finished consultant episode of all continuous inpatient stays where type of admission is emergency, by DEPCAT/homelessness. Rates per 10 000 person-years out-of-hospital risk time and numbers in brackets.

ICD10	Socio-economic circumstances			
	1-2	3-5	6-7	homeless
A – Certain infectious and parasitic diseases	4.2 (4)	3.3 (7)	7.1 (24)	28.0 (90)
B - Certain infectious and parasitic diseases	3.2 (3)	4.2 (9)	5.9 (20)	24.5 (79)
C - Neoplasms	20.1 (19)	8.0 (17)	20.3 (69)	10.3 (33)
D – In situ neoplasms	2.1 (2)	2.3 (5)	4.1 (14)	8.4 (27)
E – Endocrine, nutritional and metabolic diseases	3.2 (3)	14.5 (31)	10.0 (34)	39.1 (126)
F – Mental and behavioural disorders	16.9 (16)	5.6 (12)	19.4 (66)	193.5 (623)
G – Diseases of the nervous system	11.6 (11)	10.3 (22)	12.7 (43)	65.2 (210)
H – Diseases of the eye and adnexa	2.1 (2)	1.9 (4)	2.6 (9)	6.8 (22)
I – Diseases of the circulatory system	19.0 (18)	25.3 (54)	60.9 (207)	267.2 (860)
J – Diseases of the respiratory system	12.7 (12)	25.3 (54)	58.0 (197)	148.5 (478)
K – Diseases of the digestive system	38.0 (36)	48.3 (103)	82.4 (280)	333.3 (1073)
L – Diseases of the skin and subcutaneous tissue	8.5 (8)	15.5 (33)	30.9 (105)	284.9 (917)
M – Diseases of the musculoskeletal system and connective tissue	9.5 (9)	12.7 (127)	19.1 (65)	128.6 (414)
N – Diseases of the genitourinary system	37.0 (35)	19.7 (42)	29.4 (100)	80.8 (260)
O – Pregnancy, childbirth and the puerperium	8.5 (8)	8.0 (17)	6.5 (22)	32.9 (106)
Q – Congenital malformations, deformations and chromosomal abnormalities	0 (0)	0 (0)	0.6 (2)	0.3 (1)
R – Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	85.6 (81)	83.9 (179)	156.8 (533)	658.6 (2120)
S – Injury, poisoning and certain other consequences of external causes	43.3 (41)	58.1 (124)	115.9 (394)	721.0 (2321)
T - Injury, poisoning and certain other consequences of external causes	22.2 (21)	34.2 (73)	81.8 (278)	541.5 (743)
Z – Factors influencing health status and contact with health services	2.1 (2)	1.9 (4)	2.9 (10)	10.6 (34)
ALL	349.6 (331)	382.9 (817)	727.4 (2472)	3584.1 (11537)

Note that P - Certain conditions originating in the perinatal period, are not included because all individuals were aged 18 or over. There were no recorded ICD-10 V, X or Y codes (external causes of morbidity and mortality).

Table 33. Risk ratios and 95% confidence intervals for emergency admission rates by socio-economic circumstances. Baseline in each case is DEPCAT 1 and 2.

