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How can socioeconomic inequalities in hospital admissions be explained? A cohort study

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ABSTRACT

Objectives: To investigate which antecedent risk factors can explain the social patterning in hospital use.

Design: Prospective cohort study with up to 37 years of follow-up.

Setting: Representative community sample in the West of Scotland.

Participants: 7049 men and 8353 women aged 45–64 years were recruited into the study from the general population between 1972 and 1976 (78% of the eligible population).

Primary and secondary outcome measures: Hospital admissions and bed days by cause and by classification into emergency or non-emergency.

Results: All-cause hospital admission rate ratios (RRs) were not obviously socially patterned for women (RR 1.04, 95% CI 0.98 to 1.10) or men (RR 1.0, 95% CI 0.94 to 1.06) in social classes IV and V compared with social classes I and II. However, cardiovascular disease, coronary heart disease and stroke in women, and respiratory disease for men and women were socially patterned, although this attenuated markedly with the addition of baseline risk factors. Hospital bed days were generally socially patterned and the differences were largely explained by baseline risk factors. The overall RRs of mental health admissions in contrast were socially patterned for women (RR 1.77, 95% CI 1.38 to 2.27) and men (RR 1.51, 95% CI 1.11 to 2.06) in social classes IV and V compared with social classes I and II, but the pattern did not attenuate with the addition of baseline risk factors. Emergency hospital admissions were associated with lower social class, but there was an inverse relationship for non-emergency hospital admissions.

Conclusions: Overall admissions to hospital were only marginally socially patterned, and less than would be expected on the basis of the gradient in baseline risk. However, there was marked social patterning in admissions for mental health problems. Non-emergency hospital admissions were patterned inversely according to risk. Further work is required to explain and address this inequitable gradient in healthcare use.

ARTICLE SUMMARY

Article focus
- Are there gradients in emergency and non-emergency hospital use by social class, and to what extent is this explained by pre-existing risk factors?

Key messages
- Overall hospital admissions are only marginally socially patterned and less than would be expected on the basis of baseline risk.
- Emergency hospital admissions and admissions for mental health conditions are much higher in social classes IV and V compared with social classes I and II.
- Attention is required to explain and address the inverse gradient in non-emergency admissions.

Strengths and limitations of this study
- This cohort study has up to 37 years of follow-up, includes women and men and is representative of deprived as well as affluent communities.
- The baseline risk factors were collected at one point in time and may have since changed, potentially biasing the potential explanatory power of the baseline risks towards the null.

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INTRODUCTION

Julian Tudor Hart famously stated, "The availability of good medical care tends to vary inversely with the need for it in the population served. This inverse care law operates more completely where medical care is most exposed to market forces, and less so where such exposure is reduced."[1]

Scotland, in common with the rest of the UK, provides most healthcare services free at the point of need through the National Health Service (NHS), including the use of hospital inpatient services. In theory, therefore, the NHS model in Scotland provides no barriers to the equitable use of health services, based on need.

However, planning the distribution of health service resources and ensuring that the use of services is equitable is complicated. Without epidemiological data, information on unmet need is absent, and can

only be inferred from data on health service demand (ie, use).[2]

In the NHS, there are two routes through which a patient can get admitted to hospital. The first is as an unplanned emergency admission through self-presentation at an accident or emergency department, an emergency ambulance transfer or by referral from a general practitioner (GP or family doctor). Alternatively, non-emergency hospital admission can be planned in advance through a hospital outpatients department appointment or by arrangement through the GP, for example, for a hip replacement operation.

Higher hospital admission rates have been associated with lower socioeconomic status in Amsterdam (for psychiatric admissions),[3] New Zealand (for general and psychiatric admissions),[4] and for Australia,[5] Norway[6] and London[7] (for general hospital admissions), although the patterning is less clear in Italy,[8–10] Canada[11 12] and the USA.[13 14] Where longitudinal data are available, antecedent morbidity or risk factors can explain part of this patterning (as lower socioeconomic status is associated with greater healthcare needs).[9 13 14] Although admissions are often higher among those with lower socioeconomic status, there is evidence that those of lower socioeconomic status also have shorter hospital stays and fewer planned admissions,[4 7 11] suggesting an inverse care law. The difference in social patterning of emergency and planned hospital admissions, as well as the relation to underlying need, is not fully understood.

If the NHS is to provide an equitable service, the use of hospital inpatient services should be in proportion to need. This would suggest that general and mental health admissions, and emergency and non-emergency admissions should display a gradient across social class since mortality and morbidity, as crude markers of health need, are known to increase from social class I through to social class V.[15 16] Furthermore, much of the class gradient is likely to be explained by other markers of healthcare need, including antecedent morbidity and known risk factors.

This proposition was tested using data from a cohort study in the West of Scotland to evaluate the social patterning of hospitalisation rates and bed days, the extent to which these are explained by available baseline cardiovascular risk factors, and whether this varies between general and mental health admissions or between emergency and non-emergency admissions. Our hypothesis was that there would be a social class gradient in hospital admissions and bed days, but that this would be explained by pre-existing behavioural, anthropometric, biological and clinical risk factors.

