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Socio-demographic differences in cancer survival

Manolis Kogevinas

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MANOLIS KOGEVINAS
December 1989

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Summary

The OPCS Longitudinal Study (LS), initiated in the early 1970s, brings together information held by OPCS from censuses and key vital events for one per cent of the population. This source has provided detailed data on mortality, fertility, on cancer incidence and on social and demographic change.

This report uses data from the LS to describe patterns of survival after cancer registration, in particular differences in survival between groups with different social and demographic characteristics. The data are derived from the 1971 Census, the National Cancer Registration Scheme, from death registrations and from notifications of embarkations to the National Health Service Central Register at Southport.

Between the 1971 and 1981 Censuses, 17,844 persons included in the LS sample were registered with cancer. The socio-demographic characteristics of these cases and the incidence rates for different social and demographic groups provide a background to the analysis of survival. In the period to the end of 1983, 13,532 of these people died. This report describes for the first time at a national level detailed survival patterns for England and Wales according to cancer site and variations according to housing tenure, social class, economic position, marital status and region of residence.

The data presented here comprise only a sample of national data and as a consequence many of the individual figures are subject to greater statistical variation than would be the case in analysis of complete national data. Also, there are problems with the national scheme because of differences in the way regional registries, which contribute data to the national scheme, operate. These limitations are unlikely to have affected the differences in survival reported here.

For the majority of cancers, people in better socio-economic circumstances across the range of measures used had a greater probability of surviving their cancer than those in poorer circumstances, once account is taken of sex and age.

Differences in survival were found for cancers with poor and with good prognosis. However, absolute differences in survival were larger for good prognosis cancers and especially so for cancer of the bladder (in both sexes) and cancer of the corpus uteri.

Contrary to most studies, the LS did not support suggestions that survival from prostate and breast cancer was more favourable for people in better socio-economic circumstances. Analyses of survival curves suggested that council tenants were more likely to present with a later stage cancer than owner occupiers, and this would contribute to a lead-time bias which could explain part of the difference.

Smoking related cancers accounted for a large part of the differences observed in the incidence of new cancers. Particular relationships were also noted between the incidence of lung cancer and unemployment (not explained by health selection) and between age at first full-term pregnancy and number of children and the incidence of cancers of breast, cervix and corpus uteri. With the exception of cervical cancer, differences in incidence between socio-economic groups were not explained by differences in reproductive history.

Reproductive history was also found to be related to survival from cancer. In particular, women who had had children had significantly better survival from breast cancer than women who had not; those who had their first child before age 20 had poorer prognosis than those who had their first child later.

By bringing together information on differences between people in different housing categories in the incidence of new cases of cancer and in survival the report considers the potential for improvement by addressing these differences. The analysis suggests that elimination of differences in incidence would result in a reduction of approximately 33 per cent and 8 per cent in mortality for male and female local authority tenants respectively. Elimination of differences in survival between different housing categories would reduce mortality from cancer by approximately 4 per cent for men and 2 per cent for women.

1 Introduction

For the people of Babylon, a fictional city in a story written by Jorge Luis Borges, fate and social position were solely determined by a complicated lottery system. The narrator of the story says, 'Like all men in Babylon I have been a proconsul; like all, a slave; I have also known omnipotence, opprobrium, jail'. In Babylon, chance is the only moving force, social mobility is the rule, and socio-economic factors are distinctly absent.

Unlike Borges's city, we live in a society where our fate in life appears determined by the existence of socio-economic factors. Socio-economic differences in morbidity and mortality can be found for men and women of all ages. Such variation does not appear with the same magnitude or even the same pattern for every disease, for all time periods and all countries. Nevertheless, the overwhelming picture is that of socially disadvantaged groups having poorer health than socially advantaged ones.

This volume examines whether socio-economic factors are related to survival of cancer patients. Data from the OPCS Longitudinal Study (LS) were analysed for the years 1971 to 1983. The relationship of socio-demographic factors to cancer incidence are investigated for the period 1971-81, extending by five more years of follow-up a previous analysis. Finally, socio-economic differences in cancer mortality are evaluated in relation to observed incidence and survival differentials.

Socio-economic differences in cancer survival have not been examined as extensively as those for cancer incidence. The first studies were conducted by Cohart in 1955, who detected an association between socio-economic status and cancer survival only for breast cancer. Two decades later, interest in survival patterns was renewed when large differences among ethnic groups in the USA became evident. Variation among socio-economic groups in the timing of cancer detection has been the most frequently incriminated cause for the occurrence of survival differences. Differences in treatment, tumour characteristics, genetic factors and psychological influences have also been investigated as contributing causes, but there is still little evidence for their importance.

The LS provided an opportunity to investigate socio-economic differences in cancer survival in a large representative sample of the population of England and Wales. The existence of data on both incidence and survival, allowed an evaluation of their importance in the generation of mortality differences. Elimination of mortality differentials could therefore be examined in relation to health policies aimed mainly at cancer prevention or alternatively, at treatment.

Socio-economic differences in incidence and survival may require different explanations; risk factors related to the occurrence of cancer may not affect its prognosis. Survival of lung cancer cases, for example, depend little on whether the cause was smoking Havana cigars or working as a nickel smelter. However, appearance of socio-economic differences in various stages of the natural history of a disease lead us to examine these differences in a unified way. In this context, socio-economic factors can be identified as influencing both incidence and survival, precipitating and explaining the existence of intermediate factors which produce the observed health differentials in both pre-clinical and clinical phases of a disease.

Reproductive history and sexual habits have frequently been incriminated in the occurrence of socio-economic differences in reproductive cancers. The importance of reproductive history for the generation of socio-economic differences in both incidence and survival was examined for a subgroup of the LS population (married women).

2 Data

This chapter presents a description of the OPCS Longitudinal Study (LS) and of the available cancer incidence and survival data. The quality of information collected by the National Cancer Registration Scheme (NCRS) is evaluated, mainly referring to the comparability of registration data for major socio-economic groups.

2.1 The OPCS Longitudinal Study

The main feature of cohort studies is the identification of population groups with common characteristics, and the prospective monitoring of individuals constituting the groups in order to relate the occurrence of an event (usually disease or death) to prior characteristics. The LS is a cohort study of an approximately 1 per cent representative sample of people enumerated in England and Wales in the 1971 Census. It includes census and registration records.' The initial information for each member of the cohort was derived from their 1971 census record. Cluster sampling was used for the selection of the study population based on clusters of people with the same birthday. For this purpose, four dates evenly spaced through the year were chosen, representing approximately 1 per cent of the days of the year, and 529,935 people were included in the sample. Records were traced in the National Health Service Central Register (NHSCR) for 96.8 per cent of this sample and these 513,072 persons constitute the initial study population. Analyses published in the first report,' show that characteristics of this sample approximate very closely those of the population of England and Wales as enumerated in the 1971 Census.

OPCS routinely collects information on births, deaths and cancer registration. The NHSCR collects information on registration with a National Health Service doctor and this provides information on immigration and emigration. This information is included in the LS. The analyses in this volume are based on death registrations, LS members' characteristics from the 1971 Census, and cancer incidence from the NCRS. For the calculation of person-years at risk information on any embarkations was also taken into account. In Figure 2.1, hypothetical example is shown of the spacing of LS records in time, for an individual member of the study.

2.2 Cancer registration*

The NCRS was introduced in England and Wales in 1971. It is based on regional cancer registries corresponding (after 1974) to the Regional Health Authorities (RHA) areas, with the exception of the South Thames cancer registry. Registration records, which include several items of information on each registered case (Table 2.1), are sent from the registries to the NCRS and follow-up for each registered case is done centrally using the NHS Central Register to identify deaths among registered cases. Registration is believed to be at best 90 per cent complete, i.e. 90 per cent of the true incidence of cancer in England and Wales, but it varies between cancer registries. The report of the Advisory Committee* estimated that before 1970, the level of completeness in some registries could be as low as 60 or 70 per cent. There are indications that since 1971 registration has improved rapidly at least in some regions.[3] Incomplete registration is believed to be mainly due to the failure to notify non-fatal cancers.[4]

Published OPCS cancer statistics for the years 1971-73 do not include cancer cases first identified through a death certificate. From 1974 onwards, these cases are included. This change, together with all the other consequences of the re-organisation of the NCRS, resulted in a small artificial increase of cancer incidence rates in England and Wales in 1974. Cancer cases first identified through a death certificate are included in the LS records, providing therefore a more complete estimation of incidence patterns in 1971-73.

All death certificates mentioning cancer as a cause of death or as a contributing factor, are sent from the

* The recently published third LS report3 includes a review on the registration scheme in England and Wales. In Chapter 3 of the report a detailed account is given on the ways that cancer records are incorporated in the LS and it is shown that cancer registrations linked to the LS records are representative of the total cancer registrations in England and Wales. This section presents only summary information.

Figure 2.1 Examples of the spacing of LS records in time

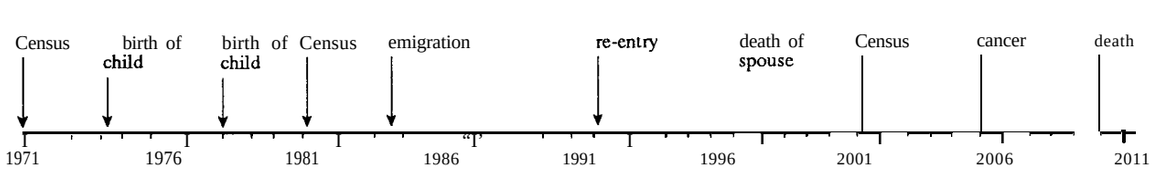


Table 2.1 Information collected by the National Cancer Registration Scheme since 1971

Reference (year, region, registration number, hospital)
NHS number
Surname, forenames, maiden name of married women
Sex
Date of birth
Home address
Place of birth
Occupation and industry
-of patient
-of husband, if married women
-of father, if child
Site of primary or main presenting secondary if primary not known
Type of growth
Anniversary date
Date of death

NHSCR to the regional cancer registries. For cases that were not already registered an anniversary date (date of diagnosis) should be identifiable from existing regional records, primarily hospitals records. The number of these cases is not available. In the LS, a date of diagnosis was not identified for 6.5 per cent of all registrations and consequently the recorded date of diagnosis and date of death, were the same. These cases are included in the calculation of incidence and mortality rates, since the individuals will have contributed person-years at risk, but are excluded from the calculation of case-fatality rates as they made no contribution to the denominator after registration. Although the major problems occur in the estimation of case-fatality rates, incidence rates are also affected, but to a much lesser extent. Denominators for incidence rates will be slightly bigger and consequently rates will estimate slightly lower incidence than in reality. Mortality rates are unaffected. The proportion of cases whose date of registration and death were the same depended on cancer site. Higher proportions were found for cancers with poor prognosis, which became progressively lower with improved prognosis (Figure 2.2). Accuracy of registration of survival time seems therefore to be related to length of survival: cases with poor prognosis are more likely to be registered with zero days survival, while cases surviving longer have a higher probability of being registered sometime during the duration of their disease and before their death. The proportion of cases registered with zero days survival also differed by age, becoming progressively higher in older age-groups (Figure 2.3). This is presumably related to the shorter survival of cancer cases at older ages due to deaths from competing causes.

Differing proportions of these cases in various socio-economic groups could bias the calculated survival differentials. Tables 2.2 and 2.3 give the proportion of these cases by housing tenure and site of cancer, for men and women respectively. Tables 2.4 and 2.5 give similar proportions for other socio-economic classifications. Not only was this proportion relatively small for many

Figure 2.2 Deaths for both sexes having the same date of diagnosis and death, over total registrations, by prognosis of the cancer

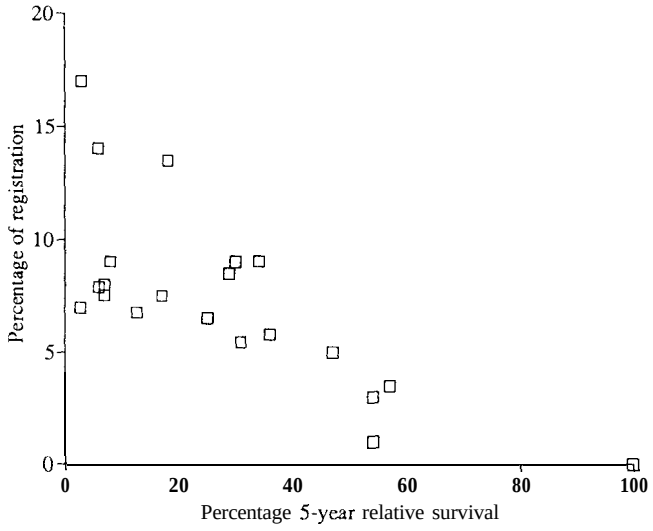
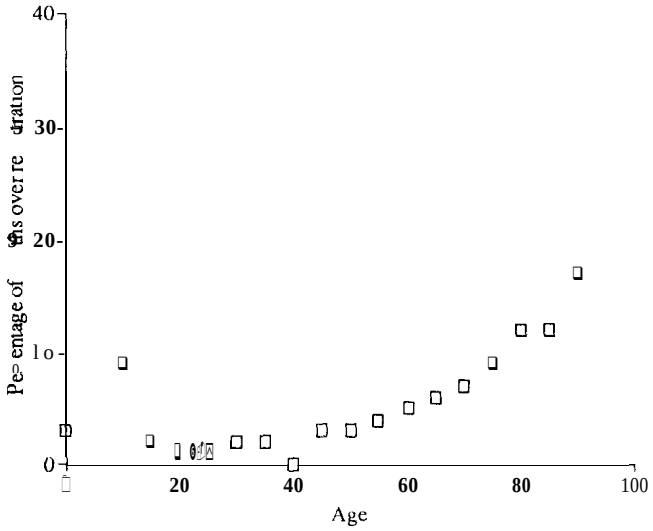


Figure 2.3 Percentage of deaths from all neoplasms over all cancer registrations having the same date of diagnosis and date of death, by age, for both sexes



cancer sites but, more importantly, for most cancer sites it was very similar for the major socio-economic groups. The problem was more apparent in small 'residual' population groups, for example persons living in non-private households, persons registered with inadequately described occupations, etc. For some cancers, however, comparison of survival between major socio-economic groups could be biased as a result. Detailed discussion of relevant cancers is undertaken in the results section.

Levels of completeness and accuracy of registration differ in the various cancer registries of the country.[3,5] The proportion of cases registered with the same date of registration and date of death differed among cancer registries (Appendix Table 2.1). For example, North East Thames and Northern RHAs and Wales in men, and North East Thames, Trent, and South Western

Table 2.2 Deaths in men having the same date of registration and death, over total registrations by housing tenure?

Cancer of registration*		Owner occupiers	Council tenants	Private renters	Non-private households	All men
All neoplasms	**R**	4,284	2,882	1,805	216	9,196
	D	248	181	145	26	600
	%	5.8	6.3	8.0	12.0	6.5
Oesophagus	R	90	65	27	5	187
	D		6		1	15
	%	7.8	9.2	3.7	20.0	8.0
Stomach	R	357	235	156	19	767
	D	28	17	12		5-8
	%	7.8	1.2	7.7	5.3	7.6
Colon	R	289	134	108	15	546
	D	24	11	12	2	49
	%	8.3	8.2	11.1	13.3	9
Rectum	R	235	141	95	10	481
	D	16	2	5		26
	%	6.8	1.4	5.3	30.0	5.4
Pancreas	R	137	65	59	8	270
	D			4		19
	%	5.1	10.9	6.8	12.5	7.0
Lung	R	1,062	1,016	574	50	2,704
	D	87	86	64	9	246
	%	8.2	8.5	11.1	18.0	9.1
Prostate	R	380	185	132	20	717
	D	23	10	6	2	41
	%	6.1	5.4	4.5	10.0	5.1
Bladder	R	278	185	122	10	595
	D	8	6		0	19
	%	2.9	3.2	4.1	0	3.2
Lymphomas	R	i14	68	42	9	234
	D		3	2		11
	%	4.4	4.4	4.8	11.1	4.7
Leukaemias	R	103	44	25	8	180
	D					14
	%	4.9	11.4	12.0	12.5	7.8

†*There were no such deaths registered among cases with laryngeal and skin cancer, and only one among those with testicular cancer.*
‡*R = registration, D = death.*

RHAs in women, had more than 15 per cent of such cases for colon cancer. With the exception of the North Thames cancer registries, differences were not as wide for bladder and breast cancer. The proportion of such cases was uniformly low for cervical cancer. RHAs were aggregated into three larger geographical regions. Proportions of cases registered with zero days survival were very similar for the aggregated groups (Table 2.6), as cancer registries with high percentages were not concentrated only in one part of England and Wales.

As already mentioned, all socio-economic information used here is derived from 1971 Census records, overcoming the absence, incompleteness and inaccuracy of this type of information on cancer registration records. For example, in 1981 only 5 1.6 per cent of male cancer registrations included information on occupation,[5] which, in many cases, had been obtained from death certification.

Cancer registration records provide all the information about the registered cancers and, even though neoplasms are fairly accurately diagnosed compared to other disease groups, the accuracy of registration varies from site to site.[6,7] Evaluation of death certification in the USA revealed that most misclassifications occurred for colorectal cancer, and for cancers of the uterus, buccal cavity and brain.[6] Cancer of the colon was over-diagnosed while rectal cancer was under-diagnosed. A considerable proportion of cases of cervical cancer and of the corpus uteri were reported on the death certificate as cancer of the uterus NOS (not otherwise specified). For cancers of the buccal cavity and the brain, misclassification occurred at a more detailed level, within the broad site specified.

2.3 Numbers, sites and socio-economic classifications

The LS sample taken from the 1971 Census contained 250,588 men and 262,484 women. During the period 1971-81, there were 9,196 cancer registrations to men and 8,652 registrations to women. All cases registered after 25 April (1971 Census day) and up to 5 April 1981 (1981 Census day) are included in this analysis. For the survival analysis, follow-up of these cases was extended

Table 2.3 Deaths in women having the same date of registration and death, over total registrations by housing tenure†

Cancer of registration*		Owner occupiers	Council tenants	Private renters	Non-private households	All women
All neoplasms	**R**	4,320	2,504	**1,607**	**212**	8,652
	D	210	144	**123**	33	510
	%	4.9	5.8	**7.7**	**15.6**	5.9
Oesophagus	R	67	45	33		148
	D	6	4	2	**0**	12
	%	9.0	8.9	6.1	**0**	8.1
Stomach	R	223	157	93	11	484
	D	28	21	20	0	70
	%	12.6	13.4	21.5	0	14.5
Colon	R	387	197	146	25	755
	D	23	21	17	4	65
	%	5.9	10.7	11.6	16.0	8.6
Rectum	R	191	105	64	70	368
	D	18	9		2	34
	%	9.4	8.6	7.8	28.6	9.2
Pancreas	R	116	45	51	10	223
	D	15	6	12	4	37
	%	12.9	13.3	23.5	4.0	16.6
Lung	R	304	246	153	18	722
	D	17	20	14	4	55
	%	5.6	8.1	9.21	22.2	7 6
Breast	R	1,074	571	348	55	2,050
	D	28	19	15	9	71
	%	2.6	3.3	4.3	16.4	3.5
Cervix uteri	R	133	140	79		359
	D	1	0		2	4
	%	0.8	0	1.3	28.6	1.1
Corpus uteri	R	183	94	53	4	336
	D	2			0	4
	%	1.1	1.1	1.9	0	1.2
Ovary	R	243	105	62	8	418
	D	15	6		3	27
	%	6.2	5.1	4.8	31.5	6.5
Bladder	R	110	57	43	6	216
	D	4	4	3	0	11
	%	3.6	7.0	7.0	0	5.1
Lymphomas	R	88	57	32	6	183
	D	3		4	0	10
	%	3.4	5.3	12.5	0	5.5
Leukaemias	R	90	43	36	8	177
	D	12	5			24
	%	13.3	11.6	13.9	12.5	13.6

† *There were no such deaths registered among cases with malignant melanoma and skin cancer.*
‡*R = registration, D = death.*

to 1983 and during these thirteen years, of those registered with a cancer, 7,466 men and 6,066 women died.

Cancer sites and socio-economic classifications for which data were analysed are given in Appendix Table 2.2 for incidence and in Appendix Table 2.3 for survival. All major cancer sites were included provided that comparison of the 8th and 9th revisions of the International Classification of Diseases was feasible. Data on cancer sites discussed here cover 80 per cent of registered incidence cases and 75 per cent of all deaths in survival analyses. The remaining cases were spread across many cancer sites, making any analysis of these sites meaningless because of the small numbers involved.

Because socio-demographic indicators were derived from census records, a multiplicity of information on each individual was available. Two previous reports[1,3] and a number of papers[8,9] have extensively referred to the inter-relation between socio-economic classifications.

Classification by *housing tenure* was found to be equally applicable to both sexes and to all ages, and to

Table 2.4 Deaths in men having the same date of registration and death, over total registrations by own social class, economic position and marital status

Cancer of registration?		Social class		
		Non-manual	Manual	Other
Colon	R	184	301	60
	D	15	25	9
	%	8.2	8.3	15.0
Lung	R	681	1,785	235
	D	62	149	35
	%	9.1	8.3	14.9
Bladder	R	164	369	59
	D	2	IO	7
	%	1.2	2.7	11.9

Cancer of registration*		Economic position				
		Employed	Unemployed	Retired	Temporarily out of work, sick	Permanently sick
Colon	R	287	16	223	4	9
	D	14	3	31	0	1
	%	4.9	18.8	13.9	0	11.1
Lung	R	1,652	96	842	38	72
	D	107	10	119	2	7
	%	6.5	10.4	14.1	5.3	9.7

Cancer of registration*		Marital status		
		Married	Single	Widowed and divorced
Colon	R	436	39	71
	D	35	5	9
	%	8.0	12.8	12.7
Prostate	R	547	55	115
	D	28	3	10
	%	5.1	5.5	8.7

†*R = registration, D = death.*

Table 2.5 Deaths in women having the same date of registration and death, over total registrations, by own social class and marital status

Cancer of registration+		Own social class			
		Non-manual	Manual	Inadequately decribed	Unoccupied
Colon	R	110	121	211	305
	D	5	6	34	20
	%	4.5	5.0	16.1	6.6
Breast	R	457	414	347	814
	D	10	6	28	25
	%	2.2	1.4	8.1	3.1
Cervix*	R	59	105	38	150
	D	0	1	1	1
	%	0	0.9	2.6	0.7

Cancer of registration†		Marital status		
		Married	Single	Widowed and divorced
Colon	R	382	94	279
	D	20	9	36
	%	5.2	9.6	12.9
Breast	R	1,374	240	436
	D	38	3	30
	%	2.8	1.3	6.9
Cervix uteri	R	258	23	78
	D	2	1	1
	%	0.8	4.3	1.3

†*R = registration, D = death.*
‡*One married woman registered with cervical cancer had not been classified in any social class.*

Table 2.6 Deaths in men and women having the same date of registration and of death, over total registrations, by grouped Regional Health Authorities

Grouped Regional Health Authorities		Men	Women			
		Colon	Bladder	Colon	Breast	Cervix
North and West	R	15.5	133	203	511	105
	D	15	2	17	22	3
	%	10	2	8	4	3
Central	R	151	164	193	545	100
	D	13	3	17	11	1
	%	9	2	9	2	1
South and East	R	239	294	356	987	153
	D	21	14	31	38	0
	%	9	5	9	4	0

†*R = registration, D = death.*

differentiate well the health experience of the constituent housing tenure groups. Therefore, housing tenure was selected as the main socio-economic classification for both incidence and survival analyses presented here. The population is separated into three major housing tenure groups and a small residual one (Figure 2.4). Study members living in owner occupied accommodation constituted 50.3 per cent of the population, those in privately rented accommodation 17.3 per cent, and council tenants 29.8 per cent. In terms of socio-economic status, owner occupiers should be regarded as the 'high' status group and council tenants as the 'low' status one. Those living in private rented accommodation can be placed in an intermediate position; it should be noted, however, that this group is quite heterogeneous and is made up of people with differing socio-economic characteristics. The fourth group, people living in non-private households, constitute 2.5 per cent of the population and includes all those enumerated in institutions, for example hospitals, halls, etc. Many of these are ill health selected, that is, they are included in this group because they have health problems.

The Registrar General's social class classification is intended to reflect a ranking of occupations according to 'general standing within the community'.[10] It comprises six main social classes and three residual groups. Figure 2.5 shows the social class distribution of male study members for all ages. For some analyses, the six social classes were aggregated into two larger groups: non-manual social classes comprising Classes I, II and IIIN, while Social Classes IIIM, IV and V constitute the manual social classes. Two of the residual groups, 'inadequately described' and 'unoccupied', include health selected persons. The third group 'armed forces', is very small. These residual groups are omitted from many analyses as they do not provide any specific information about socio-economic differences in survival. Many of the unemployed are included among those with inadequately described occupations; their cancer incidence and survival is evaluated in terms of their economic position (see below).

Classifying women by social class in a simple but still interpretable way is a complex task. Women are classified according to their own occupation and are grouped into non-manual and manual social classes (Figure 2.6). This has obvious advantages as it provides a direct means of investigating factors affecting women's health and also takes into account the contribution of a woman's earnings to her standard of life. However, it results in nearly half the female population being classified as housewives. By separating women by marital status in these analyses, a higher proportion of women who were not married are allocated to a class, while married women are classified by their own and by their husband's social class.

Classification by *economic position* separates the population into two broad groups, the economically 'active' and 'inactive'. The economically active are further subdivided into those employed in the week preceding census, those seeking work (unemployed), and those temporarily out of work because of sickness. The economically inactive include the retired, persons prevented from seeking work because of permanent sickness, housewives, students and those who have not yet entered the workforce (children) or are excluded for any other reason, for example of independent means. These analyses are limited to people aged 16 years or older at the 1971 Census. Figure 2.7 shows the distribution of the male population for the five biggest groups.

Figure 2.4 Distribution of LS population by housing tenure

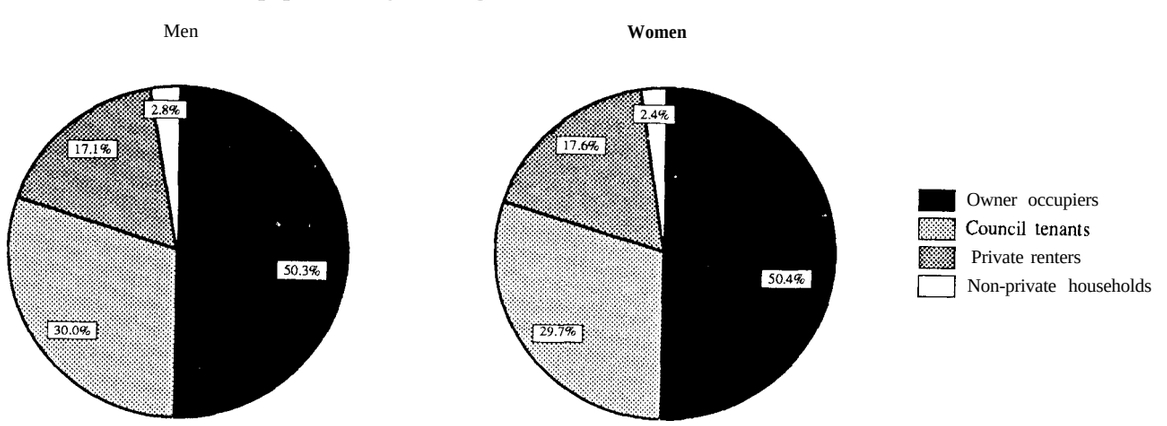


Figure 2.5 Distribution of male LS population by social class

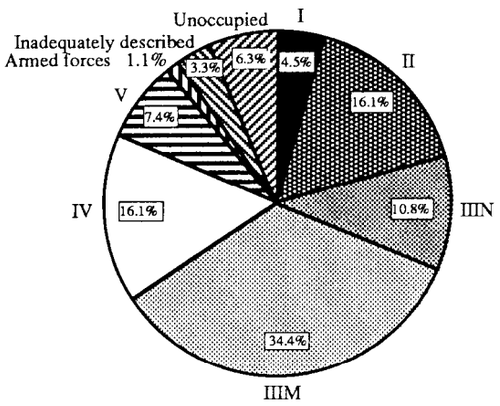


Figure 2.6 Distribution of female LS population by own social class

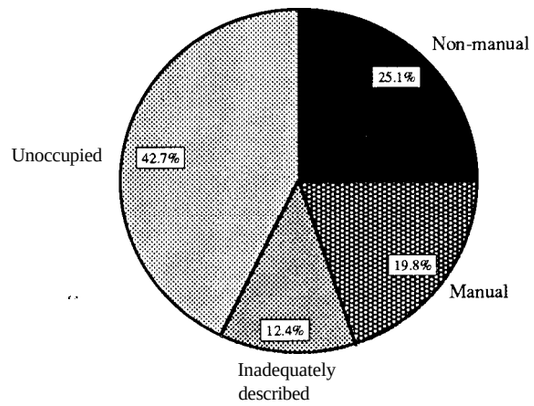
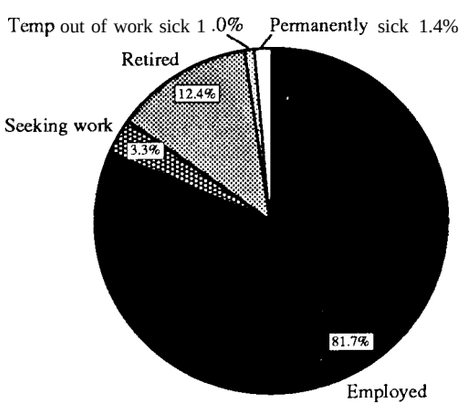


Figure 2.7 Distribution of male LS population by economic position



Geographic variation in cancer incidence was examined by classifying people according to their area of usual residence at the time of the 1971 Census, using the standard region classification (Figure 2.8). As in other regional analyses of LS data, the nine standard regions were grouped into three larger geographical regions on a south-east to north-west axis. The South and East grouped region comprises the South East, South West, and East Anglia. The Central grouped region comprises the West Midlands, East Midlands, and Yorkshire and Humberside. The North and West grouped region comprises the North, North West, and Wales. These grouped regions were used when regional data was analysed by housing tenure.