ICD10	**Socio-economic circumstances**			
	1-2	3-5	6-7	homeless
A – Certain infectious and parasitic diseases	1	0.8 (0.2-3.6)	1.7 (0.6-6.6)	6.6 (2.5-24.8)
B - Certain infectious and parasitic diseases	1	1.3 (0.3-7.6)	1.9 (0.6-9.8)	7.7 (2.6-38.4)
C - Neoplasms	1	0.4 (0.2-0.8)	1.0 (0.6-1.8)	0.5 (0.3-1.0)
D – In situ neoplasms	1	1.1 (0.2-11.6)	1.9 (0.4-17.7)	4.0 (1.0-34.5)
E – Endocrine, nutritional and metabolic diseases	1	4.6 (1.4-23.4)	3.2 (1.0-16.1)	12.4 (4.1-60.7)
F – Mental and behavioural disorders	1	0.3 (0.1-0.7)	1.1 (0.7-2.1)	11.5 (7.0-20.2)
G – Diseases of the nervous system	1	0.9 (0.4-2.0)	1.1 (0.6-2.3)	5.6 (3.1-11.4)
H – Diseases of the eye and adnexa	1	0.9 (0.1-9.8)	1.3 (0.3-11.9)	3.2 (0.8-28.4)
I – Diseases of the circulatory system	1	1.3 (0.8-2.4)	3.2 (2.0-5.5)	14.1 (8.8-23.8)
J – Diseases of the respiratory system	1	2.0 (1.1-4.1)	4.6 (2.6-9.0)	11.7 (6.6-22.8)
K – Diseases of the digestive system	1	1.3 (0.9-1.9)	2.2 (1.5-3.2)	8.8 (6.3-12.6)
L – Diseases of the skin and subcutaneous tissue	1	1.8 (0.8-4.6)	3.7 (1.8-8.7)	33.7 (17.0-78.3)
M – Diseases of the musculoskeletal system and connective tissue	1	1.3 (0.6-3.2)	2.0 (1.0-4.6)	13.5 (7.1-29.8)
N – Diseases of the genitourinary system	1	0.5 (0.3-0.9)	0.8 (0.5-1.2)	2.2 (1.5-3.2)
O – Pregnancy, childbirth and the puerperium	1	0.9 (0.4-2.5)	0.8 (0.3-2.0)	3.9 (1.9-9.3)
Q – Congenital malformations, deformations and chromosomal abnormalities	0	-	-	-
R – Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	1	1.0 (0.8-1.3)	1.8 (1.4-2.3)	7.7 (6.2-9.7)
S – Injury, poisoning and certain other consequences of external causes	1	1.3 (0.9-2.0)	2.7 (1.9-3.8)	16.6 (12.2-23.3)
T - Injury, poisoning and certain other consequences of external causes	1	1.5 (0.9-2.6)	3.7 (2.4-6.1)	24.4 (15.9-39.5)
Z – Factors influencing health status and contact with health services	1	0.9 (0.1-9.8)	1.4 (0.3-13.1)	5.0 (1.3-43.0)
ALL	35.0 (331)	38.3 (817)	72.7 (2472)	358.4 (11537)

Table 34. Selected first diagnoses in first finished consultant episode of all continuous inpatient stays where type of admission is emergency, by DEPCAT/homelessness. Rates per 10,000 person-years out-of-hospital risk time and numbers in brackets. 20 most common overall diagnoses in rank order, all head injuries grouped.

	Socio-economic circumstances			
	1-2	3-5	6-7	homeless
S00-09 – Injuries to the head	14.8	22.5	54.7	449.5
R07 – Pain in throat and chest	22.2	30.5	63.0	194.5
R10 – Abdominal and pelvic pain	30.6	20.6	33.2	182.4
T39 – Poisoning by nonopioid analgesics, antipyretics and antirheumatics	5.3	7.0	20.3	115.6
F10 – Mental and behavioural disorders due to use of alcohol	15.8	4.2	17.7	169.6
T43 – Poisoning by psychotropic drugs, not elsewhere classified	5.3	6.1	13.5	83.6
J44 – Other chronic obstructive pulmonary disease	0.0	2.8	16.5	27.0
R51 - Headache	7.4	7.5	11.5	20.8
L03 – Cellulitis	1.1	7.5	10.9	119.3
S82 - Fracture of lower leg, including ankle	2.1	10.3	8.5	22.4
J45 - Asthma	2.1	4.7	11.5	15.5
T42 – Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs	1.1	4.7	10.9	95.1
L02 –Cutaneous abscess, furuncle and carbuncle	3.2	2.3	11.2	128.3
K70 – Alcoholic liver disease	0.0	2.3	11.5	54.4
I21 - Acute myocardial infarction	5.3	5.6	7.7	7.5
K92 – Other diseases of digestive system [includes haematemesis, melaena, unspec. Gastrointestinal haemorrhage]	7.4	2.8	8.5	57.2
N39 - Other disorders of urinary system	8.5	5.6	6.2	14.6
R55 – Syncope and collapse	5.3	2.8	8.8	50.9
I20 - Angina pectoris	3.2	4.7	7.7	33.9
R56 - Convulsions, not elsewhere classified	1.1	2.3	9.4	75.5

Table 35. Selected first diagnoses in first finished consultant episode of all continuous inpatient stays where type of admission is emergency, by DEPCAT/homelessness. Risk ratios and 95% confidence intervals compared with rates in DEPCATs 1 and 2.