METHODS
We used data from the Renfrew and Paisley prospective cohort study, which was initiated between 1972 and 1976 and is described in detail elsewhere.[17] Briefly, men and women aged 45–64 years who were resident in these two towns in the West of Scotland completed a questionnaire and attended a health screening examination. There were 7049 men and 8353 women in the study, which amounted to a response rate of 78% in the eligible population. Self-reported data were collected about smoking habit, diabetes, bronchitis, angina and occupation. Bronchitis was defined as having persistent and infective phlegm and being breathless (from the Medical Research Council (MRC) questionnaire),[17] angina was derived from the Rose Angina Questionnaire, with angina defined as 'definite',[18] and social class was derived from the Registrar General's classification of occupations.[19] The social class of women was based on their own occupation, except for housewives who took the social class of their husbands. At the screening examination, blood pressure and FEV1 were measured by trained staff, a non-fasting blood sample was taken for measurement of plasma cholesterol, an ECG was taken from which ischaemia was defined, and height and weight were measured from which body mass index (BMI) in kg/m^2 was derived. These clinical, biological and anthropometric baseline characteristics were socially patterned.[17 20]

Participants were followed up for mortality by flagging with the NHS Central Register, and death information was received in the follow-up period from screening to the end of 2009. Information was also received when participants left the UK. Person-years were calculated from date of screening to date of death, date of embarkation or the end of 2009 as appropriate. A computerised linkage was made with hospital discharge records in Scotland (Scottish Morbidity Records (SMRs)).[21] They will be referred to as admissions in this paper. The Privacy Advisory Committee of NHS Scotland Information Services gave permission for the linked data to be used. General hospital admissions (SMR1) and mental health admissions (SMR4) were obtained from the date of screening to the end of 2009. As geriatric long-stay admissions (involving admissions to NHS facilities, not private nursing or care homes) were only available for part of the follow-up period due to changes in recording procedures, they were excluded from this study. Numbers of general admissions were added for each participant, with transfer admissions (where the hospital stay included transfers to other specialties) not counted. Bed days were calculated by subtracting the date of admission from the date of discharge and adding one (to ensure that day cases were not lost). For transfer admissions, the one was not added to ensure against double counting. Emergency general hospital admissions were identified by a code; all other general hospital admissions were defined as non-emergency.

Admissions and bed days were also calculated for different causes of general hospital admission: cardiovascular disease (CVD), coronary heart disease (CHD), stroke, respiratory diseases, digestive diseases and cancers. For mental health admissions, SMR1 (relating to general hospitals) admissions with mental health

codes and all SMR4 (relating to mental health hospitals) admissions were used. Mental health admissions were also subdivided into these different causes: depression/anxiety, psychoses, drug and alcohol dependence, and Alzheimer's disease and dementia. For the analyses for specific causes, only the first diagnostic coding was included. The International Classification of Diseases (ICD) codes for the different causes are given in web table 1.

Excluded from the study were 23 participants (9 men and 14 women) who were lost to follow-up and 423 participants (72 men and 351 women) with missing data on social class, leaving 14 956 participants (6968 men and 7988 women) in the analysis. Negative binomial regression analysis was used to calculate the rate ratio for admissions and bed days by social class in four groups (I and II, III non-manual (IIINM), III manual (IIIM), IV and V), using STATA V.10. Analyses were first adjusted for age, and then further adjusted for the following risk factors measured at baseline: systolic blood pressure, cholesterol, BMI, height, FEV1, angina, ischaemic ECG, bronchitis, smoking and diabetes.

RESULTS
Hospital admissions by social class
Tables 1 and 2 show the patterning of general hospital admissions and the number of bed days by social class. Overall, the admission rates to hospital for all causes together are not obviously socially patterned for men or women, with an admission rate ratio of 1.04 (95% CI 0.98 to 1.10) for women in social classes IV and V compared with social classes I and II and a rate ratio of 1.0 (95% CI 0.94 to 1.06) for men. Although there was no social patterning for overall hospital admissions, a steep social gradient was present for respiratory causes in women and men which attenuated markedly with the addition of the baseline risk factors into the model. Social patterning was also seen for CVD, CHD and stroke in women, all of which attenuated with the addition of the baseline risk factors, but was not obvious for men. There was no clear social patterning of admissions for digestive causes or cancer.

In contrast to the patterning of hospital admissions, the number of bed days for all causes was socially patterned. In women, the rate ratios were 1.07 (95% CI 0.98 to 1.17) for social class IIINM, 1.15 (95% CI 1.05 to 1.27) in social class IIIM and 1.11 (95% CI 1.03 to 1.21) in social classes IV and V. These differences attenuated markedly with the addition of the baseline risk factors. Similarly, the bed days were socially patterned in men, with a rate ratio of 1.06 (95% CI 0.94 to 1.19) in social class IIINM, 1.09 (95% CI 1.0 to 1.19) in social class IIIM and 1.13 (95% CI 1.02 to 1.23) in social classes IV and V, which again attenuated markedly with the addition of the baseline risk factors to the model. Social patterning in the rate ratios was evident for CVD and CHD in women, and for respiratory disease for men and women, all of which attenuated markedly with the addition of baseline risk factors. In contrast, there was no clear social patterning for the number of bed days for stroke, digestive causes or cancer.

Mental health hospital admissions by social class
Tables 3 and 4 show the rate ratios for mental health hospital admissions by social class for women and men (approximately 80% of which were recorded on the SMR4 through psychiatric hospitals). Overall, admissions and bed days were higher among the lower social classes for women and men. This patterning attenuated slightly with the addition of baseline risk factors in women but still remained significant (for admissions), and attenuated more in men. The social patterning of admissions was particularly marked for psychoses (with a rate ratio for admissions in women of 2.82 and in men of 1.84 in social classes IV and V compared with social classes I and II) and drug-related and alcohol-related admissions in men (with a rate ratio of 3.23 in social classes IV and V compared with social classes I and II). In men, the social patterning of bed days for psychosis was even more marked with a rate ratio of 6.15 in social classes IV and V compared with social classes I and II. Admissions to hospital for Alzheimer's and dementia were socially patterned for women and men, but the number of bed days was patterned only among men. There was a suggestion of an inverse social patterning (ie, higher admission rates among social classes I and II) for drugs and alcohol in women and depression in men, but the rate ratio estimates were imprecise because of the small numbers of admissions. The addition of the baseline risk factors did not substantially help explain the overall social patterning of admissions or bed days, or for specific causes, for women or men with the exception of drug-related and alcohol-related admissions in men where the baseline risk explained over half of the excess in social classes IV and V.