Figure 2.8 Standard regions, as constituted in 1971

For the survival analysis, geographical differences were examined on the basis of Regional Health Authorities (RHA) as defined by the 1974 reorganisation of the NHS (Figure 2.9). The fifteen RHAs were also aggregated into three larger geographical regions similar, but not identical, to the standard region groupings. The South and East for the survival analysis comprises the four Thames RHAs, East Anglian, Oxford, Wessex, and South Western. The Central grouped region comprises the West Midlands, Trent, and Yorkshire. The North and West comprises the Northern, North Western, Mersey, and Wales. In both incidence and survival analyses, aggregate regions will be referred to as South and East, Central, and North and West grouped regions.

Analysis by *marital status* applies to those who, at the 1971 Census, were 15 years or older. Four groups were identified (single, married, widowed, and divorced) with very different age distributions. The majority in the age-group 15 to 24 were single while men at most other ages and women aged under 70 were most commonly

Figure 2.9 Regional Health Authorities as constituted at 1 April 1974

married. When marital status is analysed by other variables in these analyses, widowed and divorced are combined.

Reproductive history was recorded only for married women aged 15 to 59 years at the 1971 Census. No information on subsequent childbearing was used in these analyses, but most of the women developing a cancer were of an age where they would be expected to have completed childbearing.

2.4 Case definition

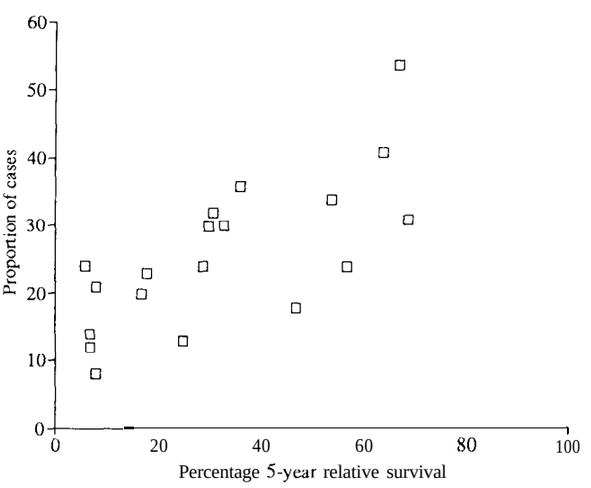
Incidence and survival analyses include only cancers registered after the 1971 Census. A small proportion of registrations, estimated for the first five years as less than 3 per cent,[3] were for second cancers or were found to be multiple registrations of the same cancer. All analyses are based on the 'first' cancer registered after the 1971 Census.

Case-fatality rates are calculated for three categories of underlying cause of death: deaths from all causes, deaths from the primary cancer, and deaths from causes other than cancer. This excludes a fourth category, deaths from *cancers* other than the primary, which can, of course, be identified by subtraction.

Results are presented routinely for all cause fatality, but for most sites differences in survival are also presented for fatality from primary cancer. In some cases, results are presented for the two other categories. All cause fatality includes those deaths caused by the cancer and those that would have occurred in any case due to other causes. There is a clear relation between prognosis of the cancer and proportion of deaths registered as due to causes other than primary cancer. This proportion is lower for poor prognosis cancers than for those cancers with longer survival (Figure 2.10).

Overall mortality varies among socio-economic groups. Comparison of case-fatality rates based on *deaths from the primary cancer* has the advantage of focusing on the disease of interest, excluding the some extent patterns of differentials in other diseases. However, analyses based on this cause of death have two limitations. First, apart from cancer registration another diagnostic step is added to the data (that of death certification), introducing a source of diagnostic bias in addition to any inaccuracy related to cancer registration. Second, death from any cause may be related to the presence of other sources of morbidity and it is not always easy to separate simultaneous morbidity processes. In retrospect, differences between socio-economic groups were generally consistent irrespective of cause of death examined.

Figure 2.10 Proportion of cases dying from causes other than cancer for both sexes by prognosis of the cancer



Concluding remarks

Problems with the accuracy of registration data collected by the NCRS were identified especially with cases that have the same date of registration and death. These cases accounted for 6.5 per cent of all registrations and could have affected estimation of case-fatality rates. Higher proportions of such cases were found for cancers of poor prognosis and for older ages. However, very similar proportions of those cases were found for major socio-economic groups and for grouped geographical regions. It is, therefore, unlikely that registration problems have biased calculated survival differentials.

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3 Statistical analysis

Techniques used for the statistical analysis are described and evaluated in this chapter. Cohort analysis methods have been applied to both incidence and survival data. For reasons of confidentiality, all analyses were based on grouped data. Denominators for incidence and case-fatality rates were based on calculation of person-years at risk for each individual in the LS population. As each individual grew older, he/she contributed person-years at risk in different cells of age and calendar year. A Lexis diagram showing how person-years were calculated for a member of the study is shown in Figure 3.1.' In the incidence analysis, each individual contributed person-years at risk until registration with a cancer or until withdrawal from the study (death, embarkation, or end of the follow-up at 1981 census day, 5 April 1981). In the survival analysis, LS members registered with a cancer after the 1971 Census, contributed person-years at risk from the time of registration until date of death from any cause, or until the end of mortality follow-up at 31 December 1983.

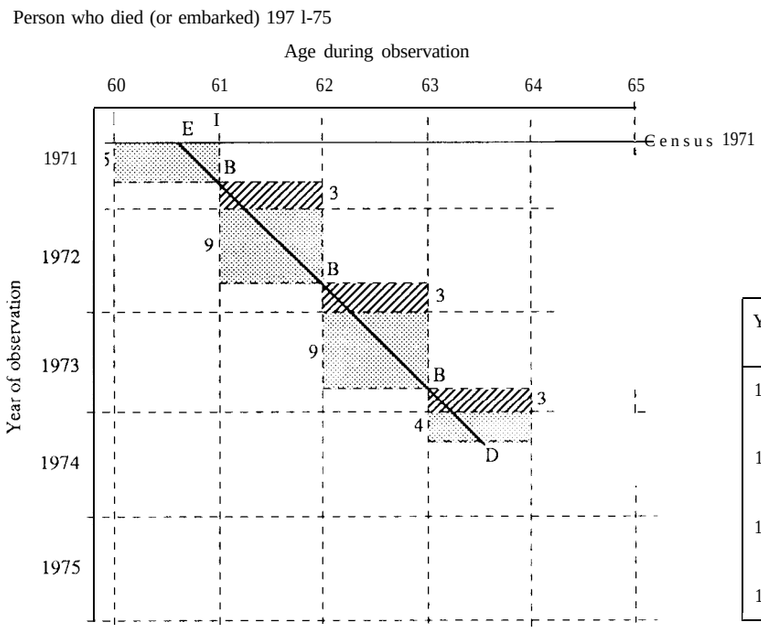
3.1 Indirect standardisation and parametric survival distributions

Indirect methods of standardisation were used. Standardised incidence ratios (SIR) and standardised case-fatality ratios (SFR) were calculated for incidence and survival data respectively. For the incidence data, the whole LS population provided the age-specific standard rates, for each sex separately. SIRs were calculated for each year of registration, for two periods (1971-75, 1976-81) and for the full study period. Following the notation used in the first LS report,' if the observed cases in group h at age i in the yearj are represented by $o(h,i,j)$ and the person-year at risk by $p(h,i,j)$ then the corresponding expected deaths $e(h,i,j)$ are calculated as

$$e(h,i,j) = p(h,i,j) \quad * \frac{d(s,i,j)}{p(s,i,j)} \qquad (3.1)$$

where s is the standard group with which comparison is to be made. For the full study period, an aggregate

Figure 3.1 Illustration of contribution to person-years-at risk



Year	Age-group	Person-years-at-risk
1971	60	5 months
	61	3 months
1972	61	9 months
	62	3 months
1973	62	9 months
	63	3 months
1974	63	4 months

E = Entry date (25th April 1971) and age on entry
B = Birthdays
D = Date of death (embarkation) and age at death (embarkation)
Period at risk in younger age-group in each calendar year
Period at nsk in older age-group in each calendar year

incidence rate for the standard group is used to calculate expected values for each subgroup. Exact Poisson 95 per cent confidence intervals were estimated for standardised ratios using computerised tables.

In the survival data, the SFRs were calculated by using the case-fatality rates of the whole LS population for the cancer in question. For example, for oesophageal cancer in men, the standard case-fatality rates would be the age-specific rates of all men with this cancer in the LS. It should be noted that ***high*** SFRs correspond to low survival. Apart from age, standardisation in the survival analysis was carried out for year of registration and period of follow-up as well. Comparisons of SFRs between socio-economic groups can therefore be made for specific age-groups, separate years of registration, or specific periods of follow-up, for example the first year after diagnosis.

A significant advantage of standardising both for age and period of follow-up is that SFRs are unbiased summary estimates of survival differences, irrespective of possible differing time trends in incidence of the compared groups and irrespective of the distribution of case-fatality rates. Figure 3.2 shows incidence patterns for ovarian cancer for owner occupiers and council tenants in two five-year periods. It can be seen that proportionally more council tenants than owner occupiers were registered with cancer towards the end of the study period. Case-fatality rates for LS members of these two housing tenure groups registered with ovarian cancer are shown in Figure 3.3 as calculated from a life-table analysis. Even if there were no real differences in survival between housing tenure groups, SFRs would possibly be found to differ. This would happen because, on the one hand, the distribution of case-fatality rates is not exponential, and also, because proportionally more council tenants would be followed for a short period of time during which case-fatality rates are very high. Table 3.1 gives examples of SFRs based only on age standardisation and those calculated after also taking into account period of follow-up. Differences between the two estimates varied between sites, but generally they were small. However, disparities between the two estimates were wide for a number of sites, most of which are presented in Table 3.1. The magnitude of the differences in SFRs was determined by two factors: the existence of significant time trends in incidence and the deviation of case-fatality rates from the exponential distribution. Standardising both for age and for period of follow-up overcomes an unwanted bias and was, therefore, applied generally to the data.

This method of comparing survival differences, adjusting for age and period of follow-up, has not been used elsewhere and was therefore validated using more complex statistical techniques. An exponential distribution did not fit any site well, but for most sites plotting the log(−log(survival function)) against log time produced a straight line, suggesting that a Weibull distribution would provide a good fit to the data.[2] The Weibull distribution is defined by a shape parameter, *p*,

Figure 3.2 Time trends in incidence for ovarian cancer by housing tenure, 1971-81

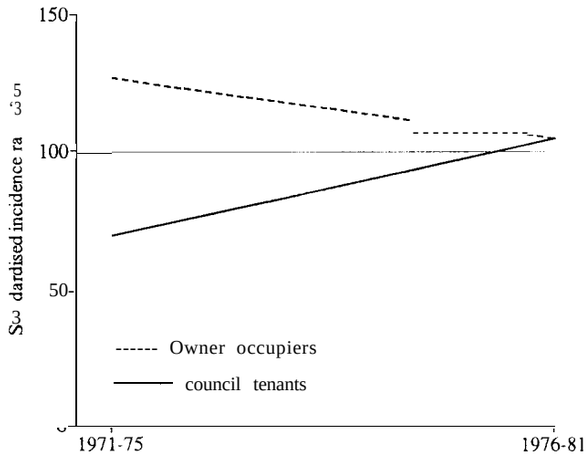


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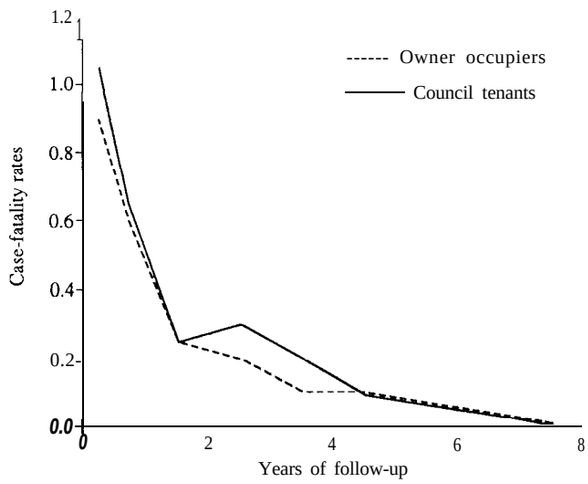
Figure 3.3 Case-fatality for ovarian cancer by period of follow-up and housing tenure*



*Hazard rate from life-table analysis

Table 3.1 Standardised case-fatality ratios (SFR) for selected cancers based on standardisation for age or alternatively, on standardisation for age and period of follow-up, by housing tenure

Cancer site	Standardised variable	Owner occupiers SFR	Council tenants SFR	Ratio of SFRs
Men				
Colon	Age	84	155	1.85
	Age + follow-up	89	128	1.44
Bladder	Age	91	114	1.25
	Age + follow-up	91	111	1.22
Women				
Pancreas	Age	91	248	2.72
	Age + follow-up	96	145	1.51
Cervix	Age	101	92	0.91
	Age + follow-up	95	97	1.01
Ovary	Age	88	116	1.32
	Age + follow-up	94	107	1.19

j-Council tenants versus owner occupiers.

and a scale parameter, d. The hazard rate of the distribution is defined as

$$h(t) = pd(pt)^{(d-1)} \qquad (3.2)$$

Aitkin and Clayton[3] have described fitting regression models to censored survival data using GLIM. Clayton[4] describes a general family of failure-time distributions using GLIM. A special case of the general model he proposes is the Weibull distribution with the log of the hazard rate being defined as

$$\log\{h(t)\} = \mu + \beta\log(t) \qquad (3.3)$$

Other distributions (Gompertz, Pareto) can also be easily applied and were used for few cancer sites for which the Weibull distribution did not provide a good fit.

Ratios of SFRs based on standardisation for age and period of follow-up, correspond well with the case-fatality rate ratios estimated from the survival models (Table 3.2). In contrast, SFRs based only on age standardisation are shown to be clearly biased for some sites, for example pancreas and cervix in women, colon in men. It should be mentioned that when fitting the models the data-set used was stratified only by period of follow-up and ***not*** by age. This could account for the minor discrepancies found between the rate ratios and the SFRs based on the double standardisation. Only for bladder cancer in men and cervical cancer in women was data reanalysed stratifying also by age (three age-groups for bladder, four age-groups for cervical cancer).

Table 3.2 Case-fatality rate ratios for selected cancers applying the Weibull or other survival distributions, by housing tenure†

Cancer site	Variables in the model	Rate ratio	Scaled deviance	Degrees of freedom
Men				
Colon	Housing tenure	1.48	*5.69*	11
Bladder	Age + housing tenure	1.24	*37.94*	*37*
Women				
Pancreas‡	Housing tenure	1.61	5.93	*8*
Cervix0	Age + housing tenure	0.99	52.19	*40*
Ovary	Housing tenure	1.18	*7.82*	11

-j-Council tenants versus owner occupiers.
‡ The Gompertz distribution provided the best fit.
ø A variation of the Compertz distribution provided the best fit.

When testing the statistical significance of a standardised ratio, a simple chi-square statistic was calculated when the standardised ratio was based on more than 15 observations. For smaller numbers, a very accurate approximation to the exact Poisson test was used as proposed by Byar (cited in Breslow & Day 1988[5]). A simple chi-square statistic can be used when testing for heterogeneity of standardised ratios of groups:

$$\chi^2 = \sum_{h=1}^{H} \frac{(O_h - E_h)^2}{E_h} \qquad (3.4)$$

If H groups are compared, then the chi-square is evaluated on H- 1 degrees of freedom. Kilpatrick's technique[6] has been used when tests of heterogeneity of standardised ratios are applied to strata of a subgroup of the LS population, for example testing differences between social classes among married women as contrasted to testing social class differences among all women. On these occasions, expected values E_{jh} of each stratum j are adjusted by the overall standardised ratio (SR_h) of the subgroup h and a new adjusted expected Value $E_{jh} = SR_h * E_{jh}$ is calculated and applied to equation (3.4). In the example mentioned above, SR_h would be the standardised ratio for all married women and E_{jh} the expected value for those married women in Social Class j.

A disadvantage of the test for heterogeneity of standardised ratios is its lack of power to detect a trend. Even if the test for heterogeneity is non-significant, gradually changing standardised ratios with increasing levels of exposure (or ordered categories) might be evident (see, for example, social class differences in incidence for 'all neoplasms except lung cancer', section 4.2). To test this alternative hypothesis of a trend in standardised ratios, a chi-square statistic with one degree of freedom can be calculated.[5] A score is defined for each level of exposure, or, as is more frequently the case in these analyses, for ordered socio-economic categories.

3.2 Poisson regression analysis

An underlying assumption for the use of indirect standardisation is that age-specific rates for the study groups differ from the standard rates by a proportion which is constant with age. Error may also occur if the age distribution of the compared populations is diverse. Some of the socio-economic classifications used separate the population into groups with very different age distributions, for example marital status, or economic position. On these occasions (and in most major socio-economic classifications) an additional, more accurate, statistical analysis was carried out using Poisson regression? It should be mentioned that very few estimates of standardised ratios were found to be inaccurate. Even so, an important advantage was gained as the goodness of fit of the model was examined and an assessment of the adequacy of the variables (or socio-economic classifications) in explaining the variation of rates was made possible. A second advantage of model-fitting occurs when variables are cross-classified and the simultaneous effect of more than one variable is investigated.

The assumption underlying the use of Poisson regression is that the number of deaths are regarded as independent Poisson variables with mean values proportional to the corresponding expected numbers.' The mean values for the number of deaths in stratum ij are represented as

$$\log E(d_{ij}) = \log(n_{ij} * \alpha_j) + x_{ij} * \beta \qquad (3.5)$$

where α_j are the standard rates, n_{ij} the person-year at risk in stratum ij, and β the regression coefficient. Poisson regression models can be easily fitted with the

statistical package GLIM.[8] In a GLIM analysis, the log expected deaths as found from the standardisation, $\log(n_{ij} * \alpha_j)$, are declared as an OFFSET. The exponent of the regression coefficient represents the relative risk. In analyses of subgroups of the population, for example, married women as opposed to all women, the grand mean of the GLIM model represents the log relative risk of the whole subgroup.

Overall measures of fit for a model can be found by comparing the deviance as given in GLIM, to the degrees of freedom left after the fit of the model. The deviance is approximately distributed as a chi-square statistic and when it substantially exceeds the mean of the distribution (which is approximately equal to the degrees of freedom) the model is regarded as giving a poor fit to the data. An estimate of the significance of added variables can be found by comparing the deviances before and after including the variable in question in the model. Differences of deviances may be treated as approximating a chi-square statistic.[5] Estimation of the significance of specific regression co-efficients (β) can be found by comparing the co-efficient to its standard error.

3.3 Life-table analysis

Many studies on cancer survival differentials provide only the five-year crude or relative survival rate. A life-table analysis was done using the SAS LIFETEST procedure,[9] and for reasons of comparability with other studies, five-year rates are also presented.

Measuring the magnitude of survival differences between socio-economic groups in terms of *person time gained* (or lost), provides another view of these differences. Median survival time by housing tenure and sex was, therefore, derived from the life-table analysis. For most cancers, especially those of poor or medium prognosis, median survival approximates to mean survival. Consequently differences in median survival between socio-economic groups express survival differentials in a time dimension, rather than as a difference in proportions (e.g. five-year rates) or as a relative value (e.g. SFRs or rate ratios).

Calculating the mean survival time for each socio-economic group would be preferable, but it implies fitting a parametric survival distribution which additionally should have an identifiable mean value. Mean survival time was calculated only for a few cancers using the Weibull distribution.[10] One problem in these calculations is associated with the very long right hand tail of many survival distributions, including the Weibull. This resulted in unrealistic estimates of mean survival for those cancer sites with good prognosis, for example corpus uteri, which are the sites of principal interest for these calculations.

It should be mentioned that the life-table analysis is carried out for all ages and could possibly provide misleading estimates for cancer sites such as cervical or breast cancer, for which not only the age distribution of cases differed but also survival diffentials varied by age.

Concluding remarks

The methods of cohort analysis applied (indirect standardisation, Poisson regression, parametric survival distributions, and life-table analysis) are described and reasons for selecting them discussed. Indirect standardisation was chosen as the principal method for the survival analysis, standardising both for *age andperiod* of *follow-up*. Survival estimates based on this method were evaluated applying more accurate but complex methods of survival analysis; they were shown to be more precise than survival estimates based on classical indirect standardisation, that is, adjusting only for age.

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4 Socio-economic differences in cancer incidence

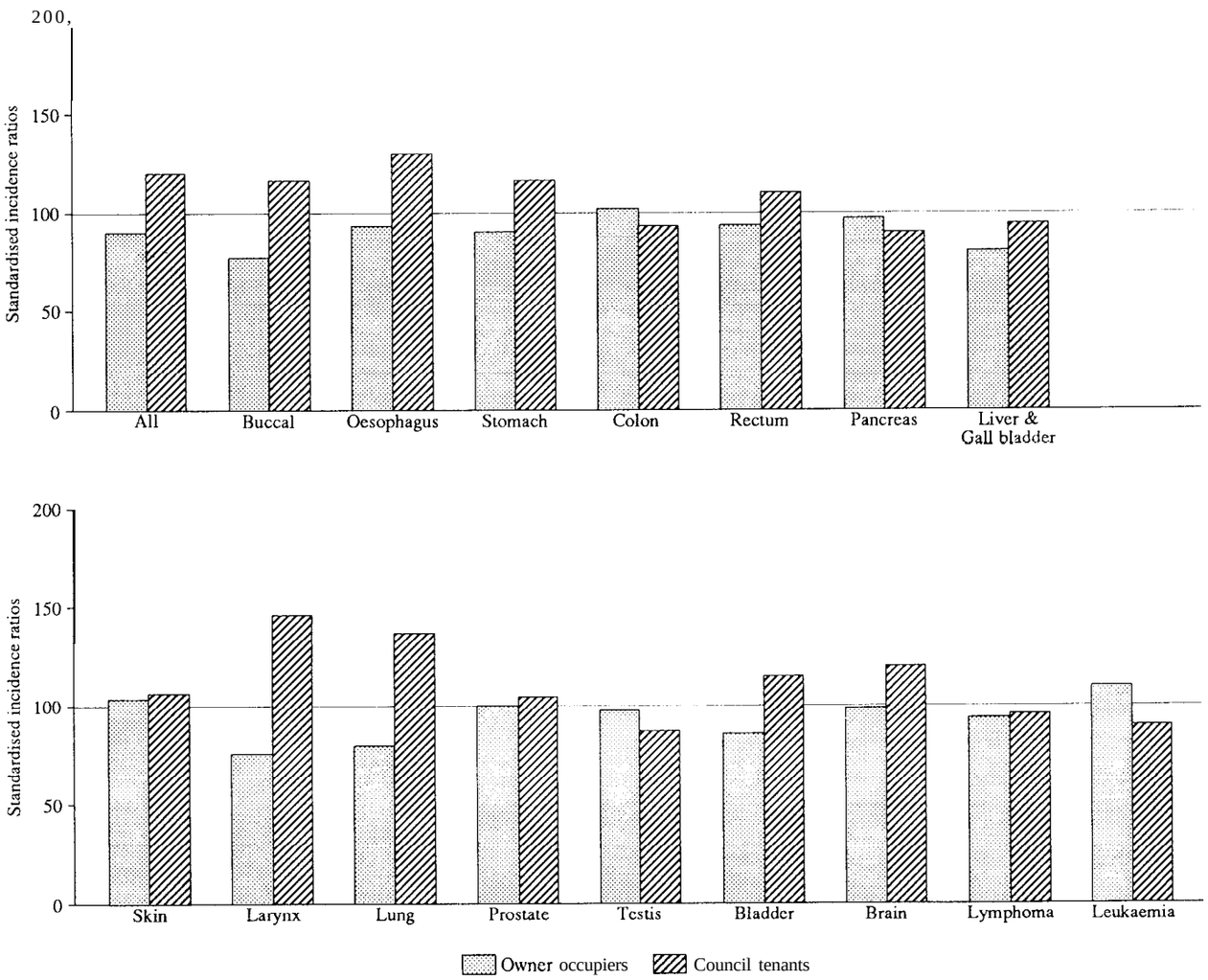
This chapter considers the relationship between socio-economic factors and cancer incidence for the period 1971-81, extending by five more years of follow-up a previous report .[2] Different socio-economic classifications (housing tenure, social class, husband's social class for married women, economic position, marital status, and region of residence) are used. Incidence differences between socio-economic groups are associated with differential exposure to risk factors. In order to identify whether underlying socio-economic differences accounted for variation in incidence between marital status and geographic region, these two variables were analysed by social class and housing tenure. Finally, time trends in incidence differentials are considered for the period 197 l-8 1.

4.1 Housing tenure

Large differences by housing tenure were observed in the occurrence of all neoplasms for both men (Table 4.1) and women (Table 4.2). In both sexes, council tenants had the highest rates (SIR= 116 for men and SIR = 105 for women). Much of the difference was due to lung cancer but even when this site was excluded, differences persisted.

In men, the widest differences between owner occupiers and council tenants were seen in cancers that have been associated with smoking, principally lung and laryngeal cancer, but also cancers of the buccal cavity, oesophagus and bladder (Table 4.1 and Figure 4.1). SIRs for cancer of the stomach differed significantly,

Figure 4.1 Cancer incidence in men by housing tenure, 1971-81



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with the risk increasing from owner occupiers (SIR = 89) to council tenants (SIR = 114). Increased incidence for cancers of the liver and gallbladder was observed for men living in private rented accommodation (SIR = 157). Owner occupiers had the highest incidence only for leukaemias and cancers of the kidney and pelvis, but in both cases 95 per cent confidence limits for SIRs included unity.

The widest differences in women were observed for cancers of the cervix uterus (both invasive and in situ). Council tenants had SIRs of 134 for invasive and 158 for in situ while SIRs for owner occupiers were 72 and 68 respectively (Table 4.2 and Figure 4.2). Among smoking related cancers, the biggest differences were found for lung and oesophageal cancer, but SIRs differed significantly only in the former. Differences in stomach cancer were also pronounced with council tenants having increased incidence (SIR = 124). Owner occupiers had increased SIRs for a number of sites (colon, other skin, breast, corpus uterus, ovaries, bladder, kidney and pelvis, brain), but only for ovarian cancer were differences between housing tenure groups significant (SIR for owner occupiers = 114).

Combined data for smoking related cancers (buccal cavity, larynx, oesophagus, pancreas, lung and bladder for men, and all the aforementioned sites apart from larynx for women) indicated that differences are wider for men, but owner occupiers had clearly the lowest incidence in both sexes (Table 4.3). Clearly, SIRs in this case are primarily affected by the patterns observed for lung cancer. Although smoking can be regarded as the most important factor for the occurrence of this difference, part of it would clearly be caused by occupational risk factors (mainly for lung and bladder cancer) and by alcohol consumption (for cancers of the buccal cavity, oesophagus and larynx).' Cancers of the buccal cavity, larynx, oesophagus, and liver are related to alcohol consumption. Incidence of alcohol related cancers was much lower for owner occupiers (SIR = 81) than for the two other housing tenure groups (Table 4.4).

In men, the widest differences in the occurrence of neoplasms are seen in the ages 45 to 64, but differences persist in older ages (Figure 4.3). Lung, stomach and bladder cancer are the three most important sites contributing to the differentials at ages under 65. Over the age of 65, differences remain wide only for the two first sites. In women, differentials are widest in younger age-groups and get narrower by age (Figure 4.4). Most of the excess in incidence of young council tenants is due to cancers of the cervix and lung and to the lymphomas, while in older women differences are mainly due to lung and stomach cancer. Wide differences persist at all ages for invasive cervical cancer but are less important at older ages because of the decrease in incidence of this cancer with age.