	Socio-economic circumstances			
	1-2	3-5	6-7	homeless
S00-09 – Injuries to the head	1	1.5 (0.8-3.0)	3.7 (2.2-6.9)	30.4 (18.1-55.7)
R07 – Pain in throat and chest	1	1.4 (0.8-2.4)	2.8 (1.8-4.7)	8.8 (5.7-14.3)
R10 – Abdominal and pelvic pain	1	0.7 (0.4-1.1)	1.1 (0.7-1.7)	6.0 (4.1-9.0)
T39 – Poisoning by nonopioid analgesics, antipyretics and antirheumatics	1	1.3 (0.5-4.7)	3.8 (1.6-12.2)	21.9 (9.3-67.8)
F10 – Mental and behavioural disorders due to use of alcohol	1	0.3 (0.1-0.7)	1.1 (0.6-2.1)	10.7 (6.4-19.3)
L03 – Cellulitis	1	7.1 (1.1-297.7)	10.3 (1.7-417.9)	112.9 (20.2-4472.0)
T43 – Poisoning by psychotropic drugs, not elsewhere classified	1	1.2 (0.4-4.1)	2.6 (1.0-8.3)	15.8 (6.7-49.1)
J44 – Other chronic obstructive pulmonary disease		-	-	-
R51 - Headache	1	1.0 (0.4-2.9)	1.6 (0.7-4.1)	2.8 (1.3-7.3)
L02 –Cutaneous abscess, furuncle and carbuncle	1	0.7 (0.1-4.8)	3.5 (1.1-17.9)	40.5 (13.8-197.1)
T42 – Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs	1	4.4 (0.6-192.6)	10.3 (1.7-417.9)	90.0 (16.0-3565.9)
S82 - Fracture of lower leg, including ankle	1	4.9 (1.2-42.8)	4.0 (1.0-34.9)	10.6 (2.8-89.1)
J45 - Asthma	1	2.2 (0.5-20.8)	5.4 (1.4-46.4)	7.4 (1.9-62.4)
K92 – Other diseases of digestive system [includes haematemesis, melaena, unspec. Gastrointestinal haemorrhage]	1	0.4 (0.1-1.3)	1.2 (0.5-3.1)	7.7 (3.7-19.5)
K70 – Alcoholic liver disease	1	-	-	-
I21 - Acute myocardial infarction	1	1.1 (0.4-3.9)	1.4 (0.6-4.8)	1.4 (0.5-4.7)
N39 - Other disorders of urinary system	1	0.7 (0.3-1.9)	0.7 (0.3-1.9)	1.7 (0.8-4.2)
I20 - Angina pectoris	1	1.5 (0.4-8.4)	2.4 (0.7-12.5)	10.7 (3.6-52.6)
R56 - Convulsions, not elsewhere classified	1	2.2 (0.3-104.9)	8.9 (1.5-362.9)	71.5 (12.7-2834.1)
R55 – Syncope and collapse	1	0.5 (0.1-2.2)	1.7 (0.6-5.5)	9.6 (4.1-30.1)

Table 36. First diagnosis in first finished consultant episode of all continuous inpatient stays where type of admission is elective, by DEPCAT/homelessness. Rates per 10 000 person-years out-of-hospital risk time and numbers in brackets.

ICD10	Socio-economic circumstances			
	1-2	3-5	6-7	homeless
A – Certain infectious and parasitic diseases	2.1 (2)	1.9 (4)	1.8 (6)	4.0 (13)
B - Certain infectious and parasitic diseases	1.1 (1)	0.5 (1)	2.1 (7)	11.8 (38)
C - Neoplasms	70.8 (67)	76.4 (163)	110.3 (375)	49.4 (159)
D – In situ neoplasms	25.4 (24)	30.0 (64)	33.0 (112)	44.4 (143)
E – Endocrine, nutritional and metabolic diseases	7.4 (7)	5.2 (11)	16.2 (55)	7.8 (25)
F – Mental and behavioural disorders	0 (0)	1.4 (3)	0.3 (1)	1.2 (4)
G – Diseases of the nervous system	19.0 18)	9.8 (21)	11.2 (38)	4.7 (15)
H – Diseases of the eye and adnexa	13.7 (13)	15.9 (34)	22.1 (75)	21.1 (68)
I – Diseases of the circulatory system	38.0 (36)	48.3 (103)	53.8 (183)	42.2 (136)
J – Diseases of the respiratory system	27.5 (26)	13.1 (28)	25.3 (86)	18.3 (59)
K – Diseases of the digestive system	89.8 (85)	126.6 (270)	125.1 (425)	97.2 (313)
L – Diseases of the skin and subcutaneous tissue	20.1 (19)	27.2 (58)	27.7 (94)	32.3 (104)
M – Diseases of the musculoskeletal system and connective tissue	30.6 (29)	58.1 (124)	62.4 (212)	40.4 (130)
N – Diseases of the genitourinary system	71.8 (68)	83.4 (178)	81.2 (276)	54.1 (174)
O – Pregnancy, childbirth and the puerperium	24.3 (23)	22.0 (47)	32.7 (111)	67.1 (216)
Q – Congenital malformations, deformations and chromosomal abnormalities	2.1 (2)	2.8 (6)	2.1 (7)	4.0 (13)
R – Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	48.6 (46)	48.3 (103)	57.7 (196)	42.2 (136)
S – Injury, poisoning and certain other consequences of external causes	2.1 (2)	8.0 (17)	6.2 (21)	16.5 (53)
T - Injury, poisoning and certain other consequences of external causes	2.1 (2)	6.6 (14)	3.2 (11)	9.9 (32)
Z – Factors influencing health status and contact with health services	59.2 (56)	57.2 (122)	58.8 (200)	63.1 (203)
	555.6 (526)	642.6 (1371)	733.0 (2491)	631.9 (2034)