Emergency and non-emergency hospital admissions by social class
Table 5 shows that the rate ratios of emergency admissions to hospital in women were 1.06 (95% CI 0.99 to 1.14), 1.10 (95% CI 1.01 to 1.18) and 1.18 (95% CI 1.11 to 1.26) in social classes IIINM, IIIM, IV and V, respectively, compared with social classes I and II. The higher rate ratios were attenuated with the addition of the baseline risk factors. In contrast, the rate ratios for non-emergency admissions to hospital were 1.03 (95% CI 0.95 to 1.11), 0.95 (95% CI 0.87 to 1.04) and 0.93 (95% CI 0.86 to 1.0) in social classes IIINM, IIIM, IV and V, respectively, compared with social classes I and II. Again, this social patterning attenuated towards a rate ratio of 1 with the addition of the baseline risk factors to the model.

A similar pattern was seen for men where the rate ratios of emergency admissions to hospital were 1.03 (95% CI 0.94 to 1.13), 1.06 (95% CI 0.99 to 1.14) and

Table 1 Number of general hospital admissions and bed days by social class and diagnosis in women from the Renfrew and Paisley study

	Social classes			
	I and II	IIINM	IIIM	IV and V
Number of women	1451	1975	1486	3076
Person-years	37 262	50 869	33 980	72 487
All causes				
Admissions*	8608 (231)	12 180 (239)	7928 (233)	17 413 (240)
Rate ratio$_1$	1	1.04 (0.98 to 1.11)	1.02 (0.95 to 1.09)	1.04 (0.98 to 1.10)
Rate ratio$_2$	1	1.04 (0.98 to 1.10)	0.99 (0.93 to 1.06)	1.01 (0.95 to 1.07)
Bed days†	2598	2800	2966	2961
Rate ratio$_1$	1	1.07 (0.98 to 1.17)	1.15 (1.05 to 1.27)	1.11 (1.03 to 1.21)
Rate ratio$_2$	1	1.06 (0.97 to 1.15)	1.08 (0.98 to 1.18)	1.02 (0.94 to 1.11)
CVD				
Admissions*	1423 (38)	2088 (41)	1442 (42)	3345 (46)
Rate ratio$_1$	1	1.10 (0.98 to 1.24)	1.11 (0.98 to 1.26)	1.21 (1.09 to 1.35)
Rate ratio$_2$	1	1.09 (0.97 to 1.22)	1.02 (0.90 to 1.15)	1.10 (0.99 to 1.22)
Bed days†	589	601	670	736
Rate ratio$_1$	1	1.04 (0.86 to 1.26)	1.13 (0.92 to 1.38)	1.25 (1.05 to 1.49)
Rate ratio$_2$	1	0.99 (0.82 to 1.20)	0.96 (0.78 to 1.17)	1.02 (0.85 to 1.22)
CHD				
Admissions*	417 (11)	531 (10)	473 (14)	1076 (15)
Rate ratio$_1$	1	0.95 (0.77 to 1.18)	1.26 (1.01 to 1.57)	1.34 (1.10 to 1.62)
Rate ratio$_2$	1	0.95 (0.78 to 1.17)	1.15 (0.93 to 1.44)	1.21 (1.0 to 1.47)
Bed days†	111	101	147	149
Rate ratio$_1$	1	1.03 (0.74 to 1.44)	1.68 (1.17 to 2.41)	1.44 (1.05 to 1.97)
Rate ratio$_2$	1	1.06 (0.76 to 1.48)	1.34 (0.94 to 1.92)	1.24 (0.91 to 1.70)
Stroke				
Admissions*	262 (7)	390 (8)	289 (9)	681 (9)
Rate ratio$_1$	1	1.09 (0.89 to 1.33)	1.12 (0.91 to 1.39)	1.29 (1.08 to 1.55)
Rate ratio$_2$	1	1.09 (0.90 to 1.33)	1.05 (0.85 to 1.30)	1.18 (0.98 to 1.41)
Bed days†	243	218	287	319
Rate ratio$_1$	1	0.91 (0.62 to 1.34)	1.05 (0.70 to 1.60)	1.31 (0.92 to 1.87)
Rate ratio$_2$	1	0.92 (0.62 to 1.35)	0.99 (0.65 to 1.50)	1.09 (0.75 to 1.58)
Respiratory				
Admissions*	392 (11)	625 (12)	462 (14)	1,207 (17)
Rate ratio$_1$	1	1.15 (0.94 to 1.40)	1.33 (1.07 to 1.65)	1.60 (1.33 to 1.92)
Rate ratio$_2$	1	1.08 (0.89 to 1.30)	0.98 (0.80 to 1.20)	1.17 (0.98 to 1.39)
Bed days†	136	187	195	209
Rate ratio$_1$	1	1.36 (0.99 to 1.88)	1.55 (1.10 to 2.19)	1.60 (1.19 to 2.15)
Rate ratio$_2$	1	1.23 (0.90 to 1.68)	0.88 (0.62 to 1.24)	1.03 (0.76 to 1.38)
Digestive				
Admissions*	1059 (28)	1497 (29)	1079 (32)	2134 (29)
Rate ratio$_1$	1	1.03 (0.91 to 1.18)	1.13 (0.98 to 1.29)	1.02 (0.91 to 1.15)
Rate ratio$_2$	1	1.04 (0.91 to 1.18)	1.10 (0.96 to 1.26)	0.99 (0.87 to 1.11)
Bed days†	239	223	296	249
Rate ratio$_1$	1	0.92 (0.75 to 1.14)	1.27 (1.01 to 1.60)	0.97 (0.80 to 1.18)
Rate ratio$_2$	1	0.93 (0.75 to 1.15)	1.19 (0.94 to 1.50)	0.89 (0.73 to 1.09)
Cancer				
Admissions*	1286 (35)	1754 (35)	1129 (33)	2179 (30)
Rate ratio$_1$	1	1.07 (0.88 to 1.30)	1.01 (0.82 to 1.25)	0.91 (0.76 to 1.09)
Rate ratio$_2$	1	1.06 (0.87 to 1.28)	1.01 (0.81 to 1.24)	0.91 (0.76 to 1.10)
Bed days†	338	342	376	335
Rate ratio$_1$	1	1.07 (0.81 to 1.41)	1.19 (0.88 to 1.60)	1.05 (0.81 to 1.36)
Rate ratio$_2$	1	1.03 (0.78 to 1.36)	1.16 (0.85 to 1.57)	0.96 (0.74 to 1.25)