Cancer incidence differentials found in this analysis were in most cases similar to those reported earlier, for

Table 4.1 Standardised incidence ratios (SIR) for men, by housing tenure, 1971-81

Cancer site		Owner occupiers	Council tenants	Private rented	χ^2
All neoplasms	**Obs**	4,284	2,882	**1,805**	**127.80****
	Exp	**4,801.1**	**2,479.9**	**1,697.3**	
	SIR	89	116	**106**	
Buccal cavity	Obs	71	54	41	8.39*
	Exp	91.7	47.5	31.7	
	SIR	77	114	129	
Oesophagus	Obs	90	65	27	6.84*
	Exp	98.2	49.8	34.2	
	SIR	92	131	79	
Stomach	Obs	357	235	156	10.38**
	Exp	401.0	205.4	142.5	
	SIR	89	114	109	
Colorectal	Obs	524	275	203	1.09
	Exp	538.6	272.1	191.7	
	SIR	97	101	106	
Colon	Obs	289	134	108	1.13
	Exp	286.6	144.4	101.9	
	SIR	101	93	106	
Rectum	Obs	235	141	95	2.82
	Exp	252.0	127.7	89.8	
	SIR	93	110	106	
Pancreas	Obs	137	64	59	2.63
	Exp	141.3	72.2	50.1	
	SIR	97	89	118	
Liver and gallbladder	Obs	42	25	30	8.66*
	Exp	52.9	26.5	19.1	
	SIR	79	94	157	
Larynx	Obs	45	49	25	12.31**
	Exp	62.7	33.7	21.9	
	SIR	72	145	114	
Lung	Obs	1,062	1,016	574	201.23**
	Exp	1,408.1	737.4	498.1	
	SIR	75	138	116	
Other **skin**	Obs	529	284	149	3.99
	Exp	517.4	268.2	171.1	
	SIR	102	106	87	
Prostate	Obs	380	185	132	0.65
	Exp	379.4	178.4	139.5	
	SIR	100	104	95	
Bladder	Obs	278	185	122	9.05*
	Exp	311.6	158.8	110.5	
	SIR	89	116	110	
Kidney and pelvis	Obs	72	37	24	0.04
	Exp	70.0	37.4	23.8	
	SIR	103	99	88	
Testis	Obs	41	22	19	1.44
	Exp	41.9	24.2	14.7	
	SIR	98	91	129	
Brain	Obs	65	46	17	2.59
	Exp	65.5	38.0	21.7	
	SIR	99	121	78	
Lymphomas	Obs	114	68	42	0.21
	Exp	119.7	66.8	41.9	
	SIR	95	102	100	
Leukaemias	Obs	103	44	25	3.54
	Exp	93.2	49.5	32.9	
	SIR	111	89	76	
All neoplasms except lung	Obs	3,222	1,866	1,231	18.21**
	Exp	3,393.0	1,742.5	1,199.2	
	SIR	95	107	103	

*$0.01 < p < 0.025$
**$p < 0.01$

Table 4.2 Standardised incidence ratios (SIR) for women, by housing tenure, 1971-81

Cancer site		Owner occupiers	Council tenants	Private rented	χ^2
All neoplasms	**Obs**	4,320	2,504	1,607	**8.50***
	Exp	**4,391.8**	2,386.0	**1,656.7**	
	SIR	97	105	97	
Buccal cavity	Obs	49	27	21	0.18
	Exp	50.5	27.6	19.5	
	SIR	97	98	108	
Oesophagus	Obs	67	45	33	1.82
	Exp	74.3	39.4	29.8	
	SIR	90	114	111	
Stomach	Obs	223	157	93	8.85*
	Exp	242.4	127.1	99.2	
	SIR	92	124	94	
Colorectal	Obs	578	302	210	1.35
	Exp	564.9	298.5	225.1	
	SIR	102	101	93	
Colon	Obs	387	197	140	0.39
	Exp	319.9	200.6	151.4	
	SIR	102	98	96	
Rectum	Obs	191	105	64	1.94
	Exp	185.0	97.9	73.1	
	SIR	103	107	87	
Pancreas	Obs	116	45	51	4.07
	Exp	111.9	58.7	45.3	
	SIR	104	77	113	
Lung	Obs	304	246	153	22.36**
	Exp	366.2	200.9	138.1	
	SIR	83	122	111	
Malignant melanoma	Obs	49	32	9	4.14
	Exp	48.0	26.4	15.8	
	SIR	102	121	57	
Other skin	**Obs**	441	224	147	2.72
	Exp	418.5	223.6	163.1	
	SIR	105	100	90	
Breast	Obs	1,074	571	348	2.38
	Exp	1,053.0	577.1	375.1	
	SIR	102	99	93	
Cervix uteri	Obs	133	140	79	30.60**
	Exp	184.6	104.3	63.2	
	SIR	72	134	125	
Cervix in situ	Obs	120	147	62	47.28**
	Exp	172.9	93.0	61.3	
	SIR	69	158	101	
Corpus uteri	Obs	183	94	53	2.59
	Exp	170.6	94.6	63.4	
	SIR	107	99	84	
Ovary	Obs	243	105	62	8.66*
	Exp	213.1	120.0	76.1	
	SIR	114	88	81	
Bladder	Obs	110	57	43	0.04
	Exp	108.8	58.1	43.3	
	SIR	101	98	99	
Brain	Obs	53	25	18	0.60
	Exp	49.4	28.1	17.6	
	SIR	107	89	102	
Lymphomas	Obs	88	57	32	0.72
	Exp	92.2	52.4	34.1	
	SIR	95	109	94	
Leukaemias	Obs	90	43	36	0.62
	Exp	89.5	48.3	34.3	
	SIR	101	89	105	
All neoplasms except lung	Obs	4,016	2,258	1,454	5.20
	Exp	4,025.6	2,185.1	1,518.6	
	SIR	100	103	96	

*$0.01 < p < 0.025$
**$p < 0.01$

Table 4.3 Incidence of smoking related cancers in men and women by housing tenure†

	Owner occupiers	Private rented	Council tenants
Men			
Observed	1,683	848	1,433
Expected	2,121.9	746.5	1,098.7
SIR	79	114	130
Women			
Observed	646	301	420
Expected	712	275.7	385.5
SIR	91	109	109

†*In men, cancers of the buccal cavity, larynx, oesophagus, pancreas, lung and bladder are included. In women, data was available for all the above apart from larynx.*

Table 4.4 Incidence of alcohol related cancers in men by housing tenure?

	Owner occupiers	Private rented	Council tenants
Observed	248	193	123
Expected	305.1	157.3	106.9
SIR	81	123	115

†*Cancers of the buccal cavity, larynx, oesophagus, liver and gallbladder are included.*

the five-year follow-up period 1971–75.[2] The number of cases was approximately double for the ten-year follow-up and therefore a larger number of sites could be analysed. For the same reason, significant results were obtained in some cases only in the ten-year data, for example all neoplasms in women, stomach cancer in both sexes (see Tables 4.1 and 4.2 in this volume and Tables 6.4 and 6.5 in the third LS report).[2]

4.2 Social class

4.2.1 Men

A clear, increasing trend from Social Class I to Social Class V was observed in the incidence of all neoplasms (Table 4.5 and Figure 4.5). Lung cancer differences were even more pronounced, with men in Social Class V having approximately 2.5 times the rate of those in Social Class I. Indeed, most of the difference between social classes for all neoplasms can be ascribed to lung cancer. Differences for all other cancers combined are still apparent but very much reduced and a test for heterogeneity of SIRs for all neoplasms except lung cancer, was not significant ($\chi^2 = 5.67$ with 5 degrees of freedom, p-value = 0.34). A disadvantage of this test is that it lacks the power to assess the existence of a trend in SIRs. However, a gradual increase of SIRs from Social Class I to Social Class V is obvious (Figure 4.5) and a test for trend was significant ($\chi^2 = 5.07$, *p*-value = 0.024). For this analysis a score, from one to six, was defined for each social class. In an alternative analysis for trend by social class, the percentage of the population in each social class was used as a weight in the regression. This method should provide very similar results to a method proposed by Pamuk.[3] This analysis was done for all neoplasms, lung cancer, and all neoplasms except lung cancer. The same results (with only small changes in the levels of significance), were reached with both methods (not shown).

Figure 4.2 Cancer incidence in women, by housing tenure, 1971-81

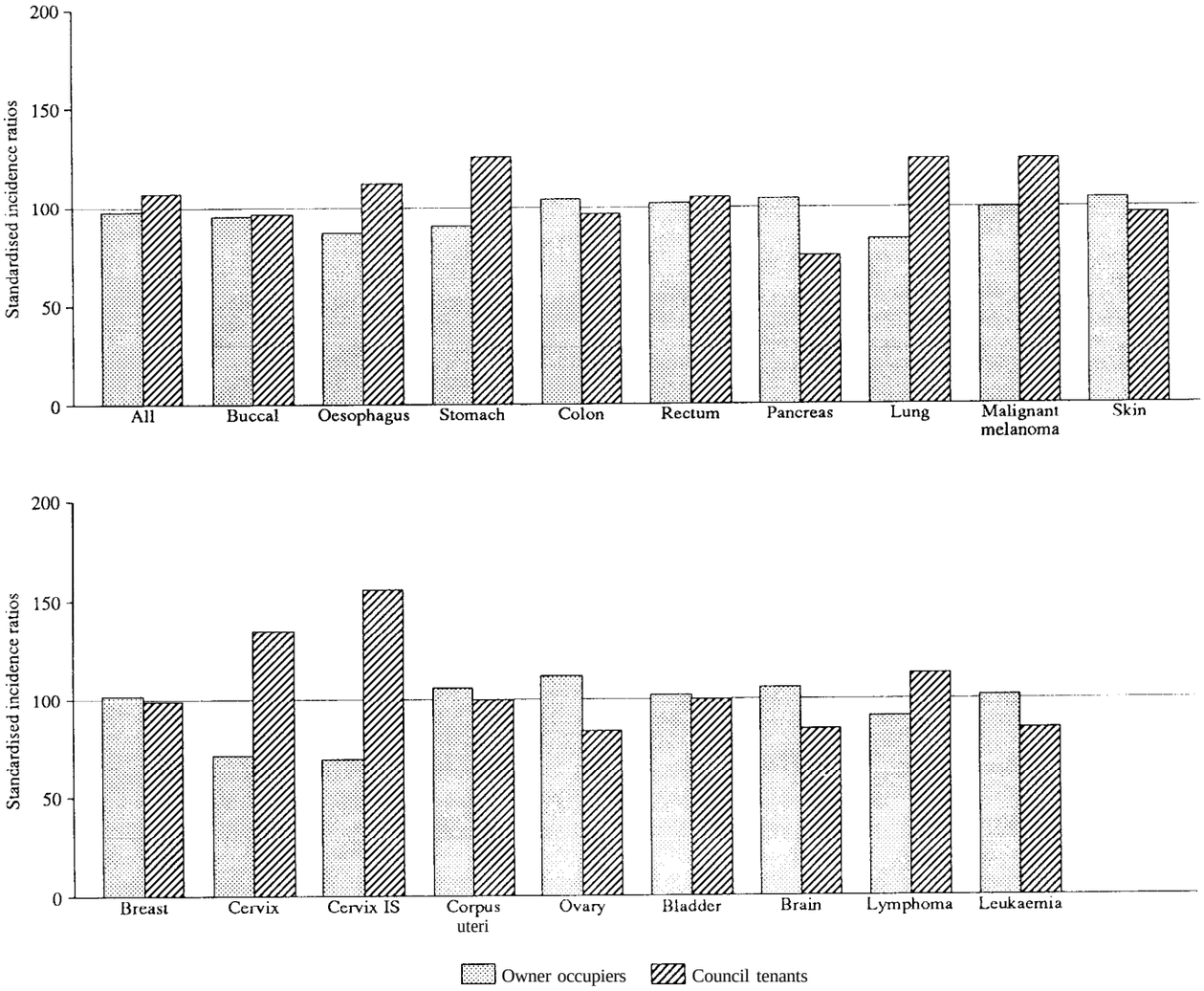

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Figure 4.3 Incidence of all neoplasms in men by age and housing tenure, 1971-81

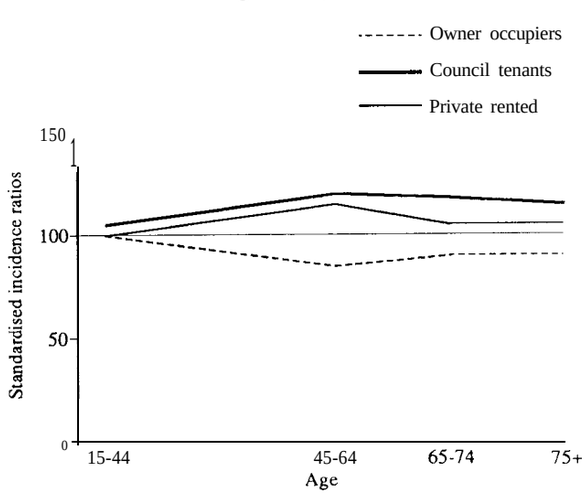


Figure 4.4 Incidence of all neoplasms for women by age and housing tenure, 1971-81

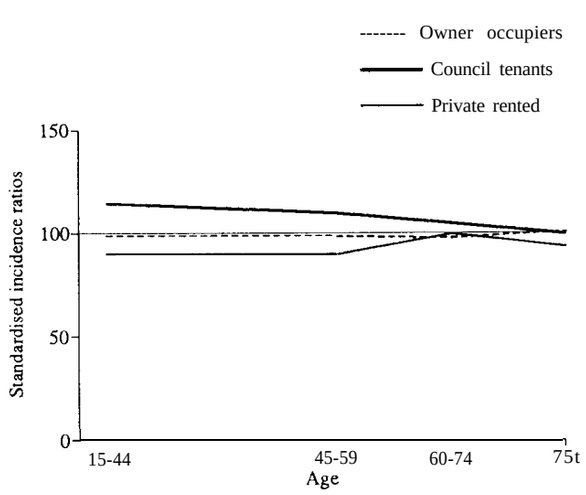


Figure 4.5 Incidence of all neoplasms, lung cancer and all other neoplasms for men by social class, 1971-81

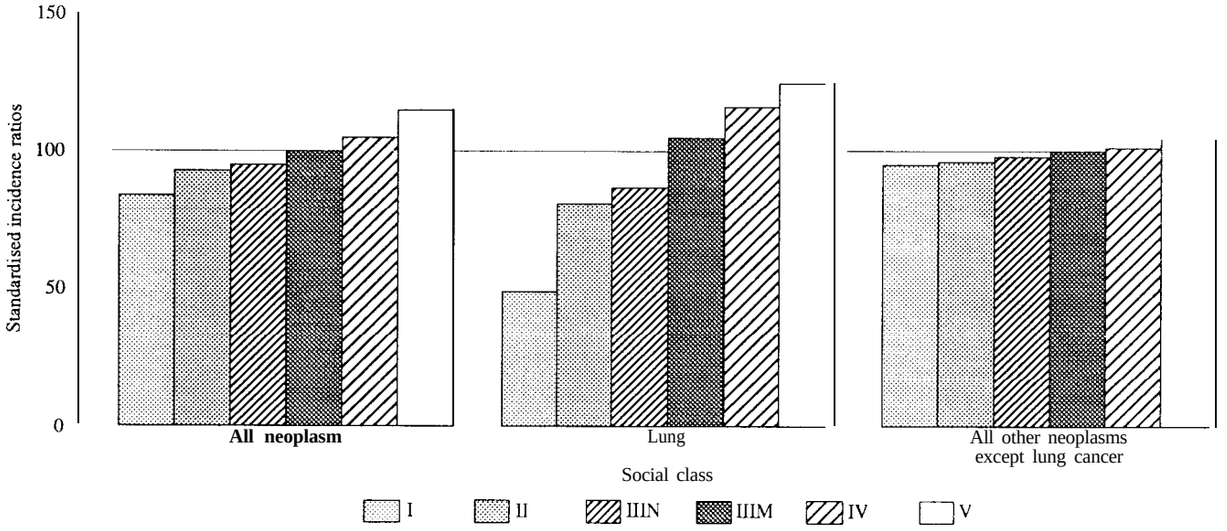


Table 4.5 Standardised incidence ratios (SIR) for men by social class, for all neoplasms and lung cancer, 1971-81

Social class		All neoplasms	Lung cancer	All neoplasms except lung
I	Obs	274	48	226
	Exp	340.3	99.5	240.8
	SIR	81	48	94
II	Obs	1,501	383	1,118
	Exp	1,659.6	494.9	1,164.7
	SIR	90	77	96
III NM	Obs	925	250	675
	Exp	988.3	291.9	696.4
	SIR	94	86	97
III M	Obs	2,880	888	1,992
	Exp	2,841	844.2	1,996.8
	SIR	101	105	100
IV	Obs	1,761	584	1,177
	Exp	1,674	504.4	1,169.6
	SIR	105	116	101
V	Obs	936	313	623
	Exp	837.8	252.6	585.2
	SIR	112	124	106
Armed forces	Obs	22	2	20
	Exp	31.1	7.3	23.8
	SIR	71	27	84
Inadequately described	Obs	586	160	426
	Exp	555.6	147.8	407.8
	SIR	105	108	104
Unoccupied	Obs	251	75	176
	Exp	208.4	60.3	148.1
	SIR	120	124	119
χ^2 heter. with 5 degrees of freedom		48.58 $p < 0.001$	59.63 $p < 0.001$	5.67 $p = 0.34$
χ^2 for trend with 1 degree of freedom		47.49 $p < 0.001$	53.78 $p < 0.001$	5.07 $p = 0.024$

Chi-squares are calculated only for the six social classes.

The lack of any pronounced differences in all neoplasms except lung cancer does not indicate that differences in incidence among social classes should not be expected for specific cancers. Differences for cancer of the stomach were as pronounced as those found for lung cancer, with SIRs ranging from a low of 21 for Social Class I to a high of 133 for Social Class V. A test for trend in SIRs was highly significant. Of all other sites examined, differences between non-manual and manual social classes were significant for cancer of the rectum and cancer of the bladder. For the latter, increased incidence of manual social classes was primarily due to the high incidence rates of men in Social Class III Manual (Table 4.6, Appendix Table 4.1).

As for housing tenure, differences in incidence of all neoplasms and of lung cancer were more pronounced in men for ages 45-64 (Figure 4.6). In men aged 15-44, there were no apparent differences for all neoplasms between the non-manual and manual social classes, and, even for lung cancer, differences in this age-group although apparent, were not as wide as in all other ages.

4.2.2 Women

Incidence of all neoplasms did not vary much between social classes. Women in manual occupations had an incidence rate ratio of 1.06 compared to women in non-manual occupations, but differences were not significant (Table 4.7). Within age-groups, SIRs for non-manual and manual social classes and for those unoccupied remained fairly constant (Figure 4.7).

Women in manual occupations had higher incidence rates than those in non-manual occupations for all specific cancers examined except breast cancer; but only for cervical cancer were differences statistically significant (Table 4.7). A similar pattern was seen when analysis was confined to married women classified by their own social class (Table 4.8). Married women with husbands in a manual social class had higher rates for

Table 4.6 Standardised incidence ratios (SIR) for men by grouped social class, 1971-81

Cancer site		Non-manual	Manual	χ^2
All neoplasms	**Obs**	2,700	5,577	**36.97****
	Exp	**2,988.2**	**5,352.8**	
	SIR	90	104	
Stomach	Obs	196	502	18.07**
	Exp	250.7	449.7	
	SIR	78	112	
Colorectal	Obs	318	598	0.53
	Exp	334.5	597.9	
	SIR	95	100	
Colon	Obs	184	301	0.89
	Exp	177.5	317.2	
	SIR	104	95	
Rectum	Obs	134	297	4.28*
	Exp	157	280.7	
	SIR	85	106	
Lung	Obs	681	1,785	69.06**
	Exp	886.3	1,601.2	
	SIR	77	111	
Prostate	**Obs**	251	389	2.64
	Exp	228.5	403.9	
	SIR	110	96	
Bladder	Obs	164	169	5.96*
	Exp	194	347.3	
	SIR	85	106	

Chi-square calculated using Kilpatrick's technique.
$* = 0.01 < p < 0.05$
$** = p < 0.01$

all cancers examined, apart from ovarian cancer (Table 4.9). Adjustment for marital status of women did not modify considerably any of the results on social class differentials.

Classification by own social class includes those unoccupied, the majority of whom are housewives, and those with inadequately described occupations, a category which includes women selected for ill-health. Analysis was therefore limited to manual and non-manual social classes in order to see whether own social class or husband's social class could differentiate better the risk of cancer in *employed* women. This found no actual improvement in terms of statistical significance.

4.3 Economic position: men

Incidence rates for all neoplasms were higher in unemployed men (SIR = 129, 95% CL 114-145) than in employed men (SIR = 98, 95% CL 95-100) (Table 4.10, Figure 4.8). This excess was particularly high in ages 15-64 (Appendix Figure 4.1). For all specific cancers examined apart from cancer of the stomach, unemployed men had higher rates than employed men, although only for lung cancer were differences statistically significant (Table 4.10, Figure 4.8). Narrowing of incidence differences with age was evident for lung cancer, while for other cancer sites the number of cases among the unemployed were too small to allow a meaningful analysis by age or any other variable. Classification by economic position is to a large extent age dependent but the employed and unemployed have simi-

Figure 4.6 Incidence of all neoplasms and lung cancer for men by age and social class, 1971-81

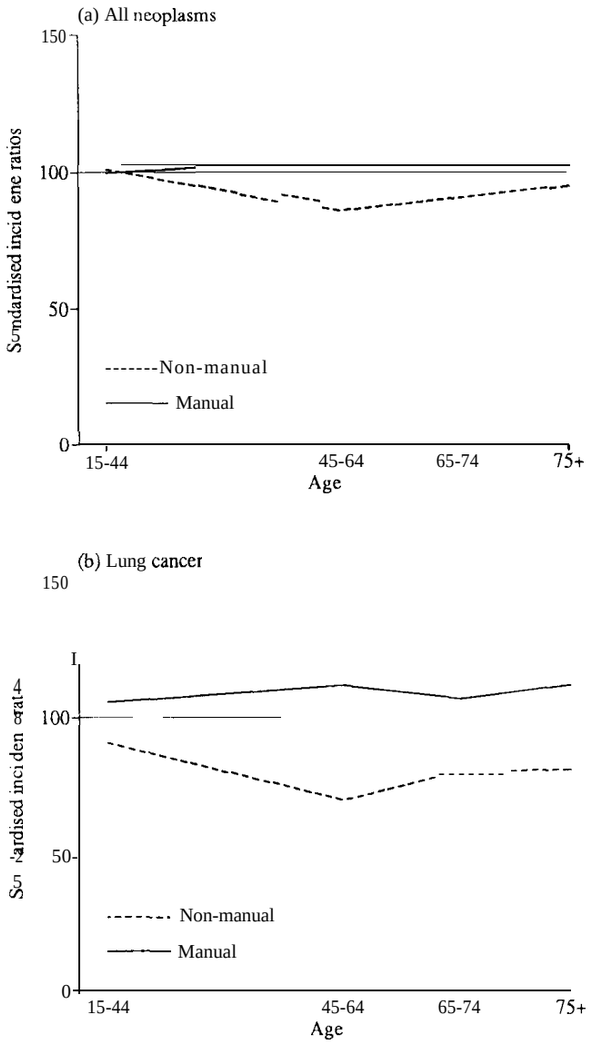


Figure 4.7 Incidence of all neoplasms for women by age and own social class, 1971-81

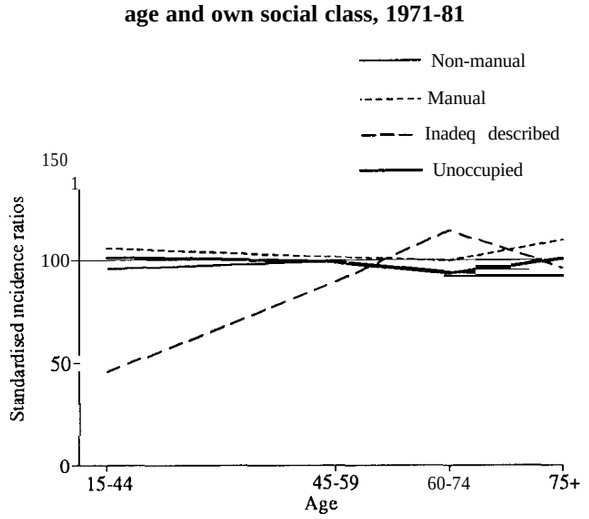


Table 4.7 Incidence rate ratios for women, by own social class, 1971–81†

Cancer	Non-manual*	Manual	Inadequately described	Unoccupied	χ^2
All neoplasms	1	**1.06 (0.99-1.14)**	**1.06 (0.99-1.14)**	**1.02 (0.96-1.08)**	5.4
Stomach	1	**1.29 (0.93-1.79)**	1.19 (0.89-1 .59)	1.02 (0.76-1.36)	4.7
Colon	1	1.05 (0X-1.36)	1.06 (0.85-1 .34)	1.09 (0.88-1.36)	0.6
Lung	1	1.1 (0.87–1.39)	1.17 (0.93-1 .47)	0.91 (0.74-1.12)	7.4
Breast	1	0.91 (0.80-1 .04)	0.88 (0.77-1 .01)	0.90 (0.81-1.01)	3.9
Cervix uteri	1	1.93 (1.40-2.65)	1.37 (0.91-2.05)	1.49 (1.11-2.02)	17.2*
Cervix in situ	1	1.93 (1 .43-2.61)	1.56 (0.83-2.93)	1.24 (0.94-1 .64)	19.5*
Ovary	1	1.07 (0.80-1 .44)	1.14 (0.84-1.55)	0.97 (0.75-I .27)	1.5

†*95% Confidence limits of rate ratios are given in brackets. Chi-square values for heterogeneity, with 3 degrees of freedom.*
**Non-manual is taken as the baseline group.*
** = p < 0.01.*

Table 4.8 Incidence rate ratios for married women, by own social class, 1971–81†

Cancer	Non-manual*	Manual	Inadequately described	Unoccupied	χ^2
All neoplasms	1	**1.06 (0.97-1.16)**	**1.10 (1.00-1.21)**	**1.02 (0.94-1.10)**	**5.1**
Stomach	1	1.05 (0.66-1 .65)	1.13 (0.74-I .71)	0.97 (0.66-1 .43)	0.9
Colon	1	1.10 (0.76-1 .60)	1.23 (0.86-1.76)	1.16 (0.85-1 .59)	1.5
Lung	1	1.17 (0.86-1.58)	1.17 (0.84-1.62)	0.98 (0.74-1 .28)	3.1
Breast	1	0.94 (0.80-1.11)	0.93 (0.76-1.13)	0.95 (0.83-1.09)	0.8
Cervix uteri	1	1.84 (1.27-2.66)	0.96 (0.52-I .75)	1.23 (0.87-1.75)	13.8**
Cervix in situ	1	1.73 (1.21-2.49)	1.58 (0.75-3.34)	1.12 (0.81-1.55)	11.1*
Ovary	1	1.17 (0.80-1.72)	1.33 (0.86-2.06)	1.11 (0.79-1 .56)	1.8

†*95% confidence limits of the rate ratios are given in brackets. Chi-square values for heterogeneity, with 3 degrees of freedom,*
**Non-manual is taken as the baseline group in all sites.*
** = 0.01 < p < 0.05 and ** = p < 0.01.*

lar age structures. Poisson regression was carried out taking into account age and year of registration and did not reveal any bias in the estimation of a summary measure of risk (SIR) for the two main groups of interest, that is, the employed and unemployed.

In previous analyses of mortality data from the LS,[4] it was postulated that if high mortality in the unemployed was due only to initial health selection then differentials would narrow with time.

Differences in incidence of all neoplasms widened with time between employed and unemployed men (Table 4.11). SIRs for the unemployed are clearly higher than those of the employed in most individual years of follow-up, and plotting the SIRs of the unemployed by individual years (Figure 4.9) indicates that a U shaped curve seems to fit SIRs for all neoplasms. There is an initial decrease of the risk and after levelling out a subsequent increase. The most significant part of the excess among unemployed occurred in the last period of

Figure 4.8 Incidence in employed and unemployed men, 1971-81

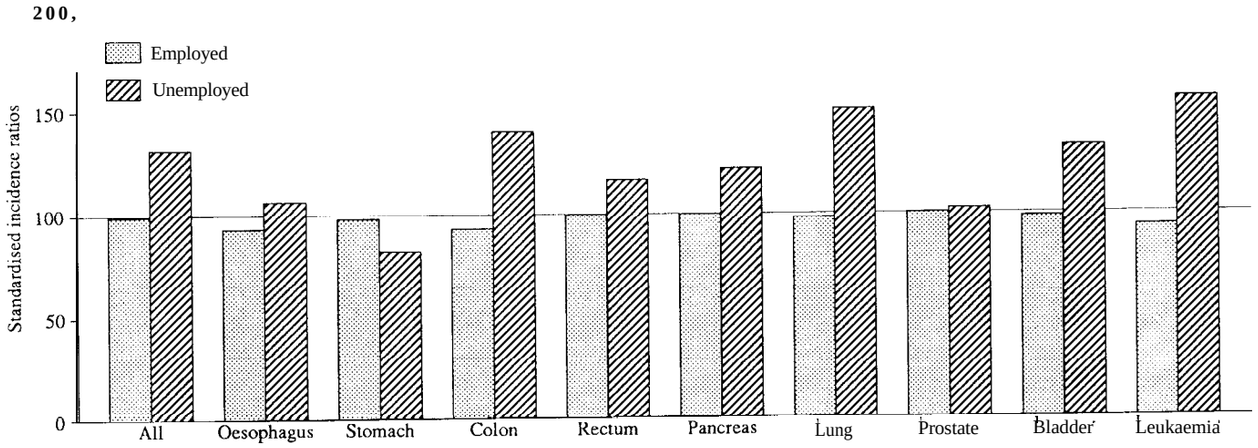


Table 4.9 Incidence rate ratios for married women, by husband's social class, 1971–81†

Cancer	Non-manual*	Manual	Other	χ^2
All neoplasms	1	**1.04 (0.98-1.10)**	**1.13 (1.01-1.27)**	**4.89**
Stomach	1	1.72 (1.28–2.30)	1.83 (1.16-2.87)	15.58*
Colon	1	1.04 (0.84-1.30)	1.08 (0.72-1 .60)	0.21
Lung	1	1.10 (0.90-1.35)	1.31 (0.90-1 .90)	2.14
Breast	1	1.03 (0.92-1.15)	1.15 (0.91-1.45)	1.41
Cervix uteri	1	1.29 (0.98–1.69)	1.72 (1 .O-2.94)	5.44
Cervix in situ	1	1.27 (0.97-1 .66)	1.10 (0.53-2.26)	3.22
Ovary	1	0.89 (0.69-1.14)	0.96 (0.56-I .65)	0.92

†*95% confidence limits of the rate ratios are given in brackets.*
Chi-square values for heterogeneity, with 2 degrees of freedom.
**Non-manual is taken as the baseline group in all sites.*
* *=p <0.01.*

Figure 4.9 Incidence of all neoplasms in employed and unemployed men by year of registration, 1971-81

follow-up, indicating a direct or indirect adverse effect of unemployment on cancer risk. Another part of the excess in the first years of follow-up could be attributed to an initial health selection of those becoming unemployed. A similar pattern was observed for those classified as permanently sick in the 1971 Census (Figure 4.10). For lung cancer, differences narrowed slightly in the second five-year period and no consistent pattern was discernible.

Table 4.12 compares SIRs for unemployed men, for men in manual social classes, and for men in Social Class V. Unemployed men have higher cancer incidence rates overall and for most specific sites, indicating that even though most of them were manual workers, as unemployed men they experience an additional risk.