Note that P - Certain conditions originating in the perinatal period, are not included because all individuals were aged 18 or over. There were no recorded ICD-10 V, X or Y codes (external causes of morbidity and mortality).

Table 37. First diagnosis in first finished consultant episode of all continuous inpatient stays where type of admission is elective, by DEPCAT/homelessness. Risk ratios and 95% confidence intervals relative to rates in residents of DEPCAT areas 1 and 2.

ICD10	**Socio-economic circumstances**			
	1-2	3-5	6-7	homeless
A – Certain infectious and parasitic diseases	1.0	0.9 (0.1-9.8)	0.8 (0.1-8.5)	1.9 (0.4-17.4)
B - Certain infectious and parasitic diseases	1.0	0.4 (>0.01-34.8)	1.9 (0.3-87.9)	11.2 (1.9-452.9
C - Neoplasms	1.0	1.1 (0.8-1.5)	1.6 (1.2-2.1)	0.7 (0.5-0.9)
D – In situ neoplasms	1.0	1.2 (0.7-2.0)	1.3 (0.8-2.1)	1.8 (1.1-2.8)
E – Endocrine, nutritional and metabolic diseases	1.0	0.7 (0.2-2.1)	2.2 (<1.0-5.7)	1.1 (0.4-2.9)
F – Mental and behavioural disorders	-	-	-	-
G – Diseases of the nervous system	1.0	0.5 (0.3->1.0)	0.6 (0.3-1.1)	0.2 (0.1-0.5)
H – Diseases of the eye and adnexa	1.0	1.2 (0.6-2.4)	1.6 (0.9-3.2)	1.5 (0.8-3.0)
I – Diseases of the circulatory system	1.0	1.3 (0.9-1.9)	1.4 (0.9-2.1)	1.1 (0.8-1.7)
J – Diseases of the respiratory system	1.0	0.5 (0.3-0.8)	0.9 (0.6-1.5)	0.7 (0.4-1.1)
K – Diseases of the digestive system	1.0	1.4 (1.1-1.8)	1.4 (1.1-1.8)	1.1 (0.8-1.4)
L – Diseases of the skin and subcutaneous tissue	1.0	1.4 (0.8-2.4)	1.4 (0.8-2.4)	1.6 (<1.0-2.8)
M – Diseases of the musculoskeletal system and connective tissue	1.0	1.9 (1.3-2.9)	2.0 (1.4-3.1)	1.3 (0.9-2.0)
N – Diseases of the genitourinary system	1.0	1.2 (0.9-1.6)	1.1 (0.9-1.5)	0.8 (0.6->1.0)
O – Pregnancy, childbirth and the puerperium	1.0	0.9 (0.5-1.6)	1.3 (0.9-2.2)	2.8 (1.8-4.5)
Q – Congenital malformations, deformations and chromosomal abnormalities	1.0	1.3 (0.2-13.5)	1.0 (0.2-9.6)	1.9 (0.4-17.4)
R – Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	1.0	1.0 (0.7-1.4)	1.2 (0.9-1.7)	0.9 (0.6-1.2)
S – Injury, poisoning and certain other consequences of external causes	1.0	3.8 (0.9-33.7)	2.9 (0.7-25.7)	7.8 (2.1-66.0)
T - Injury, poisoning and certain other consequences of external causes	1.0	3.1 (0.7-28.2)	1.5 (0.3-14.2)	4.7 (1.2-40.5)
Z – Factors influencing health status and contact with health services	1.0	1.0 (0.7-1.4)	1.0 (0.7-1.4)	1.1 (0.8-1.5)
ALL				

Table 38. Selected first diagnoses in first finished consultant episode of all continuous inpatient stays where type of admission is elective, by DEPCAT/homelessness. Rates per 10,000 person-years out-of-hospital risk time. Most common overall diagnoses in rank order.