*Number (per 1000 person-years).
†Per 1000 person-years.
IIIM, III manual; IIINM, III non-manual; CHD, coronary heart disease; CVD, cardiovascular disease; rate ratio$_1$, adjusted for age; rate ratio$_2$, adjusted for age, systolic blood pressure, cholesterol, body mass index, height, FEV1, angina, ischaemic ECG, bronchitis, smoking and diabetes.

Table 2 Number of general hospital admissions and bed days by social class and diagnosis in men from the Renfrew and Paisley study

	Social classes			
	I and II	IIINM	IIIM	IV and V
Number of men	1329	829	2814	1996
Person-years	30 385	17 036	56 966	38 331
All causes				
Admissions*	8371 (276)	4641 (272)	15 605 (274)	10 610 (277)
Rate ratio$_1$	1	0.98 (0.90 to 1.06)	0.99 (0.93 to 1.05)	1.0 (0.94 to 1.06)
Rate ratio$_2$	1	0.98 (0.91 to 1.06)	0.98 (0.92 to 1.04)	0.99 (0.93 to 1.06)
Bed days†	2556	2728	2822	2997
Rate ratio$_1$	1	1.06 (0.94 to 1.19)	1.09 (1.0 to 1.19)	1.13 (1.02 to 1.23)
Rate ratio$_2$	1	1.02 (0.91 to 1.15)	1.02 (0.94 to 1.12)	1.03 (0.94 to 1.14)
CVD				
Admissions*	1878 (62)	952 (56)	3286 (58)	2163 (56)
Rate ratio$_1$	1	0.90 (0.78 to 1.03)	0.91 (0.82 to 1.01)	0.91 (0.81 to 1.02)
Rate ratio$_2$	1	0.90 (0.78 to 1.03)	0.90 (0.82 to 1.0)	0.90 (0.81 to 1.01)
Bed days†	706	725	778	787
Rate ratio$_1$	1	0.98 (0.78 to 1.24)	1.0 (0.84 to 1.18)	1.04 (0.87 to 1.25)
Rate ratio$_2$	1	1.0 (0.80 to 1.26)	0.95 (0.80 to 1.13)	1.0 (0.83 to 1.21)
CHD				
Admissions*	674 (22)	353 (21)	1253 (22)	731 (19)
Rate ratio$_1$	1	0.93 (0.75 to 1.17)	0.98 (0.83 to 1.16)	0.87 (0.73 to 1.04)
Rate ratio$_2$	1	0.96 (0.77 to 1.20)	1.01 (0.86 to 1.19)	0.93 (0.78 to 1.12)
Bed days†	202	200	224	192
Rate ratio$_1$	1	1.05 (0.73 to 1.51)	1.02 (0.78 to 1.34)	0.95 (0.71 to 1.28)
Rate ratio$_2$	1	1.11 (0.77 to 1.61)	1.02 (0.77 to 1.34)	1.05 (0.78 to 1.42)
Stroke				
Admissions*	229 (8)	142 (8)	533 (9)	347 (9)
Rate ratio$_1$	1	1.04 (0.80 to 1.34)	1.22 (1.01 to 1.48)	1.14 (0.93 to 1.40)
Rate ratio$_2$	1	1.01 (0.79 to 1.31)	1.16 (0.96 to 1.41)	1.09 (0.88 to 1.34)
Bed days†	177	247	270	266
Rate ratio$_1$	1	0.94 (0.56 to 1.59)	1.21 (0.82 to 1.79)	1.01 (0.67 to 1.54)
Rate ratio$_2$	1	1.06 (0.63 to 1.80)	1.23 (0.83 to 1.83)	1.20 (0.78 to 1.84)
Respiratory				
Admissions*	403 (13)	320 (19)	1123 (20)	853 (22)
Rate ratio$_1$	1	1.38 (1.10 to 1.73)	1.50 (1.26 to 1.78)	1.73 (1.44 to 2.08)
Rate ratio$_2$	1	1.20 (0.97 to 1.49)	1.15 (0.97 to 1.36)	1.15 (0.96 to 1.37)
Bed days†	153	218	258	305
Rate ratio$_1$	1	1.33 (0.91 to 1.93)	1.85 (1.40 to 2.46)	1.96 (1.45 to 2.64)
Rate ratio$_2$	1	1.11 (0.77 to 1.59)	1.29 (0.98 to 1.71)	1.29 (0.96 to 1.73)
Digestive				
Admissions*	998 (33)	623 (37)	1789 (31)	1233 (32)
Rate ratio$_1$	1	1.09 (0.94 to 1.27)	0.94 (0.83 to 1.05)	0.97 (0.85 to 1.10)
Rate ratio$_2$	1	1.09 (0.94 to 1.28)	0.93 (0.82 to 1.05)	0.96 (0.84 to 1.09)
Bed days†	237	320	214	251
Rate ratio$_1$	1	1.73 (1.32 to 2.26)	0.85 (0.70 to 1.03)	0.98 (0.79 to 1.21)
Rate ratio$_2$	1	1.50 (1.14 to 1.98)	0.77 (0.63 to 0.94)	0.88 (0.71 to 1.10)
Cancer				
Admissions*	1428 (47)	738 (43)	2568 (45)	1759 (46)
Rate ratio$_1$	1	0.90 (0.72 to 1.11)	1.01 (0.86 to 1.19)	0.94 (0.79 to 1.12)
Rate ratio$_2$	1	0.90 (0.73 to 1.12)	1.0 (0.85 to 1.18)	0.96 (0.80 to 1.15)
Bed days†	358	382	452	474
Rate ratio$_1$	1	0.86 (0.63 to 1.19)	1.25 (0.98 to 1.59)	1.14 (0.88 to 1.47)
Rate ratio$_2$	1	0.86 (0.62 to 1.18)	1.22 (0.96 to 1.56)	1.19 (0.92 to 1.56)