4.4 Geographic variation

Table 4.13 for men and Table 4.14 for women give observed cases, expected cases and SIRs for major cancers by region of residence. Persons living in the North and West grouped region have the highest incidence for all neoplasms (SIR = 109 for men and 104 for women). In both sexes, but especially in men, there is a clear decreasing trend in incidence for all neoplasms from north west to south east although the pattern does not hold for each specific cancer. In lung cancer and in most of the cancers of the digestive tract, incidence rates for men are highest in the North and West grouped region. Women living in the South and East grouped region had the highest rates for lung cancer (SIR = 108), while for cancers of the digestive tract only for stomach cancer was the SIR significantly higher in the North and

Table 4.10 Standardised incidence ratios (SIR) for men, by economic position, 1971-81

Cancer		Employed	Unemployed	Retired	Temporarily out of work sick	Permanently sick
All neoplasms	**Obs**	5,442	**267***	3,067	109	**202***
	Exp	**5,581.2**	206.7	**3,044.1**	95.7	160.1
	SIR	98	**129**	**101**	114	126
Oesophagus	Obs	99	4	77	3	3
	Exp	106.7	3.8	71.2	1.8	2.9
	SIR	93	105	108	167	103
Stomach	Obs	444	14	279	9	19
	Exp	458.7	17.1	266.7	8.1	13.9
	SIR	97	82	105	111	137
Colon	Obs	287	16	223	4	9
	Exp	307.1	11.4	210.2	5.3	9.2
	SIR	93	140	106	75	98
Rectum	Obs	282	12	172	5	8
	Exp	280.9	10.5	174.6	4.9	8.4
	SIR	100	114	99	102	95
Pancreas	Obs	159	7	92	2	8
	Exp	161.2	6.0	94.3	2.8	4.8
	SIR	99	117	98	71	167
Lung	Obs	1,652	96*	842	38	72*
	Exp	1,720.6	63.8	827.2	31.1	51.9
	SIR	96	150	102	122	139
Prostate	Obs	299	12	385	12	13
	Exp	295.7	11.5	391.7	11.5	10.5
	SIR	101	104	98	104	124
Bladder	Obs	331	17	225	9	9
	Exp	346.5	12.8	216.8	6.0	10.3
	SIR	96	133	104	150	87
Leukaemias	Obs	95	6	55	2	5
	Exp	101.9	3.9	55.2	1.6	2.6
	SIR	93	154	100	125	192
All neoplasms except lung	Obs	3,790	171*	2,225	71	130*
	Exp	3,860.6	142.9	2,216.9	64.6	108.2
	SIR	98	120	100	110	120

**95% confidence limits do not include 100.*

Table 4.11 Standardised incidence ratios (SIR) for employed and unemployed men by period of registration, 1971-81

Cancer	Period of registration		Employed	Unemployed
All neoplasms	1971-75	Obs	2,197	103
		Exp	2,274.4	87.1
		SIR	97	118
	1976-81	Obs	3,245	164
		Exp	3,313.4	119.3
		SIR	98	137
Lung cancer	1971-75	Obs	664	43
		Exp	703.8	27.5
		SIR	94	156
	1976-81	Obs	988	53
		Exp	1,015.1	36.2
		SIR	97	146

Figure 4.10 Incidence of all neoplasms for men classified as permanently sick at 1971 Census by year of registration, 1971-81

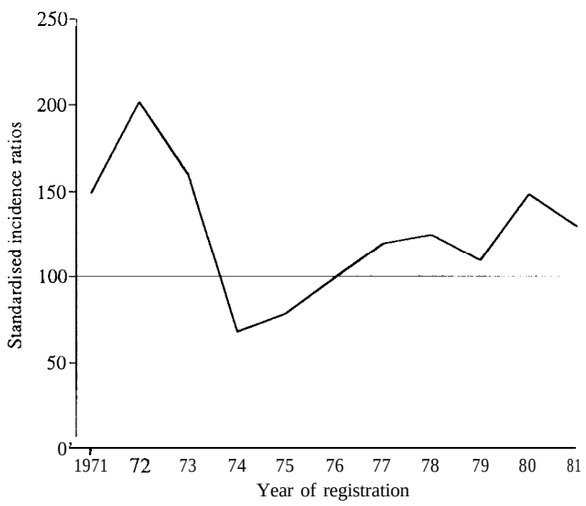


Table 4.12 Standardised incidence ratios for men in all manual social classes, Social Class V, and those unemployed, 1971-81

Cancer	Manual social classes	Social Class V	Unemployed
All neoplasms	**104**	**112**	129
Stomach	112	133	82
Colon	95	67	140
Rectum	106	130	114
Lung	111	124	150
Prostate	96	107	104
Bladder	106	96	133

Table 4.13 Standardised incidence ratios (SIR) for men by grouped region of residence, 1971-81

Cancer		South and East	Central	North and West
All neoplasms	**Obs**	**4,157**	**2,491**	2,548
	Exp	**4,413.6**	**2,446.1**	**2,336.2**
	SIR	94	**102**	109
Oesophagus	Obs	81	47	59
	Exp	90.2	49.5	47.3
	SIR	90	95	125
Stomach	Obs	312	216	239
	Exp	369.1	203.3	194.5
	SIR	85	106	123
Colon	Obs	235	151	160
	Exp	263.8	144.1	138
	SIR	89	105	116
Rectum	Obs	188	157	136
	Exp	231.9	127.3	121.8
	SIR	81	123	112
Pancreas	Obs	125	75	68
	Exp	129.9	71.5	68.4
	SIR	96	105	99
Lung	Obs	1,180	731	793
	Exp	1,293.6	721.2	689.2
	SIR	91	101	115
Prostate	Obs	362	170	185
	Exp	353.5	184.7	178.8
	SIR	102	92	103
Bladder	Obs	290	163	142
	Exp	286.7	157.5	150.7
	SIR	101	104	94
Leukaemias	Obs	81	48	51
	Exp	85.8	48.1	45.9
	SIR	94	100	111

West. Incidence rates were significantly higher in the North and West grouped region for both invasive cancer of the cervix (SIR = 114) and for in situ cancer of the cervix (SIR = 113). By contrast, women in the North and West grouped region had significantly lower rates for cancers of the corpus uteri and those in the Central region for cancer of the ovaries. Appendix Table 4.2 for men and 4.3 for women give SIRs separately for each standard region.

Table 4.14 Standardised incidence ratios (SIR) for women by grouped region of residence, 1971-81

Cancer		South and East	Central	North and West
All neoplasms	**Obs**	4,046	2,247	2,359
	Exp	**4,152.9**	2,222	2,277
	SIR	97	**101**	104
Stomach	Obs	201	124	159
	Exp	235.3	121.1	127.1
	SIR	85	102	125
Colon	Obs	344	201	210
	Exp	366.2	190.2	197.9
	SIR	94	106	106
Rectum	Obs	179	97	91
	Exp	178.7	92.7	96.3
	SIR	100	105	94
Pancreas	Obs	105	59	58
	Exp	108.6	55.9	58.3
	SIR	97	106	99
Lung	Obs	373	162	187
	Exp	345.5	185.5	191
	SIR	108	87	98
Breast	Obs	977	545	528
	Exp	977.9	533.3	538.9
	SIR	100	102	98
Cervix uteri	Obs	152	100	107
	Exp	169.8	95.3	93.9
	SIR	90	105	114
Cervix in Situ	Obs	125	104	97
	Exp	156.9	91.4	85.7
	SIR	80	114	113
Corpus uteri	Obs	177	90	67
	Exp	160.1	85.3	88.9
	SIR	111	106	75
Ovary	Obs	214	90	114
	Exp	198.3	109.1	110.2
	SIR	108	82	103
Leukaemias	Obs	85	47	45
	Exp	85.1	45.3	46.3
	SIR	100	104	97

Differences among regions for all neoplasms remain wide in men throughout most of the life-span (Appendix Figure 4.2). At older ages SIRs for the Central and South and East grouped regions were similar while rates remained high for the North and West grouped region. To a large extent, this is an effect of the persisting regional differences among owner occupiers, while for both council tenants and persons living in private rented accommodation SIRs for regions converge at older ages. In women, regional differences in incidence of all neoplasms were more evident at ages 45 to 74 (Appendix Figure 4.3).

During the study period differences in incidence between the North and West grouped region and the South and East grouped region seemed to narrow slightly for all male neoplasms combined but widen slightly for lung cancer (Table 4.15). In women, too, differences converged for all neoplasms and diverged for lung cancer although in contrast to men, lung cancer rates were higher in the South and East grouped region

(Table 4.15). Women living in the North and West grouped region had, by 1976-81, acquired higher breast cancer incidence rates than those in the South and East.

Regional differences in health partly reflect the social class composition of the population in different areas.[5,6] Therefore grouped regions were analysed by housing tenure and Poisson regression was used to distinguish, if possible, between 'regional' and 'socio-economic' effects. The scaled deviance, degrees of freedom and a corresponding chi-square statistic are presented for different models including region, housing tenure, or both variables. Tables 4.16 and 4.17 present these statistics for men and women respectively, for those cancer sites where either grouped region or housing tenure were statistically significant variables. For all neoplasms, both region and housing tenure distinguish male population groups with different risk, while in women only housing tenure appears as a significant variable. Lung cancer appears clearly as a mainly class related disease, even though in men there is still a residual significant variation among regions. Bladder cancer in men and cervical cancer in women also appear as cancers related to socio-economic status rather than to regional factors. In men, most cancers of the digestive tract (stomach, colon, rectum) seem to reflect regionally defined risk factors much more than those directly related to class. Differences in rate ratios between regions are wider than respective differences between housing tenure groups and in the Poisson regression, models including region decreased deviance much more than those including housing tenure. This pattern, however, is not clearly reflected in women.

Table 4.15 Standardised incidence ratios (SIR) for men and women by grouped region of residence and period of registration, 1971-81

			Grouped region of residence		
			South and East	Central	North and West
Men					
All neoplasms	1971-75	Obs	1,906	1,122	1,191
		Exp	2,021 .o	1,114.7	1,083.3
		SIR	94	101	110
	1976-81	Obs	2,251	1,369	1,357
		Exp	2 392.9	1,332.0	1,252.1
		SIR	94	103	108
Lung	1971-75	Obs	541	342	364
		Exp	595.9	330.1	320.9
		SIR	91	104	113
	1976-8 1	Obs	639	389	429
		Exp	697.8	391.2	367.8
		SIR	92	99	117
Women					
All neoplasms	1971-75	Obs	1,838	1,043	1,147
		Exp	1,932.2	1,033.5	1,062.2
		SIR	95	101	108
	1976-81	Obs	2,208	1,204	1,212
		Exp	2,220.3	1,188.6	1,215.1
		SIR	99	101	100
Lung	1971-75	Obs	156	72	85
		Exp	149.6	80.4	83.1
		SIR	104	90	102
	1976-81	Obs	217	90	102
		Exp	196.0	105.1	107.8
		SIR	111	86	95
Breast	1971-75	Obs	465	250	242
		Exp	457	247.7	252.3
		SIR	102	101	96
	1976-8 1	Obs	512	295	286
		Exp	521.1	285.5	286.6
		SIR	98	103	100

4.5 Marital status

4.5.1 *Men*

Single, married and widowed men had fairly similar incidence of all neoplasms, while the divorced had a clearly higher SIR of 122 (95% CL= 101 – 148). Overall, differences in SIRs of all neoplasms among marital status groups were significant (Table 4.18). Marital status is closely related to age. Single people are the largest group at younger ages, married the largest at all subsequent ages until retirement, while at older ages the majority of the population are widows (see Figure 4.1 in Fox and Goldblatt 1982).[7] SIRs decreased with age for single men and after the age of 65 they had lower rates than married men, resulting in their overall slightly lower rates (Appendix Figure 4.4). A similar trend with age can be seen for widowed men, who, at ages 45-64, have high incidence (SIR = 117) but at older ages have rates similar to those of married men. Divorced men have very high rates in nearly all age groups.

Differences in SIRs for all neoplasms were only significant for those over 75 years of age (χ^2 = 11.6 with 3 degrees of freedom, p- value = 0.009). Different age distributions of marital status groups and differing patterns of risk with age could have affected the level of an overall SIR. Such an effect was observed in the mortality analysis between single and widowed men (see Table 4.2 in Fox and Goldblatt 1982)'. Therefore Poisson regression using GLIM was applied adjusting for age. Corrected SIRs were, however, only very slightly different from those found originally (Table 4.19).

Apart from all neoplasms, significant differences among marital status groups were found for stomach and lung cancers (Table 4.18). Married men constitute the majority of cases for most sites, being the biggest marital status group; consequently their SIRs are usually around 100. Single men had high SIRs for cancer of the pancreas (SIR= 145, 95% CL 98-207). Widowed men had significantly increased SIRs for stomach cancer (SIR= 126, 95% CL 101-155). Divorced men had increased SIRs in a number of sites but only for lung cancer were results significant (SIR = 161, 95% CL 117-217). Because of small numbers, it was not meaningful to present SIRs for specific age-groups in each cancer site. Lung cancer was the one exception (Appendix Figure 4.5); differences were marginally significant for three of the four age-groups, and trends of the differences in SIRs were similar to

Table 4.16 Scaled deviances for Poisson regression models of incidence in men, by grouped region of residence and housing tenure, 1971–81

Cancer site	Variables in the model	Deviance	Degrees of freedom	Chi-square?
All neoplasms	**Nil**	**154.81**	8	
	Region	123.25	6	31.26
	housing tenure	28.40	6	126.41
	Region + housing tenure	2.61	4	
Oesophagus	Nil	11.56		
	Region	7.53	6	4.03
	housing tenure	4.96	6	6.59
	Region + housing tenure	1.33	4	
Stomach	Nil	33.33	8	
	Region	14.46	6	18.87
	housing tenure	23.03	6	10.30
	Region + housing tenure	5.35	4	
Colon	Nil	11.43	8	
	Region	3.81	6	7.62
	housing tenure	10.29	6	1.14
	Region + housing tenure	2.23	4	
Rectum	Nil	20.62	8	
	Region	4.87	6	15.75
	housing tenure	17.79	6	2.83
	Region + housing tenure	2.70	4	
Lung	Nil	219.43	8	
	Region	195.70	6	23.73
	housing tenure	21.42	6	198.01
	Region + housing tenure	3.14	4	
Bladder	Nil	12.49	8	
	Region	11.72	6	0.77
	housing tenure	3.54	6	8.95
	Region + housing tenure	2.64	4	

† *An approximate chi-square value is calculated by subtracting the deviance of the models including a variable from the nil model. When both variables are included in the model, the significance of a variable can be found by comparing the deviance of the model including the other variable with that of the model including both.*

Table 4.17 Scaled deviances for Poisson regression models of incidence in women, by grouped region of residence and housing tenure, 1971-81

Cancer site	Variables in the model	Deviance	Degrees of freedom	Chi-square†
All neoplasms	**Nil**	**19.57**	**8**	
	Region	**13.54**	**6**	6.03
	housing tenure	**11.14**	**6**	8.43
	Region + housing tenure	6.05	**4**	
Stomach	Nil	22.08	8	
	Region	8.70	6	13.39
	housing tenure	13.58	6	8.51
	Region + housing tenure	1.42	4	
Lung	Nil	32.26	8	
	Region	26.64	6	5.62
	housing tenure	10.05	6	22.21
	Region + housing tenure	3.07	4	
Cervix uteri	Nil	35.92	8	
	Region	31.63	6	4.29
	housing tenure	5.24	6	30.67
	Region + housing tenure	1.67	4	
Cervix in situ	Nil	50.95	8	
	Region	44.56	6	6.39
	housing tenure	6.12	6	44.83
	Region + housing tenure	0.83	4	
Corpus uteri	Nil	13.62	8	
	Region	5.76	6	7.86
	housing tenure	10.95	6	2.67
	Region + housing tenure	2.98	4	
Ovary	Nil	17.55	8	
	Region	12.41	6	5.14
	housing tenure	8.79	6	8.76
	Region + housing tenure	3.95	4	

† *An approximate chi-square value is calculated by subtracting the deviance of the models including a variable from the nil model. When both variables are included in the model, the significance of a variable can be found by comparing the deviance of the model including the other variable with that of the model including both.*

Table 4.18 Standardised incidence ratios (SIR) for men by marital status, 1971-81

Cancer		Single	Married	Widowed	Divorced	Chi-square†
All neoplasms	**Obs**	803	7,428	857	**108**	6.1
	Exp	836.1	**7,442.6**	828.9	88.3	
	SIR	96	loo	103	122	
Oesophagus	**Obs**	16	150	17	4	0.2
	Exp	14.3	150.8	20.1	1.7	
	SIR	112	99	85	229	
Stomach	Obs	48	618	91	10	8.2*
	Exp	59.3	628.2	72.2	7.3	
	SIR	81	98	126	137	
Colon	Obs	39	436	66	5	2.6
	Exp	43	442.9	55.1	5.0	
	SIR	91	98	120	101	
Rectum	Obs	32	394	51	4	1.2
	Exp	37.8	391.1	47.5	4.5	
	SIR	85	101	107	89	
Pancreas	Obs	30	219	21	0	5.1
	Exp	20.7	221.0	25.7	2.6	
	SIR	145	99	82		
Lung	Obs	194	2,224	242	44	14.3**
	Exp	210.6	2,247.8	218.4	27.3	
	SIR	92	99	111	161	
Prostate	Obs	55	547	111	4	1.2
	Exp	50.5	557.2	104.3	5.0	
	SIR	109	98	106	80	
Bladder	Obs	54	477	59	5	1.2
	Exp	47.3	484.4	57.7	5.6	
	SIR	114	98	102	90	
Kidney and pelvis	Obs	11	116	7	0	0.7
	Exp	12.3	111.5	8.7	1.5	
	SIR	89	104	80	—	
Brain	Obs	27	100	1	0	0.2
	Exp	27.1	95.8	3.7	1.4	
	SIR	100	104	27	—	
Lymphomas	Obs	52	248	20	2	0.3
	Exp	54.4	244	20.4	3.2	
	SIR	96	102	98	62	
Leukaemias	Obs	37	133	9	1	
	Exp	33.1	129.5	15.9	1.5	
	SIR	112	103	57	66	

† *In cancers of the oesophagus, pancreas, kidney and pelvis, and brain, divorced were not taken into account in the calculation of the chi-square. In the lymphomas and the leukaemias they were merged with the widowed.*
* $= 0.01 < p < 0.05$.
** $= p < 0.01$.

those described earlier for all neoplasms although more pronounced. Poisson regression was used for a number of specific sites in order to estimate possible biases in the calculation of SIRs for all ages. Table 4.19 shows SIRs as found in the standardisation and rate ratios as found from the Poisson regression for lung cancer and the leukaemias. As was the case for all neoplasms, small differences were apparent.

Table 4.19 Comparison of standardised incidence ratios (SIR) and Poisson regression estimates (rate ratios) for men by marital status,† 1971–81

Cancer		Single	Married	Widowed	Divorced
All neoplasms	SIR	96	100	103	122
	RR	97	101	105	124
Lung	SIR	92	99	111	161
	RR	96	103	116	171
Leukaemias‡	SIR	112	103	57	
	RR	113	98	52	

† *The grand mean (intercept) has not been included in any GLIM model so that estimates are directly comparable.*
‡ *Because of small numbers, values for widowed and divorced are merged for leukaemias.*

4.5.2 Women

Incidence of all neoplasms was similar in the three major marital status groups (Table 4.20), with single women having the lowest rate (SIR = 96). The fourth group, divorced, had a considerably higher risk

Table 4.20 Standardised incidence ratios (SIR) for women by marital status, 1971–81†

Cancer		Single	Married	Widowed	Divorced	Chi-square?
All neoplasms	**Obs**	976	5,132	2,354	140	6.59
	Exp	**1,017.3**	**5,175.6**	**2,286.7**	122.3	
	SIR	96	99	103	114	
Stomach	Obs	50	257	174	3	4.2
	Exp	60.8	240.7	177	5.5	
	SIR	82	107	98	54	
Colon	Obs	94	382	277	2	1.3
	Exp	92.1	397.3	256.3	9.3	
	SIR	102	96	108	22	
Lung	Obs	61	437	199	23	20.4**
	Exp	80.1	446.7	182.5	10.7	
	SIR	76	98	109	216	
Breast	Obs	240	1,374	401	35	5.49
	Exp	220.3	1,357.6	439.5	32.7	
	SIR	109	101	91	107	
Cervix uteri	Obs	23	258	64	14	20.5**
	Exp	40.5	261.4	50.8	6.3	
	SIR	57	99	126	222	
Cervix in situ	Obs	56	256	8	11	8.63*
	Exp	67	252.3	6.6	5.2	
	SIR	84	101	122	213	
Ovary	Obs	52	267	84	12	4.94
	Exp	47.4	276.1	84.9	6.7	
	SIR	110	97	99	180	

t In cancers of the stomach and colon, divorced were merged together with widowed for the calculation of chi-square.
** = 0.01<p<0.05.*
*** = p<0.01.*

(SIR = 114). Patterns were relatively consistent in different age-groups, with the exception of young divorced women who had a very high risk (Appendix Figure 4.6). Married women constituted the major marital status group, and therefore their SIRs were always around 100.

Single women (Table 4.20), had significantly lower rates for lung cancer (SIR = 76, 95% CL 58-98) and invasive cancer of the cervix (SIR= 57, 95% CL 36-85). Differences between single and married women were fully accounted for by the lower rates of lung and cervical cancer among the single. Conversely, single women had higher rates than married women for breast cancer and ovarian cancer, but the differences were not significant. Widowed women had increased risk for colon and lung cancer and especially for cervical cancer (SIR= 126, 95% CL 97-161). Conversely, they had lower SIRs than all other marital status groups for breast cancer (SIR = 91, 95% CL 83-101). Divorced women had markedly higher SIRs than other groups for lung cancer (SIR = 216, 95% CL 136-323) and cervical cancer (SIR = 222, 95% CL 121-373).

Marital status was analysed by own social class and in this analysis the widowed and divorced were combined in order to avoid having many cells with low numbers. However, this is not entirely satisfactory since the widowed and divorced are groups with different patterns of cancer incidence. Adjustment of marital status for own social class indicated that differences among marital status groups for all neoplasms narrowed slightly, but in general the observed changes in the rate ratios were very small. The biggest change occurred in cervical cancer for women with inadequately described occupations, due to a correlation with the widowed/divorced category. The rate ratio of those with inadequately described occupation adjusted for age was 1.37, which, after adjusting additionally for marital status, fell to 1.15, while rate ratios of widowed/divorced were practically unaffected.

4.6 Time trends in cancer incidence

Differences in the occurrence of all neoplasms between high and low socio-economic groups did not change markedly during 1971-81. However, there was a clear tendency for incidence differentials to become slightly wider. The incidence rate ratio for male council tenants compared to owner occupiers increased from 1.27 in 1971-75 to 1.33 in 1976-81, and for females from 1.05 to 1.08 (Table 4.21, Figure 4.11). For women, only in the second five-year period were differences significant. These changes could be seen in nearly all ages. A similar pattern was observed for men classified by social class (manual versus non-manual), but not for women classified by own social class (Table 4.22, Figure 4.12).

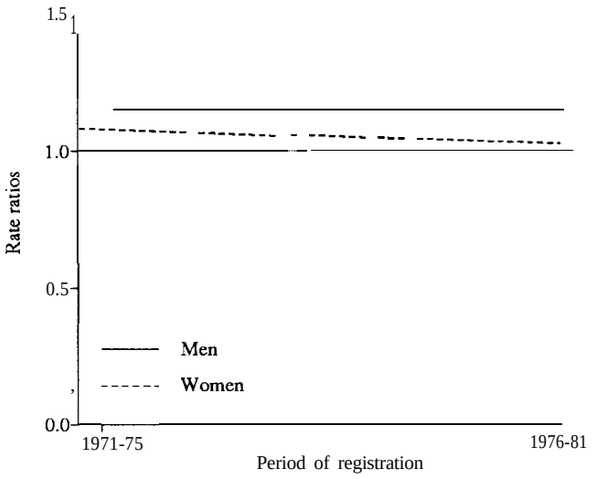
Appendix Tables 4.4 and 4.5 give observed cases, expected cases and SIRs for the most common cancers, for men and women of the two major housing tenure groups. Relative increases of SIRs for council tenants compared to owner occupiers were seen among men for cancers of the buccal cavity, oesophagus, stomach, colon, rectum, larynx and the leukaemias; among

Table 4.21 Incidence rate ratios (RR) for all neoplasms, by period of registration, age, sex and housing tenure†

Age	Housing tenure	Period of registration	
		1971-75 RR (95% CL)	1976-81 RR (95% CL)
Men			
All ages	Owner occupiers	1	1
	Council tenants	1.27 (1.18-1.36)	1.33 (1.25-1.42)
15-64	Owner occupiers	1	1
	Council tenants	1.34 (1.21-1.49)	1.38 (1.25-1.53)
Women			
All ages	Owner occupiers	1	1
	Council tenants	1.05 (0.98-1.13)	1.08 (1.01-1.16)
15-59	Owner occupiers	1	1
	Council tenants	1.08 (0.96-1 .22)	1.14 (1.02-1.28)

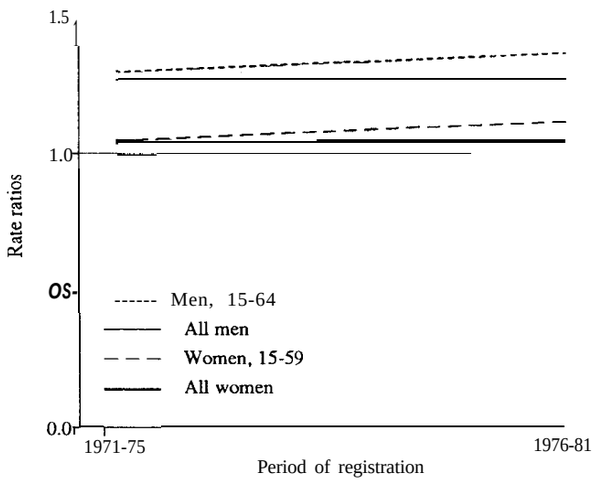
† *Council tenants versus owner occupiers; the latter were taken as the baseline group.*

Figure 4.12 Incidence of all neoplasms by period of registration, sex and own social class*



*Rate ratios of manual versus non-manual social classes

Figure 4.11 Incidence of all neoplasms for council tenants by period of registration, age and sex*



*Rate ratios of council tenants versus owner occupiers

Table 4.22 Incidence rate ratios (RR) for all neoplasms, by period of registration, sex and social class†*

Sex	Social class	Period of registration	
		1971-75 RR (95% CL)	1976-81 RR (95% CL)
Men	Non-manual	1	1
	Manual	1.14 (1.07-1.22)	1.16 (1.09-1.24)
Women	Non-manual	1	1
	Manual	1.06 (0.96-1.18)	1.05 (0.96-1.16)

† *Own social class for both men and women.*
* *Manual versus non-manual social classes. The latter were taken as the baseline group.*

women, for cancers of the breast, stomach, colon, rectum, pancreas and ovary. No change or a relative decrease in the rates of council tenants were seen among men for cancers of the pancreas, lung, prostate and bladder and among women for cancers of the lung, cervix uteri, corpus uteri and bladder. Contrary to time-trends for invasive cervical cancer, differences widened among housing tenure groups for cervical cancer in situ. It should be recognised that numbers were too small to detect significant results for changes of this order of magnitude.

Even though changes in incidence between social classes were not significant for men, for most cancers differences between manual and non-manual social classes either remained stable or widened slightly (Appendix Table 4.6). From all cancers examined, only for bladder cancer did incidence differentials narrow in the second five-year period (1976-8 1).

Concluding remarks

Persons living in advantageous socio-economic circumstances had the lowest risk irrespective of socio-economic classification used. Among major cancers, the widest differences were observed for lung cancer in men and cervical cancer in women, but significant differences between socio-economic groups were also observed for many other cancers. Smoking related cancers accounted for the biggest part of differences in incidence between housing tenure groups and between social classes. This was more evident for men. Many cancers of the digestive tract were principally related to region of residence. Women were classified by own social class and husband's social class, and for both classifications increased incidence was found for manual social classes. Unemployed men had significantly higher incidence than employed, for all neoplasms and for lung cancer. It is unlikely that the increase in risk among unemployed is mainly related to

initial ill-health selection. A decreasing trend in incidence from the north west regions of England and Wales to the south east was evident, similar to trends observed in mortality analyses. Divorced men and women had distinctly higher incidence than the married, single and widowed. During 1971-81 differences between socio-economic groups seemed to become wider.

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5 Cancer survival in the longitudinal study population

This chapter considers the survival experience of the whole LS population. Life-table analysis was carried out separately for each sex. The effect of erroneous registration is evaluated and 'corrected' survival rates which take into account the percentage of cases registered with the same date of registration and death are provided. Finally, survival rates for England and Wales are compared with those of the USA.

Life-table analysis was carried out for the whole LS population. Estimates of one, three and five-year survival rates based on deaths from all causes among cancer cases (crude rates) and corresponding rates based on deaths from the primary cancer only (relative rates), are given in Table 5.1 for men and Table 5.2 for women. In analyses based on deaths from the primary cancer only, all other deaths are treated as withdrawals. The corresponding statistic is similar in principle to the relative survival rates since both evaluate the survival experience of cancer cases taking into account mortality from all other causes.'