ICD10	Socio-economic circumstances			
	1-2	3-5	6-7	homeless
O04 – Medical abortion	21.1	19.7	26.2	61.2
Z53 – Persons encountering health services for specific procedures, not carried out	15.8	12.2	20.0	23.6
Z30 – Contraceptive management	16.9	20.2	13.5	15.8
R10 – Abdominal and pelvic pain	10.6	15.0	12.4	14.0
C50 – Malignant neoplasm of breast	0.0	13.6	17.4	11.8
I84 - Haemorrhoids	15.8	9.8	13.2	8.4
C92 – Myeloid leukaemia	0.0	0.0	22.1	9.0
K29 – Gastritis and duodenitis	2.1	9.4	12.7	10.9
K62 – Other diseases of anus and rectum [incl. polyp, prolapse, haemorrhage, ulcer]	12.7	14.1	9.7	7.1
C18 – Malignant neoplasm of colon	38.0	8.9	10.6	0.3
I25 – Chronic ischaemic heart disease	5.3	3.7	11.2	9.0
K52 – Other noninfective gastroenteritis and colitis	8.5	10.8	9.7	4.7
H26 – Other cataract	9.5	4.7	7.1	10.6
N20 – Calculus of kidney and ureter	10.6	9.8	7.9	5.9
K40 – Inguinal hernia	3.2	10.8	9.1	5.0
L72 – Follicular cysts of skin and subcutaneous tissue	5.3	9.8	9.7	4.7
K21 – Gastro-oesophageal reflux disease	4.2	9.8	7.9	6.5
J34 – Other disorders of nose and nasal sinuses	7.4	3.7	9.4	7.5
I83 – Varicose veins of lower extremities	5.3	8.4	6.8	5.9
N92 – Excessive, frequent and irregular menstruation	4.2	8.9	6.2	6.5

Table 39. Selected first diagnoses in first finished consultant episode of all continuous inpatient stays where type of admission is elective, by DEPCAT/homelessness. Risk ratios and 95% confidence intervals relative to rates in residents of DEPCAT areas 1 and 2. Most common overall diagnoses in rank order.

ICD10	**Socio-economic circumstances**			
	1-2	3-5	6-7	homeless
O04 – Medical abortion	1.0	0.9 (0.5-1.7)	1.2 (0.8-2.1)	2.9 (1.8-4.8)
Z53 – Persons encountering health services for specific procedures, not carried out	1.0	0.8 (0.4-1.6)	1.3 (0.7-2.4)	1.5 (0.8-2.8)
Z30 – Contraceptive management	1.0	1.2 (0.7-2.3)	0.8 (0.4-1.5)	0.9 (0.5-1.8)
R10 – Abdominal and pelvic pain	1.0	1.4 (0.7-3.2)	1.2 (0.6-2.6)	1.3 (0.7-2.9)
C50 – Malignant neoplasm of breast	-	-	-	-
I84 - Haemorrhoids	1.0	0.6 (0.3-1.3)	0.8 (0.5-1.6)	0.5 (0.3-1.1)
C92 – Myeloid leukaemia	-	-	-	-
K29 – Gastritis and duodenitis	1.0	4.4 (1.1-39.2)	6.0 (1.6-51.0)	5.1 (1.3-44.2)
K62 – Other diseases of anus and rectum [incl. polyp, prolapse, haemorrhage, ulcer]	1.0	1.1 (0.6-2.4)	0.8 (0.4-1.6)	0.6 (0.3-1.2)
C18 – Malignant neoplasm of colon	1.0	0.2 (0.1-0.4)	0.3 (0.2-0.5)	>0.01 (>0.01->0.01)
I25 – Chronic ischaemic heart disease	1.0	0.7 (0.2-0.8)	2.1 (0.8-6.9)	1.7 (0.7-5.6)
K52 – Other noninfective gastroenteritis and colitis	1.0	1.3 (0.6-3.3)	1.1 (0.5-2.9)	0.6 (0.2-1.5)
H26 – Other cataract	1.0	0.5 (0.2-1.4)	0.7 (0.3-1.8)	1.1 (0.5-2.6)
N20 – Calculus of kidney and ureter	1.0	0.9 (0.4-2.2)	0.8 (0.4-1.7)	0.6 (0.2-1.3)
K40 – Inguinal hernia	1.0	3.4 (>1.0-17.7)	2.9 (0.9-14.7)	1.6 (0.4-8.4)
L72 – Follicular cysts of skin and subcutaneous tissue	1.0	1.9 (0.7-6.3)	1.8 (0.7-6.0)	0.9 (0.3-3.1)
K21 – Gastro-oesophageal reflux disease	1.0	2.3 (0.8-9.3)	1.9 (0.7-7.4)	1.5 (0.5-6.2)
J34 – Other disorders of nose and nasal sinuses	1.0	0.5 (0.2-1.6)	1.3 (0.6-3.4)	1.0 (0.4-2.8)
I83 – Varicose veins of lower extremities	1.0	1.6 (0.6-5.5)	1.3 (0.5-4.3)	1.1 (0.4-3.8)
N92 – Excessive, frequent and irregular menstruation	1.0	2.1 (0.7-8.5)	1.5 (0.5-5.9)	1.5 (0.5-6.2)