*Number (per 1000 person-years).
†Per 1000 person-years.
IIIM, III manual; IIINM, III non-manual; CHD, coronary heart disease; CVD, cardiovascular disease; rate ratio$_1$, adjusted for age; rate ratio$_2$, adjusted for age, systolic blood pressure, cholesterol, body mass index, height, FEV1, angina, ischaemic ECG, bronchitis, smoking and diabetes.

Table 3 Number of mental health admissions and bed days by social class in women from the Renfrew and Paisley study

| | Social classes | | | |
	I and II	IIINM	IIIM	IV and V
Number of women	1451	1975	1486	3076
Person-years	37 262	50 869	33 980	72 487
All mental health				
Admissions*	236 (6.3)	411 (8.1)	413 (12.2)	875 (12.1)
Rate ratio$_1$	1	1.22 (0.93 to 1.60)	1.79 (1.34 to 2.38)	1.77 (1.38 to 2.27)
Rate ratio$_2$	1	1.21 (0.92 to 1.59)	1.73 (1.29 to 2.31)	1.72 (1.33 to 2.22)
Bed days†	1447	1586	2304	1925
Rate ratio$_1$	1	1.07 (0.62 to 1.83)	1.37 (0.77 to 2.45)	1.27 (0.77 to 2.08)
Rate ratio$_2$	1	1.07 (0.61 to 1.89)	1.40 (0.76 to 2.56)	1.15 (0.65 to 2.01)
Depression				
Admissions*	55 (1.48)	90 (1.77)	99 (2.91)	210 (2.90)
Rate ratio$_1$	1	1.16 (0.67 to 2.04)	1.98 (1.11 to 3.54)	1.78 (1.07 to 2.96)
Rate ratio$_2$	1	1.22 (0.70 to 2.13)	1.91 (1.06 to 3.43)	2.08 (1.24 to 3.50)
Bed days†	96	95	347	149
Rate ratio$_1$	1	1.05 (0.36 to 3.05)	5.31 (1.67 to 16.9)	1.26 (0.49 to 3.23)
Rate ratio$_2$	1	1.18 (0.39 to 3.56)	6.42 (1.82 to 22.7)	1.67 (0.55 to 5.09)
Psychoses				
Admissions*	41 (1.1)	106 (2.1)	130 (3.8)	241 (3.3)
Rate ratio$_1$	1	1.84 (1.05 to 3.23)	3.41 (1.92 to 6.06)	2.82 (1.69 to 4.72)
Rate ratio$_2$	1	1.69 (0.96 to 2.97)	3.32 (1.85 to 5.94)	2.63 (1.53 to 4.51)
Bed days†	147	378	571	385
Rate ratio$_1$	1	2.18 (0.79 to 5.98)	2.67 (0.91 to 7.81)	1.67 (0.66 to 4.25)
Rate ratio$_2$	1	1.73 (0.55 to 5.44)	2.35 (0.73 to 7.59)	1.17 (0.39 to 3.56)
Drug and alcohol dependence				
Admissions*	23 (0.6)	18 (0.4)	13 (0.4)	27 (0.4)
Rate ratio$_1$	1	0.46 (0.13 to 1.59)	0.85 (0.22 to 3.28)	0.44 (0.14 to 1.43)
Rate ratio$_2$	1	0.59 (0.19 to 1.82)	0.72 (0.21 to 2.45)	0.53 (0.17 to 1.62)
Bed days†	16	49	9	11
Rate ratio$_1$	1	3.68 (0.40 to 34.0)	0.88 (0.08 to 9.21)	0.46 (0.06 to 3.53)
Rate ratio$_2$	1	2.01 (0.14 to 29.8)	0.11 (0.01 to 2.40)	0.31 (0.01 to 7.98)
Alzheimer's and dementia				
Admissions*	109 (2.9)	201 (4.0)	163 (4.8)	381 (5.3)
Rate ratio$_1$	1	1.32 (0.95 to 1.83)	1.35 (0.96 to 1.92)	1.59 (1.18 to 2.14)
Rate ratio$_2$	1	1.29 (0.93 to 1.80)	1.36 (0.96 to 1.95)	1.58 (1.15 to 2.16)
Bed days†	1089	1004	1304	1272
Rate ratio$_1$	1	0.85 (0.41 to 1.77)	0.79 (0.35 to 1.75)	1.01 (0.51 to 1.98)
Rate ratio$_2$	1	0.88 (0.40 to 1.93)	0.76 (0.32 to 1.80)	0.94 (0.43 to 2.04)

*Number (per 1000 person-years).
†Per 1000 person-years.
IIIM, III manual; IIINM, III non-manual; rate ratio$_1$, adjusted for age; rate ratio$_2$, adjusted for age, systolic blood pressure, cholesterol, body mass index, height, FEV1, angina, ischaemic ECG, bronchitis, smoking and diabetes.