Survival for all neoplasms was markedly better in women (35.8 per cent five-year crude survival) than in men (23.0 per cent crude survival). Indeed, in most cancers, survival was slightly better in women but the markedly better survival for all neoplasms was primarily due to the good prognosis of most female reproductive cancers which constitute a considerable proportion of all cancers in women. Differences between sexes in relative survival rates were not as clear, indicating that to a considerable degree the lower crude survival rates

Table 5.1 Crude and relative survival rates for all men in the Longitudinal Study, 1971-83

Primary cancer site	Crude rates %			Relative rates %		
	1 year	3 years	5 years	1 year	3 years	5 years
All neoplasms	43	28	23	–	–	–
Oesophagus	13	5†	3†	21	12†	10†
Stomach	20	7	4	24	11	6
Colon	46	26	21	56	38	34
Rectum	52	32	23	62	44	36
Pancreas	8†	3†	3†	11†	5†	5†
Larynx	79	55	52	85	69	69
Lung	18	7	5	20	9	7
Other skin	94	83	73	100	99	99
Prostate	63	34	22	74	48	36
Testis	82	71	68	85	73	73
Bladder	71	51	40	76	62	54
Leukaemias	40	20	17	50	30	26

†*The standard error is greater than 20% of the rate.*

Table 5.2 Crude and relative survival rates for all women in the Longitudinal Study, 1971-83

Primary cancer site	Crude rates %			Relative rates %		
	1 year	3 years	5 years	1 year	3 years	5 years
All neoplasms	58	43	36	–	–	–
Oesophagus	26	8†	7†	34	12†	12†
Stomach	19	9	6	23	12	9
Colon	45	29	23	52	37	33
Rectum	52	30	26	61	43	39
Pancreas	11†	4†	3†	14†	6†	6†
Lung	20	6	5	22	8	7
Other skin	94	87	77	99	99	98
Malignant melanoma	90	77	62	91	80	71
Breast	83	63	50	87	69	58
Cervix uteri	75	57	50	78	62	57
Corpus uteri	79	64	60	88	80	78
Ovary	45	27	22	48	31	26
Bladder	60	46	40	64	51	49
Leukaemias	47	23	16	52	28	24

† *The standard error is greater than 20% of the rate.*

among men were due to their higher mortality from other causes.

Cancers of the oesophagus, stomach, pancreas and lung had less than 10 per cent, or close to 10 per cent, five-year survival rates (Tables 5.1 and 5.2) and median survival of less than 4 months (Table 5.3). Cancers of the skin, other than malignant melanoma, bladder, testis, larynx in men, breast and malignant melanoma in women, corpus uteri and cervix uteri had all higher than 50 per cent five-year relative survival rates and median survival ranging from seven to more than ten years. Survival rates for other cancer sites (prostate, colon, rectum, ovary and the leukaemias), lay between these extremes.

Table 5.3 Median survival time (in years) for all men and women in the Longitudinal Study, 1971-83

Primary cancer site	Median survival (years)	
	Men	Women
All neoplasms	0.68	1.86
Oesophagus	0.23	0.32†
Stomach	0.23	0.22
Colon	0.71	0.71
Rectum	1.16	1.16
Pancreas	0.19	0.20
Larynx	5.78†	–
Lung	0.26	0.32
Other skin	>10	>10
Malignant melanoma	–	>10
Breast	–	4.98
Cervix uteri	–	5.16†
Corpus uteri	–	9.79
Ovary	–	0.78
Prostate	1.74	–
Testis	>10	–
Bladder	3.10	2.25†
Leukaemias	0.69	0.78†

†*The standard error is greater than 20% of the estimate.*

A considerable number of cancer patients were found to be registered with the same anniversary date and date of death (see section 2.2). This percentage varied by site from a negligible proportion (skin and laryngeal cancer in men, skin and malignant melanoma in women), to 16.6 per cent for cancer of the pancreas in women. These cases were excluded from all analyses as their length of survival was not known. They are also not included in the published OPCS cancer statistics.* Their exclusion results in a false increase of survival rates, as these are the cases that most likely have the worst prognosis. Goldblatt and Murphy (personal communication), have estimated that in the majority of cases, survival is not likely to exceed two years. To assess the effect of their exclusion on recorded survival rates, these cases were re-allocated for each cancer assuming that all of them would have died in two years time and that during this period they would follow the observed survival distributions. Estimates of these calculations for one, three and five-year crude survival rates are presented in Table 5.4. As expected, the inclusion of these cases lowered the survival rates but *estimates did not appear markedly different.* The decrease varied from less than 1 per cent to more than 2 per cent for the five-year survival rate. However, it should be noted that for some sites, for example lung or pancreatic cancer, differences of this magnitude denote relative decreases of 10 per cent or more in survival rates. When rates are calculated for shorter periods, that is one or three years, differences between the two estimates are larger.

As a measure of comparison of levels of cancer survival, these estimates are contrasted to those of the population of the USA. Table 5.5 presents the rates observed in the LS population, together with published figures from the Surveillance Epidemiology and End Results (SEER) Program of the NCI,[3] for cases occurring during 1973-79 in the USA and followed-up until 1981. The SEER Program includes all cases occurring in nine areas (five states and four metropolitan areas) and is believed to cover a representative sample of the US population. Rates presented for the USA include all ethnic groups.

Survival rates in the USA are consistently better than those observed in England and Wales. Remarkably high differences, of around 20 per cent, can be observed among the British and American populations for many sites and especially for colorectal, bladder and prostate cancer (Table 5.5). However, big differences between

Table 5.4 'Corrected' crude survival rates† for all men and women in the Longitudinal Study, 1971-83

Primary cancer site	Men			Women		
	1 year	3 years	5 years	1 year	3 years	5 years
All neoplasms	42	27	21	56	40	34
Oesophagus	13	4‡	3‡	25	7‡	7‡
Stomach	19	7	4	18	8	6
Colon	44	24	19	43	26	21
Rectum	51	30	22	50	28	23
Pancreas	8‡	3‡	3‡	10	3‡	2‡
Lung	17	6	5	20	6	5
Breast	–	–	–	82	61	48
Cervix uteri	–	–	–	74	56	50
Corpus uteri	–	–	–	79	64	60
Ovary	–	–	–	44	25	21
Prostate	62	32	21	–	–	–
Bladder	70	49	39	58	44	40
Leukaemias	38	19	15	45	20	14

†*Cases registered with the same date of registration and date of death are included in the life table analysis (see text).*
‡*The standard error is greater than 20% of the estimate.*

Table 5.5 Crude and relative five-year survival rates for men and women in the LS 1971-83, and the Surveillance Epidemiology and End Results (SEER) Program (USA) 1973-81†

Primary cancer site	Men				Women			
	Crude rates %		Relative rates %		Crude rates %		Relative rates %	
	LS	SEER	LS	SEER	LS	SEER	LS	SEER
All neoplasms	23	30	–	39	36	47	–	54
Oesophagus	3	3	IO	4		5	12	6
Stomach	4	10	6	13	7	12	9	16
Colon	21	36	34	48	23	39	33	50
Rectum	23	35	36	45	26	39	39	48
Pancreas	3	2	5	3	3	2	6	3
Larynx	53	54	69	65	–	–	–	–
Lung	5	8	7	IO	5	13	7	15
Malignant melanoma	–	–	–	–	62	76	71	82
Breast	–			–	50	64	58	72
Cervix uteri	–				50	61	58	66
Corpus uteri	–			–	60	78	78	86
Ovary	–	–	–	–	22	32	26	36
Prostate	22	45	36	65	–	–	–	–
Bladder	40	54	54	72	42	54	49	68

†*The LS includes cases registered during 1971-81; the SEER Program cases registered from 1973 to 1979.*

the two countries were observed even in cancers with bad prognosis, for example lung or stomach cancer. Dissimilar diagnostic patterns could explain part of the observed differences, especially for prostate cancer, for which it is recognised that the USA improvements in survival are due to increased diagnosis of latent tumours.[4] It would seem unlikely that this could be the sole reason, as differences between the two populations occurred in nearly every site irrespective of prognosis or diagnostic accessibility. The considerably better survival rates of American cancer patients could be partly ascribed to earlier diagnosis and better treatment of these patients,

Concluding remarks

Survival for all neoplasms was better for women, mainly because of the good prognosis of most female reproductive cancers. However, relative survival for men and women for individual cancers was not very different. Corrected survival rates including cases with the same date of registration and death, were slightly lower than the original survival rates. Survival rates in the USA were considerably better than survival in England and Wales. This advantage extended to a wide range of cancers.

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3 Young JL Jr, Gloeckler-Ries L, Pollack ES. Cancer patient survival among ethnic groups in the United States. *JNCI* 1984; 73: 341-352.

4 Byar DP. Incidence, mortality and survival statistics for prostate cancer. In: Coffey DS, Bruchovsky N, Gardner WA, Resnick MI, Karr JP eds. *Current concepts and approaches to the study of prostate cancer, New* York, AR Liss. 1987.

6 Socio-economic differences in cancer survival

The influence of socio-economic factors on cancer survival is discussed in this chapter. Various socio-demographic classifications are used although most analyses are confined to housing tenure. Survival differences are examined by sex, age, prognosis of the cancer and cause of death, and both relative and absolute differences in survival are estimated. An evaluation of possible causes for survival differentials is done, specifically concerning the role of presentation at a late stage.

6.1 Housing tenure

6.1.1 AN cause fatality

Both male and female council tenants had significantly worse survival than owner occupiers when SFRs were calculated for all malignant neoplasms (Table 6.1 and 6.2). This overall figure is, however, affected by the different distribution of cancers among incidence cases. Incidence patterns by housing tenure for major cancers classified into two prognostic groups are shown in Table 6.3. Cancers of the lung, stomach, pancreas and oesophagus have less than 10 per cent five-year survival in England and Wales' and are here arbitrarily defined as 'poor' prognosis cancers. Socio-economic differences are greater for the poor prognosis group as a whole, largely due to the high lung cancer rates of council tenants. Thus, cancers with poor prognosis make up a larger proportion of cancers in lower socio-economic groups than in higher, especially in men. Among council tenants 48 per cent of male cases and 20 per cent of female were registered with one of these four cancers, compared with 38 per cent of male owner occupiers and 16 per cent of female owner occupiers. This different distribution of good and poor prognosis cancers between socio-economic groups influences any comparison of overall survival rates.

SFRs of housing tenure groups for specific cancers are presented in Table 6.1 and Figure 6.1 for men and Table 6.2 and Figure 6.2 for women. Those living in private rented accommodation usually occupied an intermediate position and are subject to larger random fluctuations than the other two groups due to smaller numbers. For ease of presentation only SFRs of the two major groups are included in the figures. Similarly, discussion of the results focuses on the comparison of owner occupiers and council tenants. Results for people living in non-private households are presented separately.

Council tenants nearly always had higher SFRs than did owner occupiers. Of 13 sites analysed in men (which comprised 86 per cent of the total number of cancer cases), council tenants had higher SFRs than owner occupiers in 11 of them. In women, council tenants had higher SFRs than owner occupiers in 12 of the 15 sites examined (which comprised 85 per cent of the total number of cancer cases).

Table 6.1 Standardised case-fatality ratios (SFR) for men, by site of registration and housing tenure, 1971–83†

Cancer site		Owner occupiers	Council tenants	Private rented	χ^2
All neoplasms	**Obs**	**3,131**	**2,198**	**1,365**	**47.2***
	Exp	**3,419.2**	2,005s	**1,290.1**	
	SFR	92	**110**	**106**	
Oesophagus	Obs	79	56	26	1.97
	Exp	84.5	54.3	20.3	
	SFR	93	103	128	
Stomach	Obs	313	210	138	1.22
	Exp	324.8	197.7	140.1	
	SFR	96	106	99	
Colon	Obs	207	109	82	9.56*
	Exp	233.4	85.4	82.2	
	SFR	89	128	100	
Rectum	Obs	175	111	73	2.09
	Exp	189.8	101.6	70.7	
	SFR	92	109	103	
Pancreas	Obs	130	55	52	0.42
	Exp	134.9	51.6	53.7	
	SFR	96	107	97	
Larynx	Obs	26	29	13	2.02
	Exp	26.9	24.3	17.3	
	SFR	97	119	75	
Lung	Obs	922	889	489	2.84
	Exp	960.7	851.6	480.9	
	SFR	96	104	102	
Other Skin	Obs	183	103	61	3.63
	Exp	202.1	90.5	58.5	
	SFR	91	114	104	
Prostate	Obs	295	136	196	0.95
	Exp	286.3	144.0	111.5	
	SFR	103	94	95	
Testis	Obs	15	8	6	1.76
	Exp	15.2	5.0	7.1	
	SFR	99	160	85	
Bladder	Obs	173	122	80	3.04
	Exp	189.2	109.8	15.2	
	SFR	91	111	106	
Lymphomas	Obs	76	46	24	2.38
	Exp	74.8	39.7	30.5	
	SFR	102	116	79	
Leukaemias	Obs	86	35	22	0.31
	Exp	81.6	36.4	23.1	
	SFR	105	96	95	

† *Chi-square values are calculated using Kitpatrick's method.*
* $p < 0.01$

Table 6.2 Standardised case-fatality ratios (SFR) for women, by site of registration and housing tenure, 1971–81†

Cancer site		Owner occupiers	Council tenants	Private rented	χ^2
All neoplasms	**Obs**	2,719	**1,601**	**1,085**	**24.03****
	Exp	**2,902.5**	**1,520.9**	994.8	
	SFR	94	**105**	107	
Oesophagus	Obs	54	41	30	1.59
	Exp	58.4	35.3	33.4	
	SFR	92	116	90	
Stomach	Obs	182	126	69	0.28
	Exp	179.1	130.9	67.1	
	SFR	102	96	103	
Colon	Obs	279	133	111	5.01*
	Exp	303.5	130.7	94.2	
	SFR	92	102	118	
Rectum	Obs	136	67	48	2.24
	Exp	130.3	78.8	44.8	
	SFR	104	85	107	
Pancreas	Obs	96	39	36	5.70*
	Exp	99.8	26.9	39.9	
	SFR	96	145	90	
Lung	Obs	265	220	135	2.69
	Exp	282.3	206.6	124.7	
	SFR	94	106	108	
Malignant melanoma	Obs	16	18	3	1.71
	Exp	19.8	14.9	4.2	
	SFR	81	121	71	
Other skin	Obs	125	71	46	5.54*
	Exp	141.9	56.9	46.4	
	SFR	88	125	99	
Breast	Obs	605	302	213	1.29
	Exp	610.1	310.7	198.9	
	SFR	99	97	107	
Cervix uteri	Obs	72	72	48	0.85
	Exp	75.5	74.43	42.9	
	SFR	95	97	112	
Corpus uteri	Obs	75	47	28	3.84
	Exp	88.3	39.1	25.6	
	SFR	85	120	109	
Ovary	Obs	176	81	50	2.59
	Exp	187.9	75.4	42.2	
	SFR	94	107	118	
Bladder	Obs	59	37	31	5.92*
	Exp	71.3	31.6	22.8	
	SFR	83	117	136	
Lymphomas	Obs	58	37	18	1.37
	Exp	62.3	29.3	15.4	
	SFR	93	116	117	
Leukaemias	Obs	72	33	27	0.81
	Exp	74.7	28.8	28.7	
	SFR	96	115	94	

† *Chi-square values are calculated using Kilpatrick's method.*
* *0.05<p<0.1*
** *p<0.001*

Table 6.3 Standardised incident ratios for all neoplasms and for cancers of poor prognosis? by sex and housing tenure, 1971–81‡

Sex and housing tenure	All neoplasms	Bad prognosis cancers
Men		
Owner occupiers	89 (4,284)	80 (1,646—38%)
Council tenants	116 (2,882)	130 (1,380—48%)
Women		
Owner occupiers	98 (4,320)	89 (710—16%)
Council tenants	105 (2,504)	116 (493—20%)

† *Data were available for cancers of the oesophagus, stomach, lung and pancreas.*
‡ *In brackets, number of cases and percentages of bad prognosis cancers.*

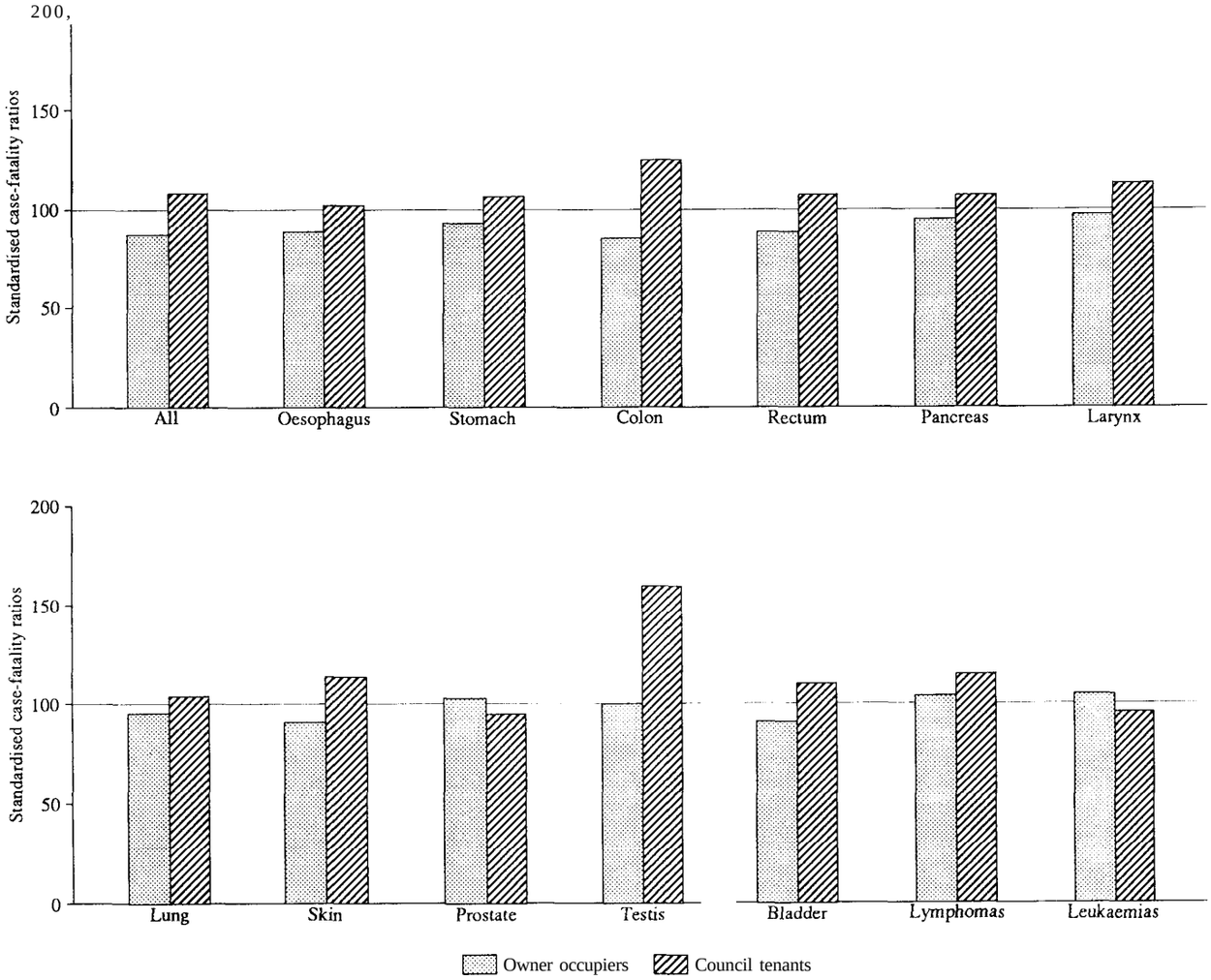
Men living in council houses had higher case-fatality rates than owner occupiers for cancers of the oesophagus, stomach, colon, rectum, pancreas, larynx, lung, skin, bladder, testis and for the lymphomas (Table 6.1). For these sites, relative differences were more pronounced for cancers of the testis, colon, bladder and skin. In women, (Table 6.2) council tenants had worse survival for cancers of the oesophagus, colon, pancreas, lung, skin, malignant melanoma, cervix uteri, corpus uteri, ovary, bladder, lymphomas, and the leukaemias. The largest differences were observed for cancers of the pancreas, skin, corpus uterus and bladder. For prostate cancer and for the leukaemias in men and for stomach, rectal and breast cancer in women, owner occupiers had higher case-fatality rates than council tenants.

6.1.2 Male-female differences

Although the overall pattern seems similar for both sexes there are some differences. Female owner occupiers had higher SFRs for stomach and rectal cancer while male owner occupiers did not, and the converse was true for the leukaemias. Differences in pancreatic cancer were pronounced in women but not for men, whereas the opposite held true for colon cancer. This non-correspondence is to a large extent due to problems in registration. Cases registered with 0 (zero) days of survival (that is, registered with the same date of diagnosis and death) were excluded from the analysis (see section 2.2). In most sites, percentages of these cases were similar for each housing tenure category (Tables 2.2 and 2.3). Differences in proportions between owner occupiers and council tenants were significant for colon cancer in women, with council tenants having a higher percentage of cases registered with zero days of follow-up. In men, differences were significant for cancers of the rectum and the pancreas and marginally significant for the leukaemias. In the latter two sites, council tenants had higher percentages of cases with zero days survival while for rectal cancer, owner occupiers had a higher percentage than council tenants. If, as has been postulated in section 2.2, these cases are those with worse prognosis, then the discrepancies observed between sexes would be less pronounced. Inclusion of these cases would probably result in narrower (or a reversal of) differences of SFRs in rectal cancer and the leukaemias in men, and a wider difference in pancreatic cancer in men and colon cancer in women.

For those cancers in which survival differences were in the same direction for both sexes, combined estimates were calculated for the two major housing tenure groups using Poisson regression. Common rate ratios

Figure 6.1 Cancer survival in men by housing tenure, 1971-83



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are estimated for cancers of the oesophasus, colon, pancreas, lung, skin, bladder and the lymphomas. Standardisation was done for each sex separately using different rates as a standard (see section 3.1). Consequently there is no means in this analysis of estimating differences in survival between sexes. Using sex as a factor in the Poisson models provided a check on the validity of combining male and female data. In none of the seven sites for which common rate ratios were estimated did sex appear as a significant factor. As a result, common rate ratios for housing tenure groups could be calculated.

Differences were statistically significant for cancers of the colon, lung, other skin and bladder (Table 6.4), while for cancer of the pancreas differences were marginally significant (χ^2 = 3.24, p-value = 0.07). For all these sites, council tenants had higher rate ratios than owner occupiers.

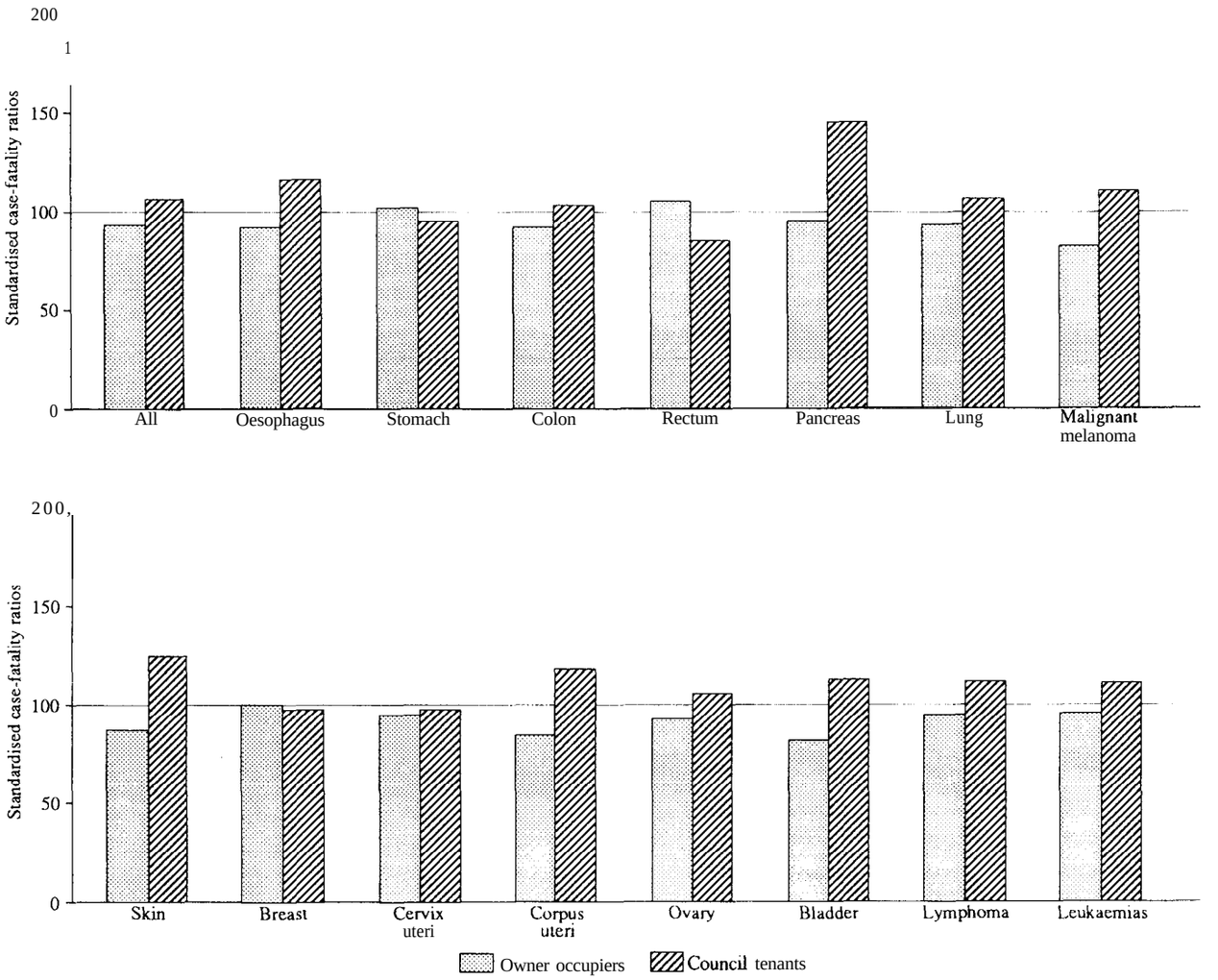
Table 6.4 Survival by housing tenure: Case-fatality rate ratios for men and women living in council houses versus owner occupiers, 1971-83

Cancer site	Rate ratios	(95%CL)
Oesophagus	1.16	(0.90-1.51)
Colon	1.24	(1.06-1.45)
Pancreas	1.25	(0.98-I .59)
Lung	1.09	(1.01-1.18)
Other skin	1.32	(1.10-1.59)
Bladder	1.26	(1.03-1.54)
Lymphomas	1.18	(0.90-I .56)

6.1.3 Survival differences by prognosis

It has been postulated that socio-economic differences would be more likely to occur in cancers of medium or good prognosis, as these are amenable to better care of earlier detection than poor prognosis cancers[2]. Results of this analysis do not bear this out. In Table 6.5, cancers are classified into four prognostic groups

Figure 6.2 Cancer survival in women, by housing tenure, 197143



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according to percentage of five-year survival. There was no clear pattern, indicating that occurrence of survival differentials was mainly related to prognosis of the cancer. Relative differences were consistent and wide for the group of cancers with the best prognosis, for example, corpus uteri, testis, malignant melanoma, but were equally present for cancers with very bad prognosis, for example, oesophagus, pancreas, lung.

6.1.4 Differences in median survival

Median survival time was calculated for the two major housing tenure groups by sex, using the life-table analysis. For cancers of poor or medium prognosis, median survival can be expected to be a close estimate of mean survival. Therefore, differences in median survival between socio-economic groups indicate the average person-time gained (or lost) for each socio-economic group.

For cancers of the stomach, pancreas and lung in both sexes, differences in median survival between owner occupiers and council tenants were around, or less than, two weeks (Table 6.6). The widest differences were observed for cancers of the bladder in both sexes and corpus uteri in women, ranging from eight months to approximately three years. For cancers of the colon, rectum, breast, cervix uteri, ovary and prostate, differences in median survival lay somewhere in between. These differences in median survival indicate that, irrespective of observed relative differences in survival, only for some cancers was there a considerable difference between housing tenure groups in length of the average person time gained (or lost).

A parametric (Weibull) distribution was applied for cancers of good prognosis in order to estimate the mean survival time for each socio-economic group, but credible estimates were obtained only for a few of these cancers. Survival can be relatively long for these cancers. Consequently, the distribution of survival times is skewed to the right, resulting in an artificial elevation of the value of the mean. Therefore, these calculations were not used further in the analysis.

Table 6.5 Survival differences (ratios of SFRs), by prognosis of the cancer? and housing tenure*, 1971-83

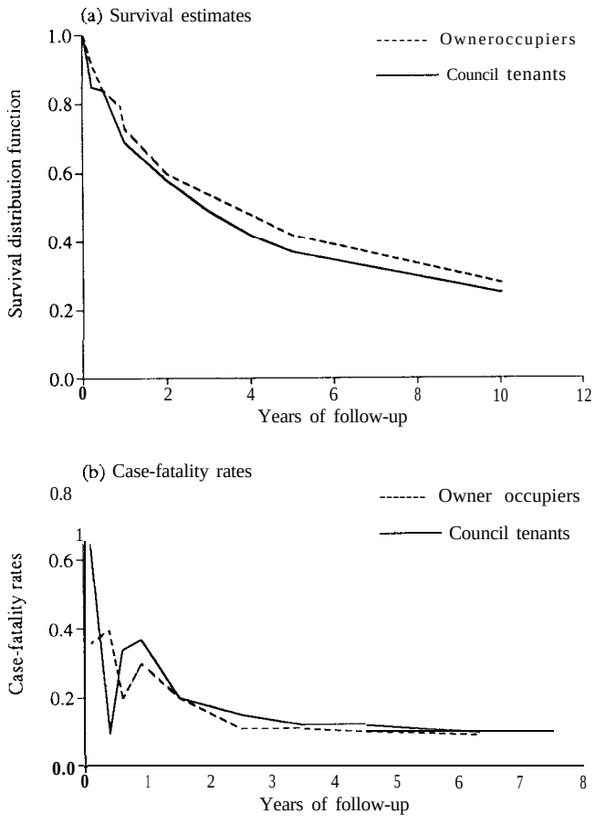
Prognosis (% 5-year relative survival)	Cancer site	Survival differences (SFR Council tenants/ SFR Owner occupiers)
Men		
1–19%	Oesophagus	1.11
	Stomach	1.10
	Pancreas	1.11
	Lung	1.08
20–39%	Colon	1.44
	Rectum	1.18
	Prostate	0.91
	Leukaemias	0.91
40–59%	Bladder	1.22
60% or more	Larynx	1.23
	Other skin	1.25
	Testis	1.62
Women		
1–19%	Oesophagus	1.26
	Stomach	0.94
	Pancreas	1.51
	Lung	1.13
20–39%	Colon	1.11
	Rectum	0.82
	Ovaries	1.14
	Leukaemias	1.20
40–59%	Breast	0.98
	Cervix uteri	1.02
	Bladder	1.41
60% or more	Melanoma	1.49
	Other skin	1.48
	Corpus uteri	1.41

t Cancers are classified according to percentage of five-year relative survival, as found in the LS (see Appendix Table 6. I).
‡ Council tenants versus owner occupiers.