Table 40. 20 most common operations, position 1, by DEPCAT/homeless for emergency admissions only. Rate per 10 000 person-years for each socio-economic group.

	Socio-economic circumstances			
	1-2	3-5	6-7	homeless
Other specified operations on unspecified organ	40.1	48.3	72.4	313.1
Intravenous chemotherapy	3.2	15.0	17.7	128.0
Other specified continuous infusion of therapeutic substance	13.7	10.3	16.2	86.7
Other specified intravenous injection	1.1	3.7	12.4	70.5
Drainage of lesion of skin – not elsewhere classified	3.2	1.4	7.1	69.9
Unspecified continuous infusion of therapeutic substance	3.2	3.7	10.0	45.4
Primary simple repair of tendon	1.1	1.9	3.2	20.8
Debridement of skin – not elsewhere classified	2.1	0.9	5.0	19.3
Insertion of central venous catheter – not elsewhere classified	0.0	0.0	1.5	15.8
Unspec. diagnostic fibreoptic endo. exam of upper gastrointestinal tract	0.0	1.9	2.4	13.0
Primary suture of skin – not elsewhere classified	1.1	0.5	2.6	12.7
Paracentesis abdominis for ascites	0.0	0.5	1.2	14.0
Insertion of tube drain into pleural cavity	0.0	0.9	3.2	11.2
Primary suture of skin of head or neck – not elsewhere classified	0.0	0.5	1.8	11.8
Fibreoptic endo. exam. upper g.i. tract & biopsy lesion upper gastrointestinal tract	1.1	0.5	2.6	8.7
Continuous subcutaneous infusion of insulin	2.1	2.8	2.1	7.5
Other specified subcutaneous injection	0.0	0.0	1.2	10.6
Drainage of perianal abscess	3.2	1.9	5.3	3.4
Unspecified exploration of skin of other site	1.1	0.9	0.9	8.4
Manipulation of fracture of bone – not elsewhere classified	3.2	2.3	2.4	5.3

Table 41. 20 most common operations, position 1, by DEPCAT/homeless for emergency admissions only. Risk ratios compared with DEPCATs 1 and 2 and 95% confidence intervals.