1.13 (95% CI 1.05 to 1.22) in social classes IIINM, IIIM, IV and V, respectively, compared with social classes I and II, a pattern which again attenuated markedly with the addition of the baseline risk factors. The rate ratios of non-emergency admissions in men were 0.95 (95% CI 0.85 to 1.05), 0.93 (95% CI 0.86 to 1.01) and 0.89 (95% CI 0.82 to 0.97) in social classes IIINM, IIIM, IV and V, respectively, compared with social classes I and II and were attenuated after adjustment for risk factors.

There were contrasting patterns, therefore, between emergency and non-emergency hospital admissions for men and women, with a progressively higher rate ratio of emergency admissions and progressively lower rate ratio of non-emergency hospital admissions from social classes I and II through to social classes IV and V (figure 1).

DISCUSSION
Main results
The overall admission rates to hospital for general health conditions in this cohort are only marginally socially patterned. However, for particular diseases (such as respiratory disease, and for CVD, CHD and stroke in women), the rate ratio of hospital admissions increases from social classes I and II through to social classes IV and V. Where the social patterning exists for particular diseases, a large proportion can be explained by a differential prevalence of baseline risk. In contrast, there is substantial social patterning for overall admissions to hospital for mental health conditions, and very markedly for psychosis, Alzheimer's and dementia in men and women, as well as for drug-related and alcohol-related

Table 4 Number of mental health admissions and bed days by social class in men from the Renfrew and Paisley study

Number of men	Social classes			
	I and II	IIINM	IIIM	IV and V
	1329	829	2814	1996
Person-years	30 385	17 036	56 966	38 331
All mental health				
Admissions*	215 (7.1)	100 (5.9)	443 (7.8)	403 (10.5)
Rate ratio$_1$	1	0.79 (0.53 to 1.19)	1.04 (0.77 to 1.39)	1.51 (1.11 to 2.06)
Rate ratio$_2$	1	0.80 (0.53 to 1.19)	0.95 (0.70 to 1.28)	1.34 (0.97 to 1.84)
Bed days†	870	617	1043	1874
Rate ratio$_1$	1	0.65 (0.30 to 1.42)	0.99 (0.55 to 1.79)	2.18 (1.17 to 4.08)
Rate ratio$_2$	1	0.72 (0.31 to 1.69)	0.83 (0.44 to 1.58)	1.79 (0.90 to 3.56)
Depression				
Admissions*	61 (2.0)	24 (1.4)	83 (1.5)	54 (1.4)
Rate ratio$_1$	1	0.71 (0.32 to 1.55)	0.63 (0.36 to 1.11)	0.67 (0.36 to 1.23)
Rate ratio$_2$	1	0.69 (0.31 to 1.54)	0.52 (0.28 to 0.96)	0.54 (0.28 to 1.05)
Bed days†	131	212	87	68
Rate ratio$_1$	1	1.96 (0.40 to 9.50)	0.69 (0.21 to 2.33)	0.56 (0.16 to 1.99)
Rate ratio$_2$	1	1.26 (0.18 to 8.79)	0.68 (0.17 to 2.77)	0.45 (0.09 to 2.25)
Psychoses				
Admissions*	32 (1.1)	23 (1.4)	96 (1.7)	77 (2.0)
Rate ratio$_1$	1	1.11 (0.47 to 2.60)	1.39 (0.74 to 2.63)	1.84 (0.94 to 3.60)
Rate ratio$_2$	1	1.18 (0.50 to 2.77)	1.28 (0.67 to 2.47)	1.78 (0.89 to 3.57)
Bed days†	75	104	190	630
Rate ratio$_1$	1	0.78 (0.14 to 4.42)	1.35 (0.33 to 5.49)	6.15 (1.59 to 23.7)
Rate ratio$_2$	1	0.91 (0.14 to 5.98)	0.99 (0.22 to 4.47)	6.42 (1.01 to 40.8)
Drug and alcohol dependence				
Admissions*	37 (1.2)	13 (0.8)	89 (1.6)	108 (2.8)
Rate ratio$_1$	1	0.67 (0.26 to 1.77)	1.55 (0.80 to 3.02)	3.23 (1.59 to 6.55)
Rate ratio$_2$	1	0.68 (0.26 to 1.77)	1.10 (0.55 to 2.21)	1.97 (0.97 to 4.01)
Bed days†	187	21	146	247
Rate ratio$_1$	1	0.11 (0.02 to 0.58)	0.80 (0.23 to 2.77)	2.0 (0.50 to 7.97)
Rate ratio$_2$	1	0.06 (0.01 to 0.47)	0.11 (0.02 to 0.64)	0.30 (0.05 to 1.89)
Alzheimer's and dementia				
Admissions*	68 (2.2)	38 (2.2)	176 (3.1)	134 (3.5)
Rate ratio$_1$	1	1.02 (0.60 to 1.74)	1.37 (0.93 to 2.03)	1.54 (1.02 to 2.32)
Rate ratio$_2$	1	1.02 (0.59 to 1.74)	1.47 (0.98 to 2.20)	1.63 (1.07 to 2.50)
Bed days†	360	238	582	620
Rate ratio$_1$	1	0.63 (0.19 to 2.06)	1.42 (0.59 to 3.45)	1.78 (0.70 to 4.57)
Rate ratio$_2$	1	0.57 (0.17 to 1.87)	1.56 (0.62 to 3.97)	1.93 (0.74 to 5.06)