Table 6.6 Median survival time of cancer cases (in years), by sex and housing tenure, 1971-83

Cancer site		Men	Women
Stomach	Owner occupiers	0.23	0.34
	Council tenants	0.23	0.35
Colon	Owner occupiers	1.03	0.96
	Council tenants	0.53	0.61
Rectum	Owner occupiers	1.34	1.00
	Council tenants	0.84	1.63
Pancreas	Owner occupiers	0.19	0.34
	Council tenants	0.18	0.30
Lung	Owner occupiers	0.27	0.39
	Council tenants	0.25	0.39
Breast	Owner occupiers		5.15
	Council tenants		5.80
Cervix uteri	Owner occupiers		6.16
	Council tenants	–	6.65
Corpus uteri	Owner occupiers		> IO
	Council tenants	–	7.19
Ovary	Owner occupiers		0.95
	Council tenants	–	0.77
Bladder	Owner occupiers	3.52	4.48
	Council tenants	2.81	1.75
Prostate	Owner occupiers	1.65	
	Council tenants	1.94	

Figure 6.3 Bladder cancer survival in men by housing tenure and follow-up period: survival estimates and case-fatality rates



6.1.5 Life-table analysis

Plotting survival curves for major cancer sites for which big differences in cancer survival were observed, indicated that owner occupiers tended to have lower case-fatality rates than council tenants throughout long periods of follow-up and especially in the initial follow-up period.

Bladder cancer for both men and women and cancer of the corpus uteri were among the sites for which owner occupiers had clearly better overall survival than council tenants (Tables 6.1 and 6.2). This was, however, not evident in all specific periods of follow-up (Figures 6.3-6.5). The better survival of owner occupiers was particularly evident for the first three months of follow-up. Nonetheless, from the third to the sixth month of follow-up for bladder cancer (Figures 6.3 and 6.4) and during the third to the ninth month of follow-up for uterine cancer (Figure 6.5), case-fatality rates of owner occupiers were higher than those of council tenants. The pattern of the case-fatality curves indicates that a considerable proportion of council tenants were diagnosed (and registered) at a very late stage of their cancer, hence their high case-fatality rates at the first period of the follow-up. It could also indicate an effect of lead-time bias, hence the temporary worse survival of owner occupiers after a few months of follow-up. Lead-time bias refers to the time period which is added to survival time not because the natural history is altered, but because diagnosis has taken place earlier in the

Figure 6.4 Bladder cancer survival in women by housing tenure and follow-up period: survival estimates and case-fatality rates

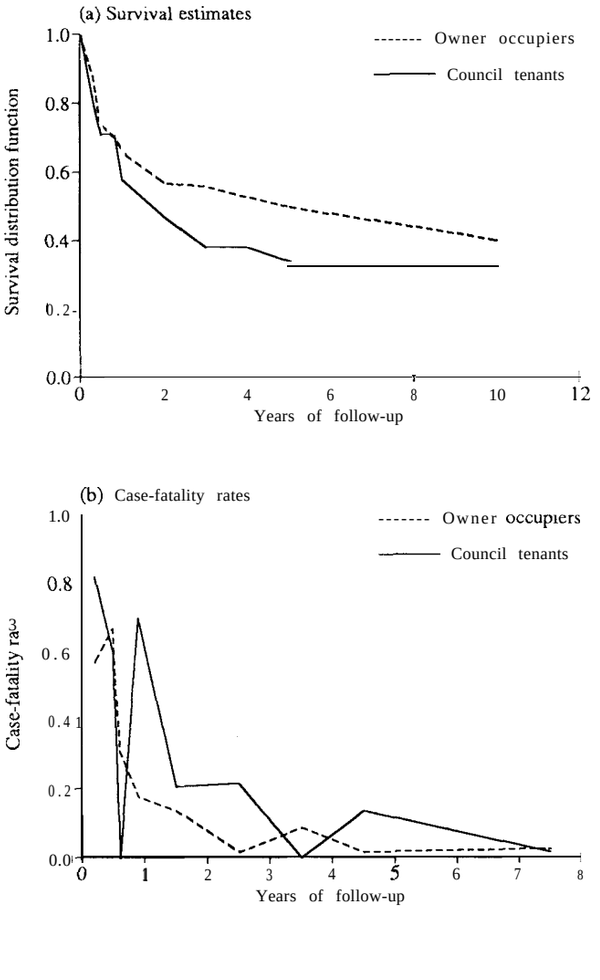
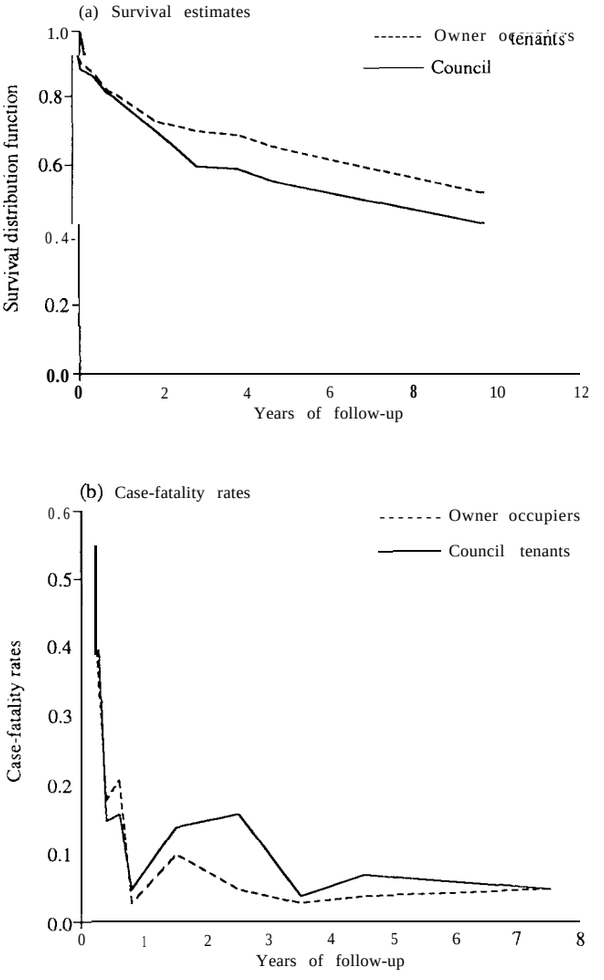


Figure 6.5 Corpus uteri cancer by tenure and follow-up period: survival estimates and case-fatality rates



natural history of the disease as a result of, for example, a screening program.[3] Further discussion of the possible role of lead-time bias in the survival comparisons is contained in Chapter 10.

Calculations of SFRs were based on the person years method, which provides a more accurate estimate than a simple calculation of the proportion surviving after a fixed period, for example five years after diagnosis. Many studies on cancer survival differentials provide only the five-year crude or relative survival rates. For reasons of comparison, these rates have been calculated and results are presented in Appendix Table 6.1. Results for both person years and life-table analyses were similar for most cancers.

6.1.6 Fatality from primary cancer

Patterns of differentials for fatality from the primary cancer only were similar to those found for fatality from all causes. In men, council tenants had higher SFRs than owner occupiers in twelve sites: oesophagus, stomach, colon, rectum, pancreas, larynx, lung, other skin, testis, bladder, lymphomas and leukaemias (Table 6.7, Figure 6.6). In prostate cancer, owner occupiers had worse survival. In women, council tenants had worse survival in eleven sites: oesophagus, colon, pancreas, lung, melanoma, other skin, cervix uteri, ovary, bladder, lymphomas and leukaemias. Owner occupiers had worse survival in cancers of the stomach, rectum, breast and corpus uteri (Table 6.8, Figure 6.7).

The biggest variation between SFRs based on all causes fatality and those based solely on fatality from primary cancer, are those observed for cancers of the skin in both sexes, and cancer of the corpus uteri in women. For skin cancer, only 2 per cent of deaths in males (8 deaths) and 6 per cent in females (16 deaths) were due to the primary cancer. The standard error of the rates are therefore very wide but it is still interesting that differences are found in a cause which should be 100 per cent curable. For corpus uteri, the wide difference in SFRs observed for all cause fatality was not evident for SFRs calculated on the basis of fatality from primary cancer alone. Council tenants had actually lower SFRs in this case. The high SFR for council tenants was partly due to deaths from cancers other than the primary (SFR = 172, Table 6.9) and to deaths from causes other than cancer (SFR = 127, Table 6.10). This difference in

Table 6.7 Standardised case-fatality ratios (SFR) for men by housing tenure, 1971-83. Fatalities from the primary cancer only

Cancer site		Owner occupiers	Council tenants	Private rented
All neoplasms	**Obs**	2,609	**1,868**	**1,137**
	Exp	**2,835.5**	**1,709s**	**1,080.2**
	SFR	92	**109**	**105**
Oesophagus	Obs	58	44	20
	Exp	63.7	42.1	15.4
	SFR	91	105	**130**
Stomach	Obs	272	179	115
	Exp	277.2	170.2	120.6
	SFR	98	105	95
Colon	**Obs**	149	75	52
	Exp	166.6	60.5	54.7
	SFR	89	124	95
Rectum	Obs	**111**	76	56
	Exp	127.2	70.1	47.9
	SFR	87	108	117
Pancreas	Obs	114	45	44
	Exp	115.1	44.0	47.8
	SFR	99	102	92
Larynx	Obs	16	16	8
	Exp	16.9	14.5	9.4
	SFR	95	110	85
Lung	Obs	843	823	450
	Exp	881.6	791.6	444.0
	SFR	96	104	101
Other skin	Obs	3	4	**1**
	Exp	4.3	2.4	**1.1**
	SFR	70	167	91
Prostate	Obs	203	81	64
	Exp	186.5	92.4	69.3
	SFR	**109**	88	92
Testis	Obs	**11**	7	5
	Exp	12.2	4.1	5.8
	SFR	90	171	86
Bladder	Obs	126	76	48
	Exp	124.3	73.7	50.6
	SFR	101	103	95
Lymphomas	Obs	62	35	17
	Exp	59.2	31.0	23.6
	SFR	105	**113**	72
Leukaemias	Obs	66	30	14
	Exp	63.1	28.0	16.9
	SFR	105	107	83

Table 6.8 Standardised case-fatality ratios (SFR) for women by housing tenure, 1971-83. Fatalities from the primary cancer only

Cancer site		Owner occupiers	Council tenants	Private rented
All neoplasms	**Obs**	2,258	**1,377**	**881**
	Exp	2,412.0	**1,292.6**	**818.4**
	SFR	94	**107**	**108**
Oesophagus	Obs	44	32	22
	Exp	45.7	28.1	26.4
	SFR	96	**114**	83
Stomach	Obs	158	112	62
	Exp	159.1	114.9	58.8
	SFR	99	97	105
Colon	Obs	207	104	87
	Exp	228.7	99.3	72.7
	SFR	91	**105**	120
Rectum	Obs	98	43	34
	Exp	91.0	56.2	30.4
	SFR	108	77	112
Pancreas	Obs	82	35	32
	Exp	88.6	23.4	31.6
	SFR	93	150	101
Lung	Obs	243	211	122
	Exp	260.8	193.0	115.2
	SFR	93	109	106
Malignant melanoma	Obs	11	12	3
	Exp	13.3	10.6	3.0
	SFR	83	113	100
Other skin	Obs	4	8	4
	Exp	8.1	3.7	3.5
	SFR	49	216	114
Breast	Obs	467	242	152
	Exp	467.9	247.8	143.7
	SFR	100	98	106
Cervix uteri	Obs	55	58	37
	Exp	60.0	58.9	31.4
	SFR	92	98	**118**
Corpus uteri	Obs	38	16	12
	Exp	39.6	18.2	11.0
	SFR	96	88	109
Ovary	Obs	154	69	44
	Exp	163.2	65.8	36.1
	SFR	94	105	**122**
Bladder	Obs	47	32	24
	Exp	59.2	25.1	17.4
	SFR	79	127	138
Lymphomas	Obs	36	26	13
	Exp	39.8	20.8	11.3
	SFR	90	125	115
Leukaemias	Obs	54	27	24
	Exp	58.5	23.2	22.8
	SFR	92	116	**105**

the results probably reflects a high percentage of misdiagnosis for cancer of the corpus uteri. Cases registered with this cancer are frequently classified on the death certificate as dying from cancer of the uterus NOS or from cervical cancer.

6.1.7 Fatality from other causes

Mortality among cases from *causes other than cancer* is more likely to reflect differentials in background mortality. SMRs for all causes were available for the whole LS population for 1971-81, and were compared with SFRs based on causes other than cancer (Table 6.11). SMRs and SFRs were very similar in men but in women differences in SFRs for causes other than cancer did not actually reflect very well the differences in background mortality.

In men, the differences in SFRs based on causes other than cancer were pronounced. Male council tenants had higher SFRs than owner occupiers for nine out of 13 sites (Table 6.12). In women the pattern was not consistent, with council tenants having better survival in ten out of the 15 sites examined (Table 6.10).

Figure 6.6 Cancer survival in men, by housing tenure, 1971-83; fatality from the primary cancer only

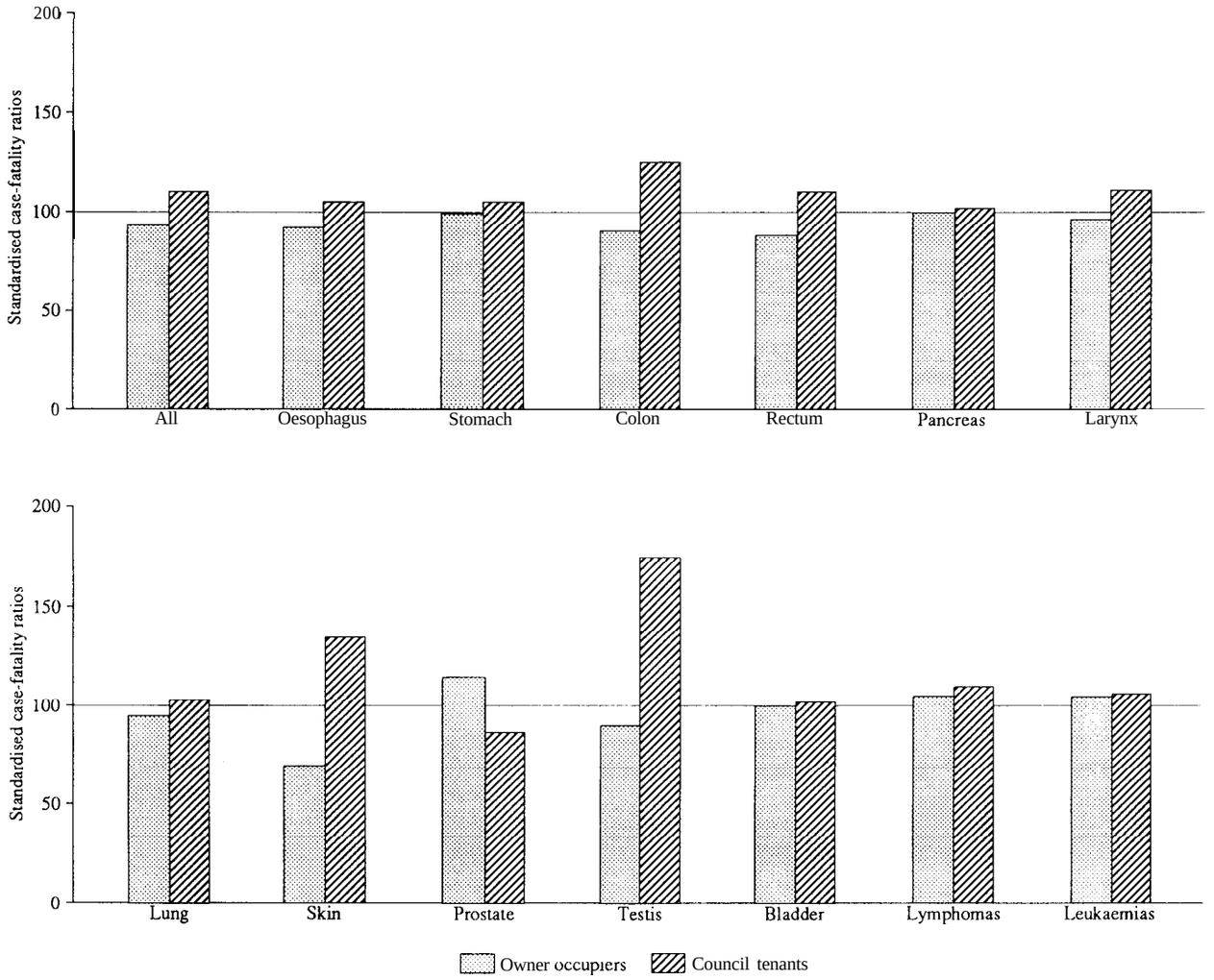


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Table 6.9 Standardised case-fatality ratios (SFR) by sex and housing tenure, 197143. Fatality from cancers other than the primary

Cancer site		Owner occupiers	Council tenants	Private rented
Men				
Rectum	Obs	32	12	7
	Exp	25.1	13.8	11.8
	SFR	127	87	59
Other skin	Obs	47	25	18
	Exp	50.3	24.5	14.8
	SFR	93	102	122
Women				
Rectum	Obs	21	13	8
	Exp	21.4	12.2	8.2
	SFR	98	107	98
Other skin	Obs	27	13	6
	Exp	28.1	12.3	8.9
	SFR	96	106	67
Corpus uteri	Obs	17	17	4
	Exp	22.6	9.9	6.2
	SFR	75	172	65

For most cancers, deaths from *cancers other than the primary* constituted a very small percentage of all deaths, making the calculation of SFRs meaningless. This was not the case, though, for cancers of the skin and rectum in both sexes and corpus uteri in women. As mentioned in Chapter 4, it is likely that a degree of misclassification occurred between colon and rectal cancer. Among cases registered with rectal cancer, 14 per cent in men and 16 per cent in women were coded on the death certificate as dying from another cancer. In women with rectal cancer, SFRs based on fatality from other cancers reflected closely the pattern observed for colon cancer, suggesting that some of these deaths were due to colon cancer (Table 6.9). This was not the case in men. Differences in SFRs for fatality from cancers other than the primary were moderate for skin cancer.

6. I. 8 Survival differences by age

Survival differences in older men (aged 65 or over) were of a similar pattern to that for all ages. Council tenants had lower SFRs than owner occupiers only for prostate cancer, the leukaemias, and the lymphomas (Appendix

Figure 6.7 Cancer survival in women, by housing tenure, 1971-83; fatality from the primary cancer only

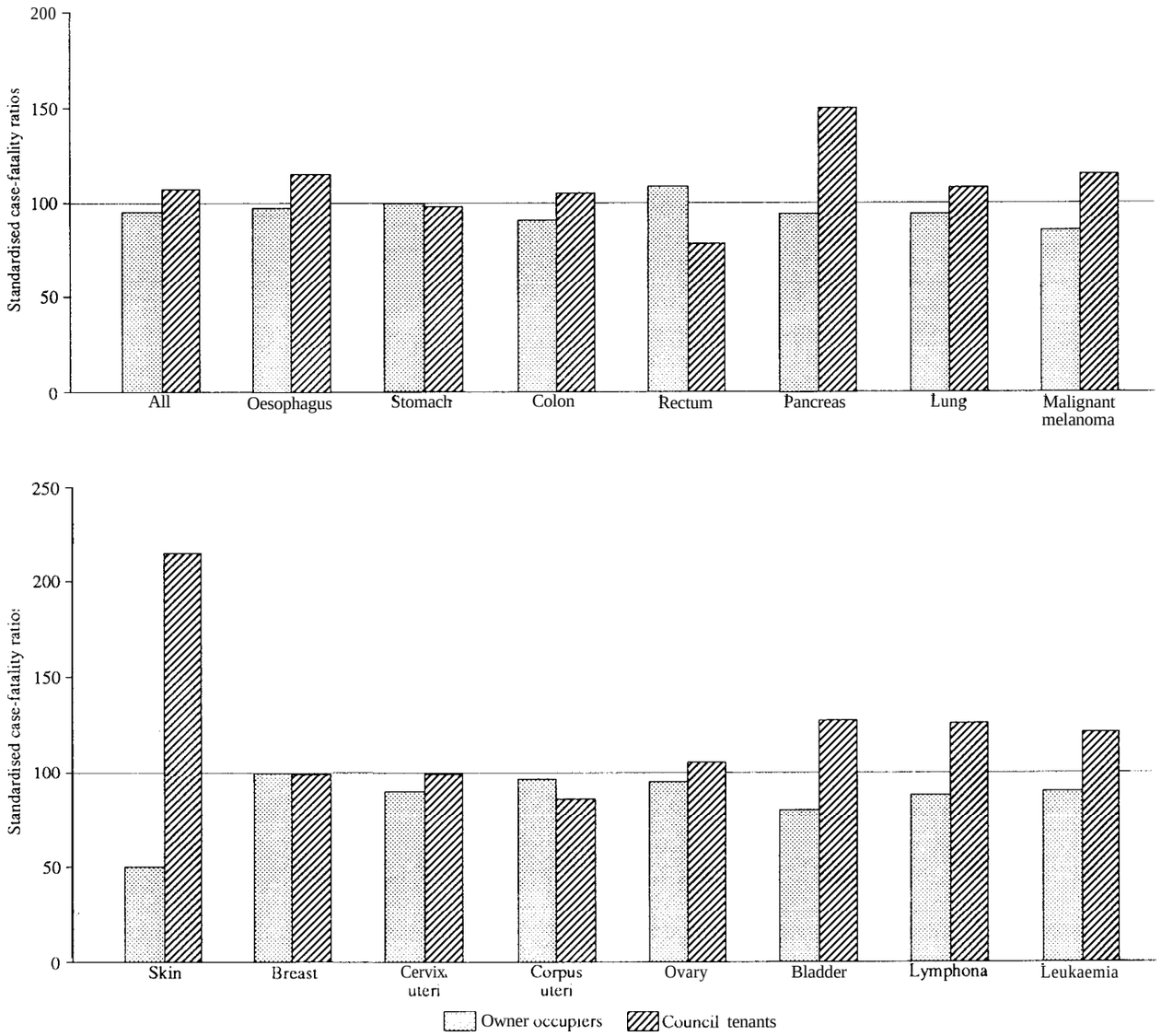

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Table 6.2). At younger ages (that is less than 65 years), council tenants had lower case-fatality for cancers of the oesophagus, pancreas, larynx and bladder. Roughly similar results were observed for SFRs calculated only for fatality from primary cancers.

Survival differentials in younger women (less than 60 years of age) and in older women (that is, aged 60 or over) were similar to those for all ages (Appendix Table 6.3). Younger council tenants had worse survival in 12 sites, better survival for stomach cancer, and nearly equal levels for cancers of the rectum and breast. At older ages, council tenants had better or nearly equal levels for cancers of the stomach, breast, ovary and the leukaemias.

Age standardisation provides accurate estimates of survival differences under certain assumptions (see section 3.2). As mentioned above, differences between socio-economic groups by age were not constant or even in the same direction for some cancers. To evaluate whether this type of difference could have biased the calculation of an overall SFR for all ages, Poisson regression using GLIM was applied for the two major housing tenure groups.

In both men and women, age was not found to be a significant factor in the log-linear models in any of the specific cancer sites. With the exception of bladder cancer in men, models including the variables age and housing tenure provided a good fit. These results should not be interpreted as indicating that age is unrelated in general to survival, as the overall effect of age was first taken into account by standardisation. The fact that age does not appear as a significant factor in these models indicates that SFRs calculated for all ages combined, provide an accurate description of survival differences between owner occupiers and council tenants (with the possible exception of bladder cancer in men). Variation by age seems to result from the disaggregation of numbers that were not large even at all ages.

Table 6.10 Standardised case-fatality ratios (SFR) for women by housing tenure, 1971-83. Fatalities from causes other than cancer

Cancer site		Owner occupiers	Council tenants	Private rented
All neoplasms	**Obs**	**451**	220	202
	Exp	482.3	223.6	173.5
	SFR	94	98	**116**
Oesophagus	Obs	5	6	6
	Exp	7.9	4.4	4.7
	SFR	63	136	128
Stomach	Obs	9	6	6
	Exp	8.7	7.4	4.5
	SFR	103	81	133
Colon	Obs	47	19	17
	Exp	48.1	20.4	15.2
	SFR	98	93	112
Rectum	Obs	17	11	6
	Exp	17.9	10.4	6.2
	SFR	95	106	97
Pancreas	Obs	9	3	3
	Exp	6.9	2.4	7.0
	SFR	130	125	43
Lung	Obs	12	6	7
	Exp	12.6	6.9	5.7
	SFR	95	87	123
Malignant melanoma	Obs	5	1	0
	Exp	4.8	2.2	0
	SFR	104	45	–
Other skin	Obs	94	50	36
	Exp	105.7	40.9	34.0
	SFR	89	122	106
Breast	Obs	122	50	52
	Exp	124.1	52.6	48.7
	SFR	98	95	107
Cervix uteri	Obs	9	5	8
	Exp	8.0	7.7	6.1
	SFR	113	65	131
Corpus uteri	Obs	20	14	12
	Exp	26.1	11.o	8.4
	SFR	77	127	143
Ovary	Obs	11	4	4
	Exp	12.5	4.4	2.9
	SFR	88	91	138
Bladder	Obs	6	4	5
	Exp	7.0	4.8	3.3
	SFR	86	83	152
Lymphomas	Obs	17	4	4
	Exp	14.3	7.0	3.1
	SFR	119	57	129
Leukaemias	Obs	13	6	2
	Exp	12.9	4.7	4.2
	SFR	101	128	48

Table 6.11 SFRs based on fatalities from causes other than cancer, and SMRs from all causes, by housing tenure†

	Men		Women	
	SMR	SFR	SMR	SFR
Owner occupiers	88	89	88	94
Council tenants	113	111	107	98

†*SMRs for 1971–81.*

Table 6.12 Standardised case-fatality ratios (SFR) for men by housing tenure, 1971-83. Fatalities from causes other than cancer

Cancer site		Owner occupiers	Council tenants	Private rented
All neoplasms	**Obs**	507	**317**	222
	Exp	567.3	285.2	203.7
	SFR	89	**111**	109
Oesophagus	Obs	9	5	3
	Exp	9.5	4.3	2.3
	SFR	95	116	130
Stomach	Obs	21	11	11
	Exp	22.5	12.6	8.5
	SFR	93	87	129
Colon	Obs	38	27	18
	Exp	44.6	16.6	20.1
	SFR	85	163	90
Rectum	Obs	32	23	IO
	Exp	37.5	17.7	11.0
	SFR	85	130	91
Pancreas	Obs	7	6	5
	Exp	11.2	3.0	3.2
	SFR	63	200	156
Larynx	Obs	7	7	2
	Exp	5.3	6.0	4.7
	SFR	132	117	43
Lung	Obs	52	43	30
	Exp	55.0	44.2	24.9
	SFR	95	97	120
Other skin	Obs	133	74	42
	Exp	147.5	63.6	42.6
	SFR	90	116	99
Prostate	Obs	79	48	38
	Exp	86.5	45.2	37.5
	SFR	91	106	101
Testis	Obs	1	0	0
	Exp	0.3	0.2	0.2
	SFR	333	–	–
Bladder	Obs	36	32	23
	Exp	48.0	25.6	18.7
	SFR	75	125	123
Lymphomas	Obs	9	8	4
	Exp	10.8	5.3	4.7
	SFR	83	151	85
Leukaemias	Obs	13	1	7
	Exp	11.9	5.0	4.4
	SFR	109	20	159

For bladder cancer in men, models including age and housing tenure did not provide a good fit (scaled deviance = 6.29, with 2 degrees of freedom). This indicates that, for this cancer site, the overall SFR might not provide an accurate description of fatality patterns. However, even in this case the rate ratios found after including age in the regression model were very similar to the ratios of overall SFRs as found from the standardisation. Nonetheless, it might be preferable, for this site, to refer to separate SFRs by age-group than to a summary measure. An interaction term including housing tenure and age was statistically significant. This term should be interpreted as explaining the differing

pattern of survival differentials among housing tenure groups by age.

6.1.9 Privately rented accommodation

Cancer survival of persons living in privately rented accommodation was generally between the two extreme groups (owner occupiers and council tenants). For men, those in privately rented accommodation had higher SFRs than owner occupiers for eight of the 13 cancers examined (Table 6.1). Only in two sites (oesophagus and prostate) did they have a higher SFR than council tenants. A similar pattern is evident for SFRs based on fatality from the primary cancer (Table 6.7), and on fatality from causes other than cancer (Table 6.12). Women living in privately rented accommodation had higher SFRs than owner occupiers in 11 sites and lower or nearly equal in four (Table 6.2). Compared with council tenants, they had higher SFRs in nine sites but in two of these (lung and lymphomas) the SFRs were nearly equal. For SFRs based on fatality from the primary cancer (Table 6.8) and on fatality from causes other than cancer (Table 6.10), their survival was clearly worse than that of owner occupiers and similar to that of council tenants.

6.1.10 Cases in non-private households

SFRs of persons living in non-private households at the 1971 census were higher in a number of sites, although there was no general pattern (Appendix Tables 6.4 and 6.5). The problems of incomplete registration were especially pronounced in this group, making an accurate estimate of their survival experience difficult (see Table 2.2 and 2.3). Furthermore, numbers are small, which prevents meaningful calculation of time trends.