	Socio-economic circumstances			
	1-2	3-5	6-7	homeless
Other specified operations on unspecified organ	1.0	1.2 (0.8-1.8)	1.8 (1.3-2.6)	7.8 (5.6-11.1)
Intravenous chemotherapy	1.0	4.7 (1.5-24.2)	5.6 (1.8-27.8)	40.4 (13.7-196.6)
Other specified continuous infusion of therapeutic substance	1.0	0.8 (0.4-1.6)	1.2 (0.6-2.4)	6.3 (3.6-12.0)
Other specified intravenous injection	1.0	3.5 (0.5-157.5)	11.7 (2.0-473.0)	66.8 (11.9-2648.3)
Drainage of lesion of skin – not elsewhere classified	1.0	0.4 (0.1-3.3)	2.2 (0.7-11.6)	22.1 (7.5-107.8)
Unspecified continuous infusion of therapeutic substance	1.0	1.2 (0.3-6.9)	3.2 (<1.0-16.1)	14.3 (4.8-70.2)
Primary simple repair of tendon	1.0	1.8 (0.2-87.4)	3.1 (0.4-131.9)	19.7 (3.4-789.7)
Debridement of skin – not elsewhere classified	1.0	0.4 (<0.1-6.1)	2.4 (0.6-21.1)	9.1 (2.4-77.0)
Insertion of central venous catheter – not elsewhere classified	-	-	-	-
Unspec. diagnostic fibreoptic endo. exam of upper gastrointestinal tract	-	-	-	-
Primary suture of skin – not elsewhere classified	1.0	0.4 (<0.1-34.8)	2.5 (0.3-109.9)	12.1 (2.0-487.7)
Paracentesis abdominis for ascites	-	-	-	-
Insertion of tube drain into pleural cavity	-	-	-	-
Primary suture of skin of head or neck – not elsewhere classified	-	-	-	-
Fibreoptic endo. exam. upper g.i. tract & biopsy lesion	1.0	0.4 (<0.1-34.8)	2.5 (0.3-109.9)	8.2 (1.4-336.7)
Continuous subcutaneous infusion of insulin	1.0	1.3 (0.2-13.5)	1.0 (0.2-9.6)	3.5 (0.9-30.8)
Other specified subcutaneous injection	-	-	-	-
Drainage of perianal abscess	1.0	0.6 (0.1-4.0)	1.7 (0.5-8.9)	1.1 (0.3-6.0)
Unspecified exploration of skin of other site	1.0	0.9 (<0.1-52.4)	0.8 (0.1-43.9)	7.9 (1.3-325.1)
Manipulation of fracture of bone – not elsewhere classified	1.0	0.7 (0.1-4.8)	0.7 (0.2-4.3)	1.7 (0.5-8.9)

Table 42. 20 most common operations, position 1, by DEPCAT/homeless for elective admissions only. Rate per 10 000 person-years for each socio-economic group.

	Socio-economic circumstances			
	1-2	3-5	6-7	homeless
Intravenous chemotherapy	56.0	57.2	51.8	25.8
Fibreoptic endo. exam. upper g.i. tract & biopsy lesion upper g.i. tract	31.7	38.0	46.8	38.8
Unspecified diagnostic endoscopic examination of bladder	35.9	29.1	31.8	11.2
Dilation of cervix uteri and vacuum asp. prod. conception from uterus	10.6	7.5	13.2	31.1
Unspec. diagnostic fibreoptic endo. exam. of upper g.i. tract	8.5	16.4	18.5	19.3
Unspecified diagnostic endo. exam. of large bowel using fibreoptic sigmoidoscope	14.8	19.7	17.1	8.4
Other specified continuous infusion of therapeutic substance	3.2	29.1	14.1	3.7
Unspecified diagnostic endoscopic examination of colon	12.7	13.6	13.8	10.3
Diag. fibreoptic endo exam. of colon & biopsy of lesion of colon	10.6	13.6	14.1	5.3
Insertion of prostaglandin pessary	6.3	7.0	6.2	17.7
Unspecified excision of lesion of skin	15.8	9.8	8.8	4.7
Insertion of prosthetic replacement for lens	9.5	4.7	7.7	10.9
Transfusion of coagulation factor	0.0	0.5	0.9	22.7
Diag. endo. exam & biopsy lesion lower bowel using fibreoptic sigmoidoscope	8.5	12.2	8.2	3.4
Insertion of abortifacient pessary - not elsewhere classified	3.2	5.2	5.3	9.0
Other specified operations on unspecified organ	4.2	5.2	7.7	5.9
Bilateral vasectomy	10.6	11.2	5.9	1.6
Excision of lesion of skin of head or neck - not elsewhere classified	4.2	8.4	7.1	3.7
Septoplasty of nose - not elsewhere classified	5.3	5.6	5.0	4.3
Attention to central venous catheter	0.0	0.0	8.2	5.6

Table 43. 20 most common operations, position 1, by DEPCAT/homeless for elective admissions only. Risk ratios compared with rates in DEPCATs 1 and 2 with 95% confidence intervals.