*Number (per 1000 person-years).
†Per 1000 person-years.
IIIM, III manual; IIINM, III non-manual; rate ratio$_1$, adjusted for age; rate ratio$_2$, adjusted for age, systolic blood pressure, cholesterol, body mass index, height, FEV1, angina, ischaemic ECG, bronchitis, smoking and diabetes.

admissions in men. The overall social patterning in hospital admissions masked contrasting social patterns for emergency and non-emergency admissions. The declining rate ratio for non-emergency hospital admissions from social classes I and II through to social classes IV and V, despite the greater prevalence of risk factors and morbidity and mortality, suggests that non-emergency admissions are not in proportion to need.

Strengths and weaknesses of the study

The socioeconomic patterning in hospital admissions is well known from routine data, but this study uses pre-existing morbidity data on a variety of risk factors including blood pressure, smoking and cholesterol, which can assess the degree to which the patterning might be influenced by these risks. The data from this cohort study have the additional advantages of a very low attrition rate, up to 37 years of follow-up data and a sample which is highly representative of the communities from which it was drawn (social classes IV and V comprised 29% of the men and 39% of the women in the cohort, and 78% of the target community was recruited into the study at baseline). As the cohort was recruited in late middle age, there is unlikely to have been much subsequent social mobility (which would have created a misclassification bias).

Data on risk factors are only available for one point in time, and therefore are likely to underestimate the risk

Table 5 Number of emergency and non-emergency general admissions by social class in men and women from the Renfrew and Paisley study

	Social classes			
	I and II	IIINM	IIIM	IV and V
Women				
Number of women	1451	1975	1486	3076
Person-years	37 262	50 869	33 980	72 487
Emergency admissions				
Number of admissions	3848	5590	3953	8967
Admissions*	103	110	116	124
Rate ratio$_1$	1	1.06 (0.99 to 1.14)	1.10 (1.01 to 1.18)	1.18 (1.11 to 1.26)
Rate ratio$_2$	1	1.05 (0.98 to 1.13)	1.02 (0.94 to 1.10)	1.07 (1.01 to 1.15)
Non-emergency admissions				
Number of admissions	4760	6590	3975	8446
Admissions*	128	130	117	117
Rate ratio$_1$	1	1.03 (0.95 to 1.11)	0.95 (0.87 to 1.04)	0.93 (0.86 to 1.0)
Rate ratio$_2$	1	1.03 (0.95 to 1.12)	0.97 (0.89 to 1.06)	0.95 (0.88 to 1.02)
Men				
Number of men	1329	829	2814	1996
Person-years	30 385	17 036	56 966	38 331
Emergency admissions				
Number of admissions	3649	2161	7350	5252
Admissions*	120	127	129	137
Rate ratio$_1$	1	1.03 (0.94 to 1.13)	1.06 (0.99 to 1.14)	1.13 (1.05 to 1.22)
Rate ratio$_2$	1	1.01 (0.93 to 1.11)	1.01 (0.95 to 1.09)	1.06 (0.99 to 1.14)
Non-emergency admissions				
Number of admissions	4722	2480	8255	5358
Admissions*	155	146	145	140
Rate ratio$_1$	1	0.95 (0.85 to 1.05)	0.93 (0.86 to 1.01)	0.89 (0.82 to 0.97)
Rate ratio$_2$	1	0.97 (0.87 to 1.08)	0.96 (0.88 to 1.04)	0.93 (0.85 to 1.01)

*Per 1000 person-years.
IIIM, III manual; IIINM, III non-manual; rate ratio$_1$, adjusted for age; rate ratio$_2$, adjusted for age, systolic blood pressure, cholesterol, body mass index, height, FEV1, angina, ischaemia on ECG, bronchitis, smoking and diabetes.

of some factors such as smoking, which have become increasingly socially patterned over time, with people from higher social classes more likely to give up.[22] The social patterning of hospital admissions also varies by age,[23] and therefore care should be taken to generalise only to similarly aged populations, given that the cohort was aged 45–64 years at baseline. There are also no baseline risk data for physical activity or diet, or for a wider range of risk factors that may be applicable to mental health outcomes. Although the study is internally valid, there may be limited generalisability beyond this time period and the West of Scotland—both because of the higher mortality and wider health inequalities in this population than in most other populations in western Europe during this time period[24–26] and because patterns of hospital use will inevitably reflect the particular healthcare system in which they occur.

## Comparisons to other studies

Social patterning in hospital admissions has been found internationally[4–7] and in England and Scotland.[27–31] Adjusting for the deprivation profile and demographic characteristics of practice populations leaves a large amount of variation in hospital admissions unexplained.[29]

Patterns of hospital use are likely to reflect patterns of non-hospital care in their catchment areas. In the UK, the flat distribution of GPs across areas of widely contrasting socioeconomic status rations the time available to address the higher prevalence of multimorbidity in deprived areas, reducing the scope to prevent or postpone emergency admissions.[23 30 32] The lower expectations of people in deprived areas[33 34] may also explain their less than expected use of non-emergency cardiology services.[35]

Healthcare needs are known to increase progressively across the socioeconomic spectrum,[22] and this study shows that cardiovascular risk factors can explain a large proportion of the social patterning in hospital admissions in this study. Yet, we have shown that the populations with the greatest need (social classes IIIM, IV and V) do not consistently use hospital services in proportion to need as approximated by the baseline cardiovascular risk factors and social class. For non-emergency admissions, there is an inverse gradient between service use and health needs.