6.2 Social class: men

The social class classification comprises six main social classes and three residual groups. For most of the survival analyses, the six social classes were aggregated into two larger groups, non-manual and manual. Two of the residual groups, 'Inadequately described' and 'Unoccupied', include health selected persons (that is, persons assigned to these groups because of health problems) and had high SFRs (Table 6.13). The third group, 'Armed forces', is very small. These residual groups were omitted from further analysis as they do not provide any specific information about socio-economic differences in survival. Survival of the unemployed is evaluated in section 6.3.

Analysis by social class supports the findings for housing tenure. In all three cancers examined, manual social classes had worse survival (Table 6.14). Differences were significant for colon and bladder cancer. For colon cancer, the SFR for men in manual social classes was 111, compared with 80 for non-manual; for bladder cancer, the SFR for men in manual classes was 107, compared with 84 for men in non-manual classes. However, increasing risk of dying by social class was not constant (Table 6.13, Figure 6.8) and a test for trend with class, assuming a constant increasing risk from Social Class I to Social Class V, was significant only for colon cancer.

Table 6.13 Standardised case fatality ratios for men by social class, 1971-83

Social class		Colon cancer	Lung cancer	Bladder cancer
I	Obs	14	42	9
	Exp	21.4	43.5	11.6
	SFR	65	97	78
II	Obs	71	333	54
	Exp	81.3	358.6	59.0
	SFR	87	93	92
III NM	Obs	44	212	34
	Exp	57.9	207.7	45.5
	SFR	76	102	75
III M	Obs	124	767	135
	Exp	116.4	767.9	127.2
	SFR	107	100	106
IV	Obs	83	516	68
	Exp	67.1	545.3	66.5
	SFR	124	95	102
V	Obs	24	273	39
	Exp	24.1	244.3	33.2
	SFR	100	112	117
Armed forces	Obs	0	1	3
	Exp	–	4.6	1.9
	SFR	–	22	158
Inadequately described	Obs	36	132	30
	Exp	35.9	118.2	29.2
	SFR	100	112	103
Unoccupied	Obs	14	64	9
	Exp	6.1	50.0	6.8
	SFR	231	128	132
χ^2 heterog. (5 degrees of freedom)		11.54*	6.72	5.46
χ^2 trend (1 degree of freedom)		7.28**	1.79	3.06

Chi-squares are calculated only for the six social classes using Kilpatrick's technique.
** = $0.01<p<0.05$.*
*** = $p<0.01$.*

The pattern observed for fatality from all causes was also reflected in SFRs calculated using only deaths from the primary cancer or deaths from causes other than cancer (Table 6.14). Survival differentials were consistent in different age-groups although slightly more pronounced in older men (not shown). Analysis of social class differentials including age-specific observed and expected values and of an age term in the Poisson regression model did not show any bias in the calculation of SFRs.

As in the analysis by tenure, alternative methods of survival analysis (one, three and five-year crude survival rates) are presented in Appendix Table 6.6 for non-manual and manual social classes.

6.3 Economic position: men

Classification by economic position at 1971 Census separates the population of cancer cases into five main groups. Two of these groups, 'Temporarily out of work sick' and 'Permanently sick', include persons selected

Figure 6.8 Cancer survival in men by social class, 1971-83

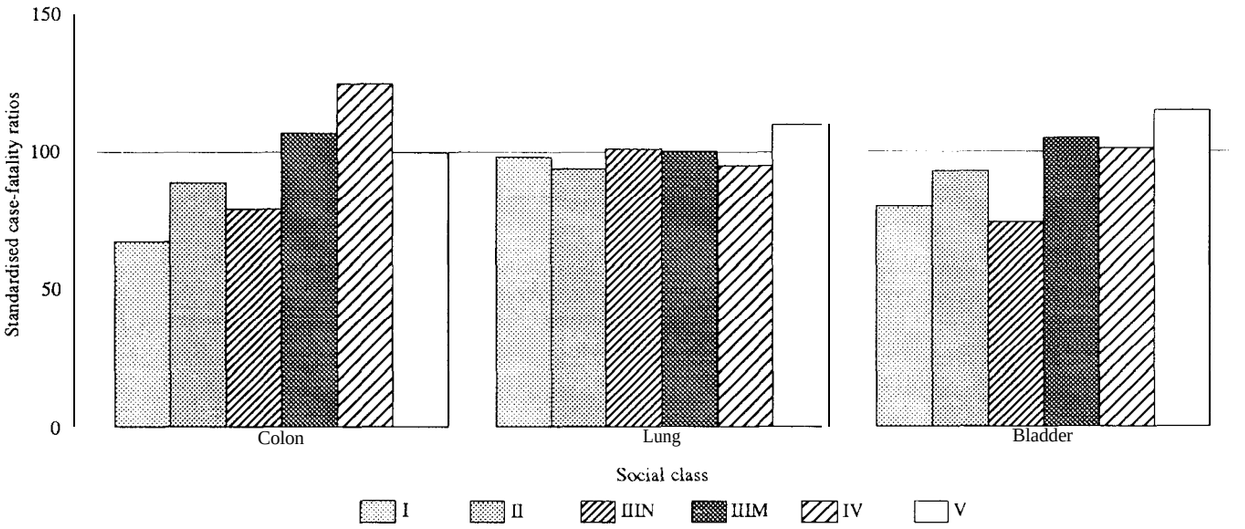

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Table 6.14 Standardised case-fatality ratios (SFR) for men by grouped social class and cause of death 1971-83

Cancer site and cause of death		Non-manual	Manual	χ^2
Colon cancer				
All cause	Obs	129	231	8.87**
	Exp	160.6	207.6	
	SFR	80	111	
Primary cancer	Obs	93	158	3.27
	Exp	111.3	149.4	
	SFR	84	106	
Other causes	Obs	32	43	0.71
	Exp	34.4	38	
	SFR	93	113	
Lung				
All causes	Obs	587	1,556	0.59
	Exp	609.8	1,557.5	
	SFR	96	100	
Primary cancer	Obs	539	1,435	0.44
	Exp	558.8	1,438.5	
	SFR	96	100	
Other causes	Obs	32	84	0.38
	Exp	34.8	80.4	
	SFR	92	104	
Bladder cancer				
All causes	Obs	97	242	4.15*
	Exp	116.1	226.9	
	SFR	84	107	
Primary cancer	Obs	69	162	1.17
	Exp	76.4	153.6	
	SFR	90	105	
Other causes	Obs	18	60	5.20*
	Exp	29.3	53.4	
	SFR	61	112	

Chi-square calculated using Kilpatrick's technique.
* = $0.01<p<0.05$.
** = $p<0.01$.

for ill-health. Their survival was worse than other categories of economic position (Table 6.15) and will not be discussed any further.

It is likely that registration problems have affected the comparison of SFRs, diminishing artificially the SFRs of unemployed and even more so of retired men. Among unemployed men, 10.4 per cent (n = 10) of those registered with lung cancer and 18.8 per cent ($n = 3$) of those registered with colon cancer had the same date of registration and death, and were consequently not taken into account in the survival analysis. Equivalent proportions for those retired were 14.1 per cent (n = 119) for lung cancer and 13.9 per cent (n = 31) for colon cancer. These proportions were lower for employed men. As speculated in section 2.2, these cases are likely to be those with the worse prognosis. Comparisons for colon cancer are especially affected.

For men registered with lung cancer, the unemployed had higher SFRs than the employed, irrespective of the specific cause of death, although none of these differences were statistically significant (Table 6.15). Survival for colon cancer was found to be better in the unemployed but it should be noted that confidence limits were wide because of small numbers.

An estimation of survival differences, when cases with the same date of registration and death were included in the analysis, showed that the survival advantage of unemployed men for colon cancer was totally removed. For lung cancer, differences were unchanged. As in the previous chapter for the whole LS population, life-table analyses were conducted excluding, or alternatively including, cases with the same anniversary date and date of death, and assuming that they would have died during the first two years of follow-up. The five-year survival rate for colon cancer in the unemployed

Table 6.15 Standardised case-fatality ratios (SFR) in men for lung and colon cancer, by economic position and cause of death, 1971-83

Cancer site		All cause fatalities	Fatalities from primary cancer	Fatalities from causes other than cancer
Lung cancer				
Employed	Obs	1,452	1,353	60
	Exp	1,485.9	1,380.9	67.5
	SFR	98	98	89
Unemployed	Obs	83	76	6
	Exp	75.2	70.2	3.2
	SFR	110	108	188
Retired	Obs	705	634	55
	Exp	701.7	631.4	52.8
	SFR	100	100	104
Temporarily out of work, sick	Obs	36	33	2
	Exp	27.1	25.8	0.8
	SFR	133	128	250
Permanently sick	Obs	62	56	4
	Exp	49.2	45.1	2.7
	SFR	126	124	148
Colon cancer				
Employed	Obs	201	152	31
	Exp	219.9	164.9	35.4
	SFR	91	92	88
Unemployed	Obs	9	7	1
	Exp	13.1	9.4	2.4
	SFR	69	74	42
Retired	Obs	182	116	50
	Exp	169.2	109.8	44.0
	SFR	108	106	114
Temporarily out of work, sick	Obs	4	2	1
	Exp	1.7	1.5	0.2
	SFR	235	133	500
Permanently sick	Obs	8	8	0
	Exp	2.3	1.9	0.3
	SFR	348	421	0

decreased from 35 per cent to 28 per cent when these cases were included in the analysis. The corrected survival rate nearly equalled that of employed men, which decreased from 28 per cent to 27 per cent (Table 6.16). For lung cancer, changes in the five-year survival rate were small.

Table 6.16 Life-table analysis for colon and lung cancer in employed and unemployed men, including or alternatively not including cases with the same date of registration and death†

	Including cases			Not including cases		
	Percentage surviving:			Percentage surviving:		
	1 year	3 years	5 years	1 year	3 years	5 years
Lung Cancer						
Employed	20%	8%	6%	21%	9%	7%
Unemployed	15%	5%	4%	15%	6%	4%
Colon Cancer						
Employed	54%	32%	27%	55%	33%	28%
Unemployed	63%	38%	28%	69%	46%	35%

†*Cases with the same date of registration and death are not included in any survival statistic as they are registered with zero (0) days of survival (see text for details).*

For both cancers, case fatality for the unemployed was higher in younger ages (SFR= 124 for lung and SFR = 148 for colon, Appendix Table 6.7). The effect of the variability of survival differentials according to age on the calculation of an overall SFR, was evaluated using GLIM. There was no indication that age produced any important distorting effect when the unemployed were compared with the employed, with only a slight increase in the rate ratio of the latter occurring in colon cancer.

Estimation of SFRs by year of registration indicated that, for lung cancer, survival was worse for unemployed men who had been registered with cancer in 1976-81 than for those registered in the first five-year period (Table 6.17). However, this difference was not significant. Numbers were too small to allow similar calculations for colon cancer.

Table 6.17 Standardised case-fatality ratios (SFR) for lung cancer in employed and unemployed men, by period of registration, 1971-83

Period of registration		Employed	Unemployed
1971-75	Obs	610	37
	Exp	611.1	38.1
	SFR	100	97
1976681	Obs	842	46
	Exp	869.5	42.1
	SFR	97	109

Persons retired at 1971 Census have average SFRs for lung cancer and higher than average SFRs for colon cancer although not significantly so. As mentioned above, it is difficult to evaluate the magnitude of the effect for this group because a considerable number of them had incomplete dates of cancer registration.

6.4 Marital status: men

Differences in cancer survival by marital status were examined for two sites (colon and prostate) in conjuction with housing tenure. Problems of registration of colon cancer for single and widowed/divorced persons probably resulted in an artificial decrease of their SFRs (see section 2.2).

Married men had the best survival for both sites (Table 6.18). Single and widowed/divorced men had equally raised SFRs for colon cancer. Only for prostate cancer were the differences in SFRs between marital status groups significant ($\chi^2 = 8.21$ with 2 degrees of freedom, p-value $= 0.02$), with single men having a SFR of 149 (95% CL 1.09-1.98). Differences for SFRs based on deaths from primary cancer were significant for both sites.

Analysing status by housing tenure, using GLIM, indicated that for colon cancer, housing tenure was the only significant variable ($\chi^2 = 9.92$ with 3 degrees of freedom, $p<0.01$), with council tenants and those in non-private households having the highest case-fatality (Table 6.19). The opposite held true for prostate cancer.

Table 6.18 Standardised case-fatality ratios (SFR) for colon and prostate cancer in men by marital status and cause of death, 1971-83

Marital status		All cause fatalities	Fatalities from the primary cancer
Colon cancer			
Single	Obs	28	21
	Exp	22.2	16.1
	SFR	126	127
Married	Obs	323	222
	Exp	341.0	238.2
	SFR	95	93
Widowed/ divorced	Obs	59	45
	Exp	46.7	33.1
	SFR	126	136
Prostate cancer			
Single	Obs	47	29
	Exp	31.6	18.6
	SFR	149	156
Married	Obs	415	278
	Exp	432.0	281.8
	SFR	96	99
Widowed/ divorced	Obs	93	49
	Exp	91.2	55.7
	SFR	102	88

Table 6.19 Case-fatality rate ratios (RR) for men registered with colon or prostate cancer by marital status and housing tenure?, 1971-83

	RR	(95% CL)	χ^2
Colon cancer			
Marital status*			4.05
Married	1		
Single	1.29	(0.87-1.90)	
Widowed and divorced	1.29	(0.97-1.70)	
Housing tenure ø			8.61*
Owner occupier	1		
Council tenant	1.42	(1.12-1.79)	
Private rented	1.12	(0.87-1.45)	
Non-private households	1.35	(0.75-2.44)	
Prostate cancer			
Marital status			7.23*
Married	1		
Single	1.55	(1.15-2.09)	
Widowed and divorced	1.06	(0.85-1.33)	
Housing tenure			2.64
Owner occupier	1		
Council tenant	0.92	(0.75-1.12)	
Private rented	0.92	(0.74-1.15)	
Non-private households	1.33	(0.83-2.15)	

†*Married men and owner occupiers are taken as the baseline group in all models.*
**Controlling for housing tenure.*
øControlling for marital status.
** = 0.01 < p < 0.05.*

Marital status was the only significant variable ($\chi^2 = 7.23$ with 2 degrees of freedom, p-value <0.05) with single men having a higher risk of dying (case-fatality rate ratio = 1.55, 95% CL 1.15–2.09), while housing tenure did not differentiate well between groups.

The effect of age was examined, as in previous sections, using Poisson regression. For neither site was age found to be a factor biasing the calculation of an SFR over all ages. The majority of cases and deaths in prostate cancer occurred at older ages and consequently estimates for young men are very unstable. In colon cancer a roughly similar pattern occurred at all ages.

6.5 Social class and marital status: women

In this analysis, women's own social class was analysed by marital status and, for married women, by their husband's social class. Data were analysed for colon, breast, and cervical cancer and are presented for each site separately. For the analyses using Poisson regression, married women and those who themselves, or their husbands, were classified to a non-manual social class were taken as the baseline group.

6.5.1 Colon *cancer*

Single women registered with colon cancer had a statistically significant high risk of dying (rate ratio = 1.33, 95% CL 1.02–1.71), although overall survival differences between marital status groups were not significant (Table 6.20). Women in manual social classes, women with inadequately described occupations, and those unoccupied (mainly housewives) had worse survival than those in non-manual social classes, but differences were not significant. Similar results were obtained when marital status was analysed by own social class.

When analysis was limited only to married women, those in a manual social class and those with a husband who was unoccupied or who had an inadequately

Table 6.20 Case-fatality rate ratios (RR) for women registered with colon cancer by marital status and own social class, 1971–83†

Variable in the model	RR (95% CL)	χ^2	degrees of freedom
Marital status		4.53	(2)
Married	1		
Single	1.33 (1.02-1.72)		
Widowed and divorced	1.10 (0.92-1.32)		
Own social class		2.28	(3)
Non-manual	1		
Manual	1.24 (0.91-1.68)		
Inadequately described	1.05 (0.80-1.39)		
Unoccupied	1.07 (0.82-1.39)		
Marital **status** and own social class			
Marital status		5.07*	(2)
Single	1.35 (1.04-1.77)		
Widowed and divorced	1.12 (0.93-1.34)		
Own social class		2.82	(3)
Manual	1.28 (0.94-1.73)		
Inadequately described	1.07 (0.81-1.42)		
Unoccupied	1.14 (0.87-1.49)		

†*Married women and women in non-manual social class are taken as the baseline group in all models.*
** = 0.05 < p < 0.1.*

described occupation had the worse survival. However, neither a woman's own social class nor her husband's social class differentiated well between the survival of cancer cases.

6.5.2 Breast cancer

Widowed and divorced women with breast cancer had high case-fatality rates (rate ratio= 1.14, 95% CL 0.99–1.30), compared with married or single women, but marital status was not a significant variable in the regression (Table 6.21). Own social class was a marginally significant variable and women in a manual social class had worse survival than those in non-manual occupations (rate ratio of dying for manual = 1.24, 95% CL 1.03-1 .48). Limiting the analysis to women in non-manual and manual social classes gave the same results, although in this case own social class was significant (Appendix Table 6.8). A similar analysis was carried out for married women only, but neither own social class nor husband's social class were significant. However, women in a manual social class or with a husband in a manual social class had worse survival than non-manual social classes.

6.5.3 Cervical cancer

There were non significant differences between marital status groups for survival of women registered with cervical cancer. Single women were found to have the best survival (rate ratio for single = 0.91) but the upper 95 per cent confidence limit was well above unity (Table 6.22). No significant differences were found between social classes although, as with breast and colon cancer, women in non-manual occupations had better survival than the other three groups. In a model with both marital status and own social class, the rate ratio for single women came very close to unity because of a positive correlation between single status and social classes other than non-manual. When the analysis was carried out only for married women, differences were not significant either for own social class or for husband's social class.

Table 6.21 Case-fatality rate ratios (RR) for women registered with breast cancer by marital status and own social class, 1971–83†

Variable in the model	RR (95% CL)	χ^2	degrees of freedom
Marital status		3.40	(2)
Married	1		
Single	1.01 (0.85-1.20)		
Widowed and divorced	1.14 (0.99-1.30)		
Own social class		6.63	(3)
Non-manual	1		
Manual	1.24 (1.03-1.48)		
Inadequately described	1.13 (0.94-1.35)		
Unoccupied	1.04 (0.89-1 .22)		
Marital status and own social class			
Marital status		3.05	(2)
Single	1.02 (0.85-1.22)		
Widowed and divorced	1.13 (0.99-1.31)		
Own social class		6.28	(3)
Manual	1.24 (1.03-1.49)		
Inadequately described	1.09 (0.91-1.32)		
Unoccupied	1.04 (0.89-1 .23)		

†*Married women and those in non-manual social classes are taken as the baseline group in all models.*

Table 6.22 Case-fatality rate ratios (RR) for women registered with cervical cancer by marital status and own social class, 1971–83†

Variable in the model	RR (95% CL)	χ^2	degrees of freedom
Marital status		0.48	(2)
Married	1		
Single	0.90 (0.44-1.85)		
Widowed and divorced	1.10 (0.80-1.51)		
Own social class		2.59	(1)
Non-manual			
Manual	i.28 (0.81-2.03)		
Inadequately described	1.51 (0.90-2.54)		
Unoccupied	1.31 (0.84-2.03)		

†*Married women and those in non-manual social classes are taken as the baseline group in all models.*

6.6 Geographic variation

Differences in survival by Regional Health Authority (RHA) were examined for two sites in men (colon, bladder) and three sites in women (colon, breast, cervix).

The range of SFRs was wide in all sites examined. The widest range was found in men for bladder cancer, from a low of 57 for North West Thames to a high of 149 for Northern RHA (Table 6.23). In women, the widest differences were found for cervical cancer, ranging from a low of 56 in South West Thames to a high of 161 in Northern RHA (Table 6.24). Differences between RHAs were, however, not statistically significant. Similar results were obtained for SFRs based on deaths from the primary cancer only (Appendix Table 6.9 for men and Appendix Table 6.10 for women). SFRs for deaths from causes other than cancer were mostly based on few deaths and are not presented.

The 15 RHAs were also aggregated into three larger geographical regions roughly corresponding to the grouping of standard regions used in the first LS report.[4] In all five sites, SFRs were lower in the South and East region (Figures 6.9 and 6.10). Statistically significant differences in survival between the three grouped regions were found for bladder cancer in males ($\chi^2 = 10.97$ with 2 degrees of freedom, p-value = 0.004) and also for colon cancer in females ($\chi^2 = 8.52$ with 2 degrees of freedom, p-value = 0.014). A test for trend was applied to this data to see whether the north-south trend observed in cancer mortality4 and cancer incidence[5] (see also Tables 4.13 and 4.14), is also present for cancer survival. Significant results were found for colon and breast cancer in women, and for bladder cancer in men.

Published data from the Hospital In-patient Enquiry,[6] gave the opportunity of correlating health services provision indicators for each RHA with cancer survival.

Table 6.23 Standardised case-fatality ratios (SFR) for men registered with colon cancer or bladder cancer, by Regional Health Authority, 1971-83.

Regional Health Authority		Colon	Bladder
All males	**Obs**	**410**	**381**
Northern	Obs	30	31
	Exp	32.1	20.8
	SFR	93	149**
Yorkshire	Obs	30	30
	Exp	27.4	29.3
	SFR	109	102
Trent	Obs	40	40
	Exp	30.5	33.3
	SFR	131	120
East Anglia	Obs	16	14
	Exp	13.0	16.4
	SFR	123	85
NW Thames	Obs	25	20
	Exp	27.2	35.0
	SFR	92	57**
NE Thames	Obs	18	31
	Exp	19.7	25.6
	SFR	91	121
SE Thames	Obs	34	35
	Exp	23.7	39.4
	SFR	143*	89
SW Thames	Obs	32	15
	Exp	32.8	16.6
	SFR	98	90
Wessex	Obs	19	28
	Exp	20.2	28.0
	SFR	94	100
Oxford	Obs	16	11
	Exp	19.3	17.2
	SFR	83	64
South Western	Obs	21	24
	Exp	30.0	26.3
	SFR	70	91
West Midlands	Obs	45	36
	Exp	48.8	40.3
	SFR	92	89
Mersey	Obs	22	19
	Exp	22.3	16.3
	SFR	99	117
North Western	Obs	42	26
	Exp	38.8	21.2
	SFR	108	123
Wales	Obs	20	21
	Exp	24.2	15.3
	SFR	83	137
chi-square		13.5	21.4
degrees of freedom		14	14
p-value		0.49	0.09

* =p < 0.10.
***=p < 0.05*

Table 6.24 Standardised case-fatality ratios (SFR) for women registered with colon or breast or cervical cancer, by Regional Health Authority, 1971-83

Regional Health Authority		Colon	Breast	Cervical
All females	**Obs**	542	**1,155**	**195**
Northern	Obs	37	72	14
	Exp	31.5	66.4	8.7
	SFR	117	108	161
Yorkshire	Obs	45	74	20
	Exp	46.4	77.6	12.7
	SFR	97	95	157**
Trent	Obs	51	115	17
	Exp	43.8	112.2	21.3
	SFR	116	103	80
East Anglia	Obs	24	51	8
	Exp	35.6	55.7	9.8
	SFR	67*	92	82
NW Thames	Obs	32	74	11
	Exp	27.5	71.1	13.1
	SFR	116	104	84
NE Thames	Obs	28	68	15
	Exp	25.8	71.8	12.2
	SFR	109	95	123
SE Thames	Obs	50	89	16
	Exp	46.8	79.0	14.6
	SFR	107	113	110
SW Thames	Obs	33	58	8
	Exp	42.7	79.2	14.2
	SFR	77	73**	56
Wessex	Obs	24	60	7
	Exp	25.3	72.0	12.0
	SFR	95	83	58
Oxford	Obs	27	51	4
	Exp	35.5	51.9	5.1
	SFR	76	98	78
South Western	Obs	26	93	12
	Exp	38.7	95.5	11.4
	SFR	67**	97	105
West Midlands	Obs	47	127	18
	Exp	35.4	120.9	16.1
	SFR	133*	105	112
Mersey	Obs	31	51	9
	Exp	29.8	52.9	10.1
	SFR	104	96	89
North Western	Obs	62	96	24
	Exp	54.4	86.8	21.4
	SFR	114	111	112
Wales	Obs	25	76	12
	Exp	22.8	62	12.3
	SFR	110	123	98
chi-square		20.7	15.0	15.5
degrees of freedom		14	14	14
p-value		0.109	0.281	0.344

*** =p < 0.10.**
***=p < 0.05.*

Median waiting times of patients for admission to hospital were available for breast and cervical cancer. Correlation of median waiting time with the SFRs for each RHA was totally absent for breast cancer (correlation coefficient = – 0.14, p-value = 0.63), but was highly significant for cervical cancer (Pearson correlation coefficient = 0.68, p-value = 0.005, Figure 6.11). However, differences in median waiting time are too small to allow any further analysis, even if the correlation for cervical cancer is significant.

Figure 6.9 Survival for men registered with colon or bladder cancer by grouped regional health authority, 1971-83

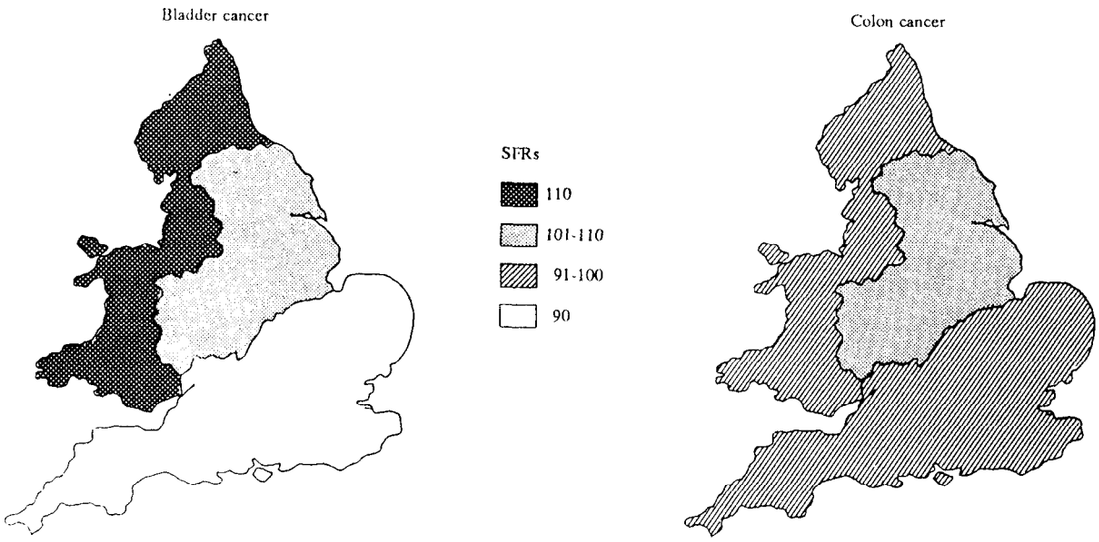
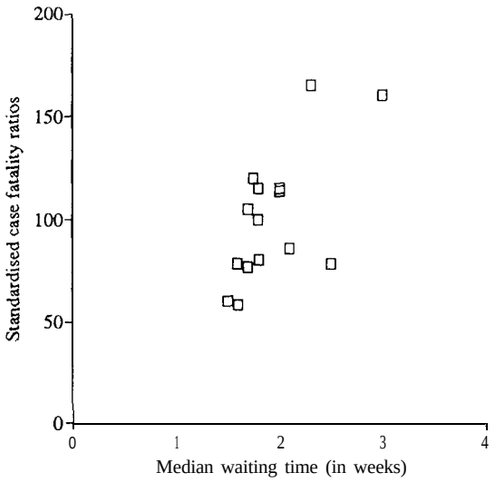


Figure 6.10 Survival for women registered with colon, breast or cervical cancer, by grouped regional health authority, 1971-83

Figure 6.11 Cervical cancer survival and median waiting list by regional health authorities (time until admission in hospital)



Concluding remarks

In the majority of cancer sites, lower socio-economic groups had poorer survival (higher SFRs) than higher socio-economic groups. This finding was consistent irrespective of sex, age, cause of death, and socio-economic classification. Absolute differences in survival were larger for good prognosis cancer than for poor, but wide relative differences were found irrespective of prognosis. Council tenants had higher case-fatality rates than owner occupiers in 11 out of 13 major cancer sites in men and in 12 out of 15 major sites in women. As in other studies, wide differences were found for bladder cancer in both sexes and for cancer of the corpus uteri. However, contrary to most studies, results for prostate and breast cancer did not indicate a clear survival advantage for high socio-economic groups. Men and women living in the South and East regions of England had better survival than those living in the North and in Wales. Analysis of survival curves indicated that council tenants tended to appear in a later stage than owner occupiers. The possibility that lead-time bias might explain part of these results cannot be excluded.

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7 Socio-economic differences in mortality: the contribution of incidence and survival differences

This chapter considers the relationship between incidence, case fatality, and mortality rates and evaluates the extent to which socio-economic differences in cancer mortality are due to incidence, or to survival differentials.

Research on inequalities in health has often focused only on mortality differentials. These are affected by both incidence and survival rates. Cancer survival data may be a more sensitive measure of the efficacy of health care provided for different socio-economic groups. The extent to which mortality differentials are due to inequalities in the use or efficacy of health services has not always been dealt with clearly. Furthermore, one could estimate how much do incidence differentials and how much do survival differentials contribute to cancer mortality differentials. The LS provides the possibility of addressing these issues, as for many cancer sites different socio-economic groups have different patterns of incidence and survival.