	Socio-economic circumstances			
	1-2	3-5	6-7	homeless
Intravenous chemotherapy	1.0	1.0 (0.7-1.4)	0.9 (0.7-1.3)	0.5 (0.3-0.7)
Fibreoptic endo. exam. upper g.i. tract & biopsy lesion upper g.i. tract	1.0	1.2 (0.8-1.9)	1.5 (<1.0-2.3)	1.2 (0.8-1.9)
Unspecified diagnostic endoscopic examination of bladder	1.0	0.8 (0.5-1.3)	0.9 (0.6-1.3)	0.3 (0.2-0.5)
Dilation of cervix uteri and vacuum asp. prod. conception from uterus	1.0	0.7 (0.3-1.8)	1.3 (0.6-2.8)	2.9 (1.5-6.3)
Unspec. diagnostic fibreoptic endo. exam. of upper g.i. tract	1.0	1.9 (0.9-4.8)	2.2 (>1.0-5.3)	2.3 (1.1-5.5)
Unspecified diagnostic endo. exam. of large bowel using fibreoptic sigmoidoscope	1.0	1.3 (0.7-2.6)	1.2 (0.6-2.2)	0.6 (0.3-1.2)
Other specified continuous infusion of therapeutic substance	1.0	9.2 (3.0-45.7)	4.5 (1.4-22.4)	1.2 (0.3-6.5)
Unspecified diagnostic endoscopic examination of colon	1.0	1.1 (0.5-2.3)	1.1 (0.6-2.3)	0.8 (0.4-1.7)
Diag. fibreoptic endo exam. of colon & biopsy of lesion of colon	1.0	1.3 (0.6-3.0)	1.3 (0.7-3.0)	0.5 (0.2-1.2)
Insertion of prostaglandin pessary	1.0	1.1 (0.4-3.5)	1.0 (0.4-3.0)	2.8 (1.2-7.9)
Unspecified excision of lesion of skin	1.0	0.6 (0.3-1.3)	0.6 (0.3-1.1)	0.3 (0.1-0.6)
Insertion of prosthetic replacement for lens	1.0	0.5 (0.2-1.4)	0.8 (0.4-2.0)	1.1 (0.5-2.7)
Transfusion of coagulation factor	-	-	-	-
Diag. endo. exam & biopsy lesion lower bowel using fibreoptic sigmoidoscope	1.0	1.4 (0.6-3.7)	1.0 (0.4-2.5)	0.4 (0.1-1.2)
Insertion of abortifacient pessary - not elsewhere classified	1.0	1.6 (0.4-9.1)	1.7 (0.5-8.9)	2.8 (0.9-14.6)
Other specified operations on unspecified organ	1.0	1.2 (0.4-5.3)	1.8 (0.6-7.1)	1.4 (0.5-5.6)
Bilateral vasectomy	1.0	1.1 (0.5-2.5)	0.6 (0.2-1.3)	0.1 (>0.01-0.5)
Excision of lesion of skin of head or neck - not elsewhere classified	1.0	2.0 (0.7-8.1)	1.7 (0.6-6.6)	0.9 (0.3-3.8)
Septoplasty of nose - not elsewhere classified	1.0	1.1 (0.3-3.9)	0.9 (0.3-3.3)	0.8 (0.3-2.9)
Attention to central venous catheter	-	-	-	-

Table 44. Death rates in the homeless cohort per 100 000 person-years for ages 18-64 only. Numbers in brackets. 436 of 457 deaths.

	Age (years)		
sex	18-24	25-44	45-64
male	1017.7 (54)	1696.4 (209)	3254.4 (93)
female	420.5 (17)	773.5 (51)	1450.3 (12)

Soundexing

The exact algorithm is as follows:

1. Retain the first letter of the string
2. Remove all occurrences of the following letters, unless it is the first letter: a, e, h, i, o, u, w, y
3. Assign numbers to the remaining letters (after the first) as follows:
    - b, f, p, v = 1
    - c, g, j, k, q, s, x, z = 2
    - d, t = 3
    - l = 4
    - m, n = 5
    - r = 6
4. If two or more letters with the same number were adjacent in the original name (before step 1), or adjacent except for any intervening h and w (American census only), then omit all but the first.
5. Return the first four characters, right-padding with zeroes if there are fewer than four.

Using this algorithm, both "Robert" and "Rupert" return the same string "R163" while "Rubin" yields "R150".

New York State Identification and Intelligence System

1. Translate first characters of name: MAC → MCC, KN → NN, K → C, PH → FF, PF → FF, SCH → SSS
2. Translate last characters of name: EE → Y, IE → Y, DT, RT, RD, NT, ND → D
3. First character of key = first character of name.
4. Translate remaining characters by following rules, incrementing by one character each time:

EV → AF else A, E, I, O, U → A

Q → G, Z → S, M → N

KN → N else K → C

SCH → SSS, PH → FF

H → If previous or next is nonvowel, previous.

W → If previous is vowel, previous.

Add current to key if current is not same as the last key character.

5. If last character is S, remove it.
6. If last characters are AY, replace with Y.
7. If last character is A, remove it.