The inverse social pattern in planned, proactive and preventive work, as represented by non-emergency hospital admissions, may be related to supply factors, such as the inequitable distribution of resources, including
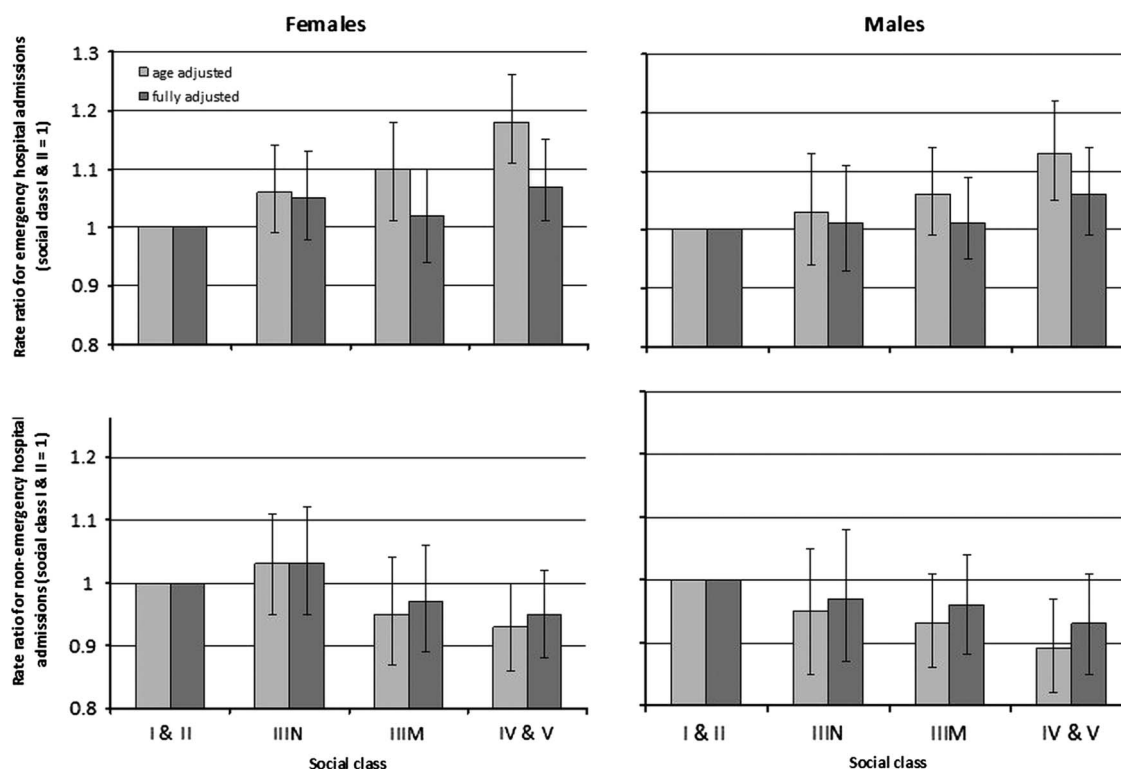
Figure 1 Patterning of emergency and non-emergency admissions to hospital by social class.

time, in primary care, but is also likely to reflect the higher prevalence and greater complexity of multimorbidity in more deprived populations, which are only captured in a limited way in the baseline risk data recorded in this study.[23]

Implications

The contribution that healthcare services make in reducing inequalities in health outcomes is limited by emergency hospital use not fully reflecting health needs, and non-emergency hospital use being inversely related to need. Despite the long-standing commitment of the NHS to universal healthcare access, there is still a need to monitor, explain and address inequitable patterns of healthcare use.[36]

Conclusions

General admissions to hospital in the West of Scotland were only marginally socially patterned, and less than would be expected on the basis of the gradient in baseline risk factors across social classes, whereas the social patterning in admissions for mental health problems was more marked. There were contrasting social patterns for emergency and non-emergency hospital admissions compared to the prevalence of baseline risk, with those with the lowest prevalence of risk factors having a higher rate ratio for non-emergency admissions. Further work is required to make the NHS more responsive to the greater needs of people in social classes IIIM, IV and V.

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Webtable 1 - International Classification of Diseases (ICD) codes for causes of admissions

	ICD8	ICD9	ICD10
Cardiovascular disease	390 – 458	390 - 459	I00 - I99, G45, M300, M303, R58X
Coronary heart disease	410 - 414	410 - 414	I20 - I25
Stroke	430 - 438	430 - 438	I60 - I69, G45
Respiratory diseases	460 - 519	460 - 519	J00 - J99
Digestive diseases	520 - 577	520 - 579	K00 - K93
Cancer	140 - 209	140 - 208	C00 - C97
Depression/anxiety	300	300, 308-9, 311	F32 -34 (except F32.3, F33.3), F40 - 43
Psychoses	298.2	295, 296.0 - 296.5, 297, 298.0 - 298.4, 298.8 - 298.9	F20, F21 - 29, F31, F32.3, F33.3
Drug & alcohol dependence	291, 303-4	291, 292.1, 303-4	F10 - F19
Alzheimer's & dementia	290	290, 294.1, 331.0	F00 - F03, G30