7.1 Methodological aspects

In populations assumed to be in a steady state situation, the relation between incidence, case fatality and mortality rates can be expressed quite simply.' The mean duration of life would be the sum of mean duration of life before getting the disease and mean duration from onset of disease until death. In this theoretical situation, the reciprocal of the mean duration would equal the incidence rates and therefore, the relation of mortality, incidence and case fatality rates would be

$$\frac{1}{A4} = \frac{1}{Z} + \frac{1}{F}$$

with M, Z and F being the mortality, incidence and case-fatality rates respectively. Conditions for the use of this simple equation are too strict to be applied in a cohort study. However, this equation provides the basis for understanding the relationship between incidence, survival and mortality.

Two approaches were followed for the estimation of the relative contribution of incidence and survival to differences in mortality. Both gave similar results and the simplest one, based on standardised expected numbers of cases and deaths, is presented here. The alternative method, together with a more theoretical approach to the relationship between incidence, case fatality and mortality rates, is described in the Statistical Appendix.

SMRs for council tenants were calculated separately for each sex, using the rates of owner occupiers as the standard. The expected number of deaths provided an estimate of the number of deaths that would have occurred among council tenants if the latter had experienced the mortality rates of owner occupiers. In this case, the combined effect of both incidence and survival is measured.

A similar reasoning applies when calculating SIRs. The expected number of incidence cases among council tenants was calculated for each sex separately using the rates of owner occupiers as the standard. This provided an estimate of the number of cancer cases that would have occurred among council tenants if the latter had experienced the incidence of owner occupiers. To estimate how many of these expected cases would have died during the study period, the following method was followed. The proportion of deaths among council tenants registered with a cancer was calculated for each age-group. This proportion was then multiplied by the expected number of cases, thus providing an estimate of expected deaths among council tenants. For example, 129 lung cancer cases occurred among council tenants at ages 55 to 60, and of those 117 died (91 per cent). If council tenants had the incidence of owner occupiers, 70 cases would have been expected in this age-group. Under this assumption, 64 deaths (70×0.91) would have consequently been expected to occur among council tenants.

The number of deaths that can be ascribed to survival differentials is simply the difference between expected deaths found from the incidence standardisation, and expected deaths found from the mortality standardisation.

What has been frequently termed 'expected deaths' when using indirect standardisation does not necessarily correspond to the 'real' number of deaths that would occur in the study population if it experienced the rates of the standard population. This happens because person years of life are incorporated in the calculations. As mentioned by Berry[2] '. . . In the extreme case, say a follow-up of 100 hundred years, all subjects would be dead so the observed number of deaths would no longer have a random component. The expected number would still be a random variable and would be smaller than the size of the group if the mortality was higher than the reference rates and vice versa.' An estimation of the extent of the bias[3] showed that the use of expected number of deaths, as found from standardisation, as an estimator of the real expected deaths would always

exaggerate the differences between the study and standard population. However, this bias was found to be small when mortality rates are small, while being considerable when mortality is high. This conclusion applied to the LS population means that expected incidence cases provide a good estimate of the number of cases that would have occurred if the study population had the incidence rates of the standard population. A similar conclusion holds true for mortality. Excluding age-groups above 75 years of age at death further minimised this bias, as below this age incidence and mortality rates are low. However, expected deaths in the survival analysis could be considerably biased in most cancer sites as case-fatality rates are very high, sometimes even larger than one death per person year at risk. For this reason, expected deaths for the survival analysis were calculated indirectly combining incidence and mortality data.

Cancers for which some kind of intervention (prevention, screening or therapy) could be expected considerably to affect mortality are included in this analysis. This selection was based on a recent publication by the National Cancer Institute[4] and further assessment of this issue is done in the Discussion section.

7.2 Results

Differences in incidence and mortality between council tenants and owner occupiers were wide and were more pronounced in men than in women. Table 7.1 gives observed and expected cases, SIRs, observed and expected deaths and SMRs for male council tenants. Table 7.2 gives similar values for female council tenants. Cancers are ranked in a decreasing order, according to the number of observed cases.

Table 7.1 Incidence and mortality for male council tenants aged 20 to 74†

Cancer site		Incidence	Mortality
Lung	Obs	784	733
	Exp	426.8	388.3
	SIR	184 (171-197)	189 (175-203)
Colorectal	Obs	199	153
	Exp	193.1	129.5
	SIR	103 (89-l 18)	119 (100-138)
Bladder	Obs	139	78
	Exp	105.1	47.9
	SIR	132 (111-156)	163 (129-203)
Prostate	Obs	109	66
	Exp	104.8	65.7
	SIR	104 (85-125)	101 (78-128)
Pancreas	Obs	48	45
	Exp	50.1	49.7
	SIR	96 (71-127)	91 (66-121)
Oesophagus	Obs	44	42
	Exp	28.0	24.4
	SIR	157 (114-211)	172 (124-233)
All the above sites	**Obs**	**1,323**	**1,117**
	Exp	907.9	705.5
	SIR	**146 (138-154)**	158 **(149-168)**

95 per cent confidence limits are shown in parentheses.
†Male owner occupiers are taken as the standard population.

Table 7.2 Incidence and mortality for female council tenants aged 20 to 74†

Cancer site		Incidence	Mortality
Breast	Obs	477	214
	Exp	474.0	228.7
	SIR	101 (92-l 10)	94 (81-107)
Lung	Obs	188	179
	Exp	124.5	111.8
	SIR	151 (130-174)	160 (138-185)
Colorectal	Obs	171	105
	Exp	188.5	123.6
	SIR	91 (78-105)	85 (70-103)
Cervix Uteri	Obs	131	62
	Exp	68.9	34.3
	SIR	190 (159-226)	181 (139-232)
Ovary	Obs	89	70
	Exp	104.6	75.3
	SIR	85 (68–105)	93 (72-l 17)
Corpus Uteri	**Obs**	85	31
	Exp	87.0	19.6
	SIR	98 (78-121)	158 (107-225)
Bladder	Obs	35	15
	Exp	34.8	12.4
	SIR	101 (70-140)	121 (68-200)
Oesophagus	Obs	26	26
	Exp	20.3	16.8
	SIR	128 (84-188)	155 (101-227)
Pancreas	Obs	22	22
	Exp	29.3	28.1
	SIR	7s (47– 114)	78 (49– 119)
All the above sites	**Obs**	**1,224**	724
	Exp	**1,131.9**	650.6
	SIR	**108 (102–114)**	**111 (103–120)**

95 per cent confidence limits are shown in parentheses.
**Female owner occupiers are taken as the standard population.*

In men, among the sites examined, council tenants had clearly higher rates in lung, oesophageal and bladder cancer (Table 7.1). The largest differences, both in relative and in absolute terms, occurred in lung cancer. In women (Table 7.2), the widest relative differences were observed for cervical cancer; council tenants had nearly double the incidence and mortality of owner occupiers. In lung cancer, although relative differences were smaller than those of cervical cancer, absolute differences were bigger as it is a more common cancer and cause of death than cancer of the cervix. For cancer of the corpus uteri, there were wide differences in mortality but not in incidence.

Standardised case-fatality ratios for owner occupiers and council tenants are shown in Table 7.3 for men and Table 7.4 for women. These SFRs are similar to those presented in Chapter 6, that is, standardisation was done both for age and period of follow-up using rates of the *whole LS population;* however, calculations are limited to cases 20 to 74 years old at death.

Table 7.3 Survival differences (SFR) for men aged 20 to 74 by housing tenure, and percentage of five-year survival*

Cancer sites	Survival differences (SFR)		% of five-year survival
	Owner occupiers	Council tenants	
Lung	97	103	5.1
Colorectal	88	118	21.9
Bladder	89	119	39.9
Prostate	104	100	22.2
Pancreas	103	97	3.2
Oesophagus	92	98	3.4

†*Percentage five-year survival of total male LS population.*

Table 7.4 Survival differences in women aged 20 to 74 by housing tenure and percentage of five-year survival?

Cancer sites	Survival differences (SFR)		% of five-year survival
	Owner occupiers	Council tenants	
Breast	100	93	49.9
Lung	92	106	5.2
Colorectal	97	92	23.8
Cervix uteri	96	98	50.4
Ovary	91	110	22.2
Corpus uteri	80	144	60.3
Bladder	76	120	42.3
Oesophagus	93	107	7.3
Pancreas	112	130	3.2

†*Percentage five-year survival of total female LS population.*

Table 7.5 for men and Table 7.6 for women show the changes in the number of deaths that would occur among council tenants if it were assumed that no differences existed among housing tenure groups in incidence rates, or alternatively in case-fatality rates. *Numbers and proportions are negative if a reduction of the number of deaths occurred and positive otherwise.* In the age-group 20 to 75, 68 per cent of deaths among male cancer cases living in council houses occurred among those registered with the six cancer sites examined. For female council tenants the corresponding percentage for the nine cancer sites examined was 69 per cent.

During 1971-83, there would have been 33 per cent fewer deaths (365 out of 1 ,117 observed) among men and 8 per cent fewer deaths (60 out of 724 observed) among women living in council houses, if there were no incidence differentials observed (Figure 7.1). The corresponding figures for case-fatality are 4 per cent fewer deaths in men (47 deaths less) and 2 per cent fewer deaths in women (14 deaths less). These overall figures hide considerable diversity among cancer sites.

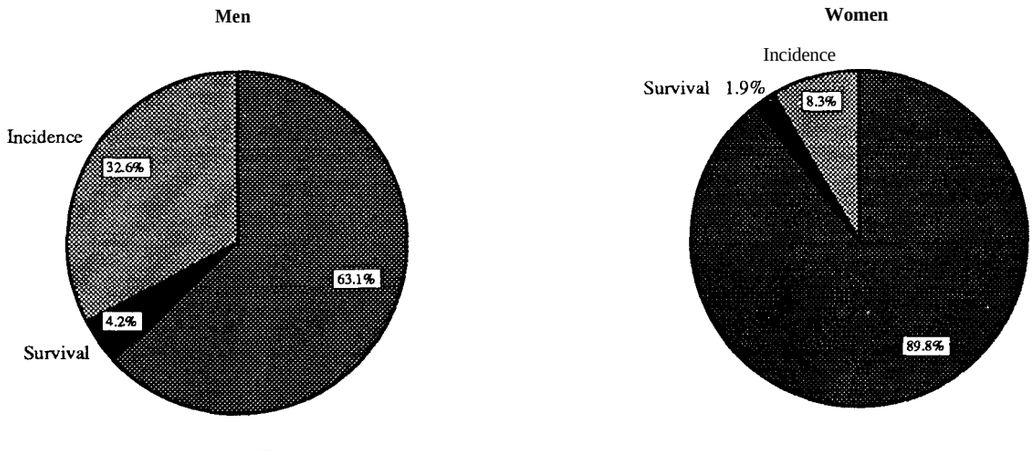
Table 7.5 Relative effect of incidence and survival differences on mortality of male council tenants aged 20 to 74†

Cancer sites	Effect of incidence differentials		Effect of survival differentials	
	Number of deaths	%	Number of deaths	%
Lung	− 330.7	-45.1%	− 14.0	− 1.9%
Colorectal	−7.7	− 5.0%	−15.9	−10.4%
Bladder	−13.4	−17.2%	−16.7	− 21.4%
Prostate	−1.2	− 1.7%	+0.8	+ 1.2%
Pancreas	+2.8	+ 6.2%	+ 1.9	+ 4.2%
Oesophagus	− 14.5	− 34.5%	-3.1	− 7.2%
All the above sites	− 364.7	− 32.6%	− 47.0	− 4.2%

†*Changes in the number of deaths among council tenants if they had the incidence or alternatively the case-fatality rates of owner occupiers. A negative sign indicates a reduction in the number of deaths and a positive sign an increase.*

If differences in survival were eliminated for lung cancer, deaths among male council tenants could have been reduced by about 2 per cent and in female by about 4 per cent. By contrast, if differences in incidence were eliminated, lung cancer deaths would have been reduced among male council tenants by 45 per cent and in women by 30 per cent. In cancers of better prognosis than lung cancer, survival differences had a much bigger impact on mortality differences. For cancer of the corpus uteri, deaths among council tenants could have been reduced by approximately 40 per cent if they had the case-fatality rates of owner occupiers while incidence differences made no contribution to mortality. By contrast, for cancer of the cervix, wide differences in mortality are principally due to incidence

Figure 7.1 Reduction of deaths among council tenants if incidence or survival differences were eliminated



n = 1,117

n = 724

Table 7.6 Relative effect of incidence and survival differences on mortality of female council tenants aged 20 to 74†

Cancer sites	Effect of incidence differentials		Effect of survival differentials	
	Number of deaths	%	Number of deaths	%
Breast	-2.2	−1.0%	+16.9	**+7.9%**
Lung	− 59.8	− 33.4%	**-7.5**	**−4.2%**
Colorectal	+ 13.8	+ 13.2%	+4.7	**+ 4.4%**
Cervix uteri	-24.8	-40.1%	**-2.9**	**−4.6%**
Ovary	+ 10.7	+ 15.2%	**-5.4**	− 7.7%
Corpus uteri	0.0	0.0%	-11.4	− 36.9%
Bladder	+0.8	**+5.0%**	**-3.4**	**− 22.6%**
Oesophagus	−5.9	**− 22.1%**	**-3.3**	**− 12.8%**
Pancreas	+7.6	**+ 34.4%**	**− 1.5**	− 6.8%
All the above sites	**−59.8**	**− 8.3%**	**−13.8**	**− 1.9%**

†*Changes in the number of deaths among council tenants if they had the incidence or alternatively the case-fatality rates of owner occupiers. A negative sign indicates a reduction in the number of deaths and a positive sign an increase.*

patterns, as case-fatality rates are similar. In men, both incidence and survival differences for bladder cancer contributed equally to the observed mortality differences.

These results indicate that the differences in overall mortality between social groups primarily reflect incidence rather than survival differentials. This is mainly a result of the pre-eminence of lung cancer. However, for some cancers, survival differences constitute the major or even the sole cause of mortality differences.

Concluding remarks

Overall elimination of incidence differentials between housing tenure groups for the cancers examined would result in an approximately 33 per cent reduction in deaths in men and an 8 per cent reduction in women, among council tenants. Elimination of the observed survival differentials would result in an approximately 4 per cent reduction of deaths in men and 2 per cent in women. There was considerable diversity in the relative effects of incidence and survival differentials among cancers. These results suggest that incidence differentials between social classes are far more important than survival differences in the production of the wide social class differences in mortality observed in England and Wales.

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8 Reproductive factors, cancer incidence and survival

The independent effects of parity and age at first full-term pregnancy (FFTP) on cancer incidence and survival are discussed in this chapter. Reproductive history has been associated with occurrence of cancer in a number of specific sites[1,2] and has also been associated to prognosis of breast cancer.[3] Incidence data were analysed for eight sites (all neoplasms, colon, breast, cervix, cervix in situ, corpus uteri and ovary) and survival data for three sites (breast, cervix and ovary). In both cases, parity and age at FFTP were analysed by housing tenure.

Information on parity, age at FFTP and housing tenure was derived from the 1971 Census records. Married women aged 15 to 59 years at census were asked for the date of birth of all live births. Parity was examined either as a dichotomous variable (nulliparous versus parous), or as a variable with three levels (nulliparous, one child, more than one children). Age at FFTP was grouped in three categories: less than 20 years of age, 20 to 29, 30 years and over. Nulliparous women are taken as the baseline group for all Poisson regression models. In analyses of parous women only, those with age at FFTP of less than 20 and women with one child are regarded as the baseline group.

Table 8.1 Incidence for married women aged under 60 at Census, according to number of children†

Cancer of registration		Number of children				
		0	1	2+	χ^2 heter	χ^2 trend
All neoplasms	**Obs**	**472**	722	1,992	**6.65***	**1.24**
	Exp	**430.3**	**766.5**	**2,001.3**		
	SIR	**110**	**94**	**100**		
Colon	Obs	27	41	119	0.69	0.16
	Exp	25.4	46.0	116.7		
	SIR	106	89	102		
Breast	Obs	138	246	592	5.55	4.89*
	Exp	122.6	221.8	619.3		
	SIR	113	111	96		
Cervix uteri	Obs	27	45	161	4.12	3.22
	Exp	31.1	53.8	142.6		
	SIR	87	84	113		
Cervix in situ	Obs	32	55	174	6.73*	6.69**
	Exp	42.8	59.2	148.3		
	SIR	75	93	117		
Corpus uteri	Obs	31	29	69	12.1 1**	8.79**
	Exp	19.1	34.6	87.1		
	SIR	162	84	79		
Ovary	Obs	30	47	125	0.48	0.29
	Exp	26.8	48.4	127.7		
	SIR	112	97	98		

† *Standard rates are those of* all women *aged 15 to 60 at 1971 Census. Kilpatrick's technique was used for the calculation of chi-squares.*
* = *0.01<p<0. 05.*
** = *p<0.01.*

8.1 Incidence

All neoplasms

Parity was significantly related to lower incidence of all neoplasms (Table 8.1). Parous women (SIR = 98) had lower risk than nulliparous (SIR = 110) but there was no apparent trend with increasing parity, suggesting that it is giving birth to one or more children that is related to a reduced risk of cancer. SIRs were also calculated for all neoplasms except the reproductive cancers (breast, cervix and corpus uteri, ovary). A similar pattern to that seen for all neoplasms was apparent, with parous women having a lower risk than nulliparous. Incidence of all neoplasms was not related to age at FFTP (Table *8.2).*

Breast cancer

Parous women had significantly lower risk of breast cancer than nulliparous (Table 8.1). Even though a test for trend in SIRs by parity was significant ($\chi^2 = 4.89$, $0.01<p<0.05$), only women with two or more children had clearly lower incidence than the nulliparous. Differences in incidence between nulliparous and parous women were wider among women over 45 years of age (most of whom presumably were post-menopausal), than among younger women (Table 8.3). In the age-group 16-34, in which most of the pregnancies occur, nulliparous women had 3 times higher risk of breast cancer (SIR = 207) than parous women (SIR = 79), (Table 8.3). In this age-group, married women had higher incidence than single, an excess totally due to the high risk of nulliparous married women. Breast cancer incidence rates increased with later age of FFTP and a linear trend in risk was evident (χ^2 for trend = 8.33, $p<0.001$). This pattern was observed in all age-groups (Table 8.4).

When parity and age at FFTP were analysed by housing tenure, their association with breast cancer incidence remained practically unaffected (Appendix Table 8.1). Actually, the chi-square value for parity slightly increased after adjusting for housing tenure, becoming significant at the 5% level.

In situ and invasive cancer of the cervix uteri

Parity was significantly related to cancer in situ of the cervix but only marginally so to invasive cancer (Table 8.1). In both cases, parous women had higher rates than nulliparous. It should be mentioned that comparisons

Table 8.2 Incidence of parous women aged under 60 at Census, by age of first full-term pregnancy (FFTP)†

Cancer of registration		Age at FFTP				
		Under 20	20-29	30 and over	χ^2 heter.	χ^2 trend
All neoplasms	**Obs**	**216**	**1,978**	496	1.03	0.93
	Exp	**208.7**	**2,018.7**	**520.4**		
	SIR	**103**	98	95		
Colon	Obs	11	115	32	0.004	0.001
	Exp	11.3	117.1	33.0		
	SIR	97	98	97		
Breast	Obs	49	608	174	8.34*	8.33**
	Exp	64	622.7	148.3		
	SIR	77	98	117		
Cervix uteri	Obs	32	148	22	16.3**	13.78**
	Exp	16.8	145.9	32.4		
	SIR	190	101	68		
Cervix in situ	Obs	61	159	6	28.0**	27.48**
	Exp	32.0	158.1	16.1		
	SIR	191	101	37		
Corpus uteri	Obs	13	68	17	6.48*	3.51
	Exp	8.3	87.9	24.8		
	SIR	157	77	69		
Ovary	Obs	14	115	33	0.20	0.007
	Exp	13.0	128.6	33.1		
	SIR	108	89	100		

† *Standard rates are those of* all women *aged 15 to 60 at 1971 Census. Kilpatrick's technique was used for the calculation of chi-squares.*
* = *0.01<p<0.05.*
** = *p<0.01.*

Table 8.3 Standardised incidence ratios (SIR) for breast cancer by parity, marital status and age at registration†

Parity (married women)	Age			
	16-44		45-69	
	No	SIR	No	SIR
Nulliparous	25	108	113	114
All parous	187	102	651	99
1 child	44	115	202	110
2 + children	143	99	449	95
Marital status and parity	**Age**			
	16-34		35-44	
	No	SIR	No	SIR
Single	9	92	13	88
All married	27	105	184	102
Nulliparous	12	207	13	76
Parous	15	79	172	105

†*Among married women only those aged less than 60 at 1971 Census are included. Consequently the upper limit for the older age-group will be 69 years, for women aged 59 at 1971 Census and getting breast cancer in* 1981.

here are done within ever married women, who as a whole have much higher risk than single women (Table 4.20). Parous women with a late age at FFTP had clearly lower risk than those with an early age, for both in situ and invasive cancer (Table 8.2). Differences

Table 8.4 Standardised incidence ratios (SIR) for breast cancer by age at first full-term pregnancy (FFTP) and age at registration+

Age at FFTP	Age			
	16-44		45-69	
	No	SIR	No	SIR
Under 20	20	91	29	69
20-29	147	102	461	96
30 and over	18	119	156	117

†*Married women aged less than 60 at 1971 Census. The upper age limit for the older age-group is 69 years as it includes women aged 59 at 1971 Census and getting breast cancer in 1981.*

between SIRs were statistically significant and a test for linear trend highly significant. Adjusting for housing tenure weakened the association with parity, but did not affect results for age at FFTP (Appendix Table 8.2).

Cancers of the colon, corpus uteri and ovary

Parous women had lower incidence than nulliparous for all three cancer sites (Table 8.1), but only for cancer of the corpus uteri were differences significant and a test for trend on parity levels was highly significant ($\chi^2 = 8.79$, $p<0.001$). Parous women with a late age of FFTP had a lower risk of cancer of the corpus uteri and of cancer of the ovary, than those with an early age of FFTP (Table 8.2); but again, only for the former were differences significant. No apparent trend was evident for colon cancer.

8.2 Survival

Information on parity, age at FFTP and housing tenure was available for 941 women registered with breast cancer, 200 women registered with ovarian cancer and 187 women registered with cervical cancer.

Breast cancer

Parous women had significantly better survival than nulliparous (rate ratio of dying for parous = 0.71, 95% CL 0.56–0.92), Table 8.5. Increasing parity seemed to carry an additional improved prognosis for breast cancer cases and a test for trend of the rate ratios was

Table 8.5 Case-fatality rate ratios for breast cancer in married women aged less than 60 at Census, by parity and housing tenure†

	RR (95% CL)	χ^2	Degrees of freedom
Parity (dichotomous)		6.51*	(1)
0	1		
1+ children	0.71 (0.56-0.92)		
Parity		7.27*	(2)
0	1		
1	0.76 (0.57-1.02)		
2+	0.69 (0.5440.90)		
Housing tenure		4.31	(2)
Owner occupiers			
Council tenants	A.96 (0.78–1.18)		
Private rented	1.30 (0.9991.71)		

†*Nulliparous and owner occupiers were taken as the baseline group.*
* = *0.01<p<0.05.*

highly significant ($\chi^2 = 6.7$, p – value <0.01). The pattern of risk was not homogeneous through all age-groups (Table 8.6). Nulliparous women aged under 44 had better prognosis (SFR = 96) than parous (SFR = 124), while in older women (over 45 years) the opposite pattern was apparent. Only in older women were differences significant and consistent, even in finer age strata.

Analysis of fertility patterns for parous women indicated that age at FFTP was a marginally significant factor ($\chi^2 = 5.65$, p – value = 0.06), with women aged under 20 at FFTP having the higher risk (Table 8.7). The risk did not decrease steadily with age, though; women aged 20–29 at FFTP had the lowest risk (RR = 0.66, 95% CL 0.45–0.96). Analysis was also carried out for specific age-groups (Table 8.6). The U shaped pattern was more pronounced in women aged less than 44 years, but was clearly evident in older women as well. Controlling for housing tenure did not alter results either for parity or for age at FFTP.

Table 8.6 Standardised case-fatality ratios (SFR) for breast cancer by parity, age at first full-term pregnancy (FFTP) and age at death†

Parity and age at FFTP	Age at death			
	16-44		45-71	
	No	SFR	No	SFR
Parity				
Nulliparous	9	96	65	139
Parous	46	124	328	93
Age at FFTP				
Under.20	6	133	25	135
20-29	33	90	228	89
30 and over	7	226	78	100

†*Married women aged less than 60 at 1971 Census. The upper age limit for the older age-group is 71 years as it includes women aged 59 at 1971 Census, getting a cancer in 1971 and surviving until 1983.*

Table 8.7 Case-fatality rate ratios for breast cancer in parous, married women aged less than 60 at Census, by parity, age at first full-term pregnancy (FFTP) and housing tenure†

	Rate ratio	(95% CL)	χ^2	Degrees of freedom
Age at FFTP			5.65*	(2)
Under 20	1			
20-29	0.66	(0.45-0.96)		
30 and over	0.79	(0.52-1.19)		
Housing tenure			2.28	(2)
Owner occupiers	1			
Council tenants	1.00	(0.80-1 .26)		
Private rented	1.27	(0.93-I .72)		
Parity			0.76	(1)
1 child	1			
2 + children	0.91	(0.73-1.13)		

† *Women with age of FFTP less than 20 years, nulliparous and owner occupiers were taken as the baseline group.*
* = *0.05<p<0. I.*

Ovarian and cervical cancer

Survival of cases with ovarian cancer was worse for parous women and the risk of dying was higher with increasing parity, but neither the rate ratios nor a test for trend were significant (Table 8.8). When analysis was limited to parous women, rate ratios by age at FFTP showed a U shaped pattern similar to that observed for breast cancer, but for ovarian cancer it was far from being significant (Table 8.9).

For cervical cancer, none of the variables examined were found to be significantly associated with survival. Parous women had better survival than nulliparous (Appendix Table 8.3) and the risk by age of FFTP again followed a U shaped curve. Confidence limits for the rate ratios were very wide.

Concluding remarks

Parity was associated with lower risk for all neoplasms, breast cancer, cancer of the corpus uteri and with higher risk for in situ and invasive cervical cancer. Early age at

Table 8.8 Case-fatality rate ratios for ovarian cancer in married women aged less than 60 years at Census, by parity and housing tenure†

Parity and housing tenure	RR	(95% CL)	χ^2	Degrees of freedom
Parity (dichotomous)			0.39	(1)
0	1			
1 + children	1.15	(0.73-1.81)		
Parity			0.42	(2)
	1			
0	1.12	(0.65-1.94)		
2 +	1.16	(0.73-1.85)		
Housing tenure			11.32*	(2)
Owner occupiers	1			
Council tenants	1.27	(0.88-1 .84)		
Private rented	2.26	(1.45-3.53)		

†*Nulliparous and owner occupiers were taken as the baseline group.*
* = *p<0.001.*

Table 8.9 Case-fatality rate ratios for ovarian cancer in parous, married women aged less than 60 at Census, by age at first full-term pregnancy (FFTP), parity and housing tenure?

Age at FFTP, housing tenure, and parity	Rate ratio	(95% CL)	χ^2	Degrees of freedom
Age at FFTP			4.11	(2)
Under 20	1			
20-29	0.64	(0.35-1.18)		
30 and over	0.95	(0.48-1.87)		
Housing tenure			5.87*	(2)
Owner occupiers	1			
Council tenants	1.13	(0.76-I .68)		
Private rented	1.94	(1.17-3.19)		
Parity			0.03	(1)
1 child	1			
2 + children	1.03	(0.69-1 .55)		

† *Women with age at FFTP less than 20 years, nulliparous and owner occupiers were taken as the baseline group.*
* = *0.05<p<0. I.*

FFTP was associated with a reduced risk for breast cancer and increased risk for cancer of the corpus uteri and cervical cancer. These data suggest that any effect of parity on breast cancer incidence may differ by age. Parous women registered with breast cancer had significantly better survival than nulliparous and increasing parity seemed to carry an additional improved prognosis. Age at FFTP was also associated with survival and women with age at FFTP before age 20 had the highest risk of dying.

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9 Socio-economic differences in incidence and survival: the contribution of reproductive factors

This chapter considers the impact of reproductive factors on the appearance of socio-economic differences in incidence and survival. Housing tenure was analysed by parity and age at first full-term pregnancy (FFTP) for eight sites for incidence (all neoplasms, colon, breast, cervix uteri, cervix in situ, corpus uteri and ovary) and three cancers for survival (breast, cervix uteri and ovary).

Table 9.1 shows the frequency distribution for parity and age at FFTP, for the three major housing tenure groups. Council tenants had a lower percentage of nulliparous women (8 per cent), than owner occupiers (18 per cent). They also had a higher percentage of women with more than two children and tended to have their first pregnancy at an earlier age than owner occupiers.

Table 9.1 Frequency distribution of levels of parity and age at first full-term pregnancy (FFTP) for women aged less than 60 at 1971 Census, by housing tenure

Parity and age at FFTP	Housing tenure					
	Owner occupiers		Council tenants		Private rented	
	No	(%)	No	(%)	No	(%)
Parity						
0	10,488	(18.1)	2,581	(8.2)	3,923	(21.8)
1	14,277	(24.6)	6,601	(20.9)	4,778	(26.5)
2+	33,259	(57.3)	22,334	(70.9)	9,309	(51.7)
Total	58,024		31,516		18,010	
Age **at FFTP**						
Under 20	3,711	(7.8)	5,238	(18.1)	2,278	(16.2)
20-29	36,491	(76.7)	20,940	(72.36)	10,187	(72.4)
30 and over	7,365	(15.5)	2,760	(9.5)	1,607	(11.4)
Total	47,567		28,938		14,072	

9.1 Incidence

Women living in council houses had a significantly higher incidence of *all neoplasm* (Rate ratio = 1.13, 95% CL 1.05–1.23), which was independent of reproductive history.

In *breast cancer,* differences between housing tenure groups were not significant. Even so, the observed pattern was not similar to that generally observed,[1] with council tenants (the low socio-economic group) having higher rates than owner occupiers (the high socio-economic group). Differences between housing tenure groups were only slightly altered by adjusting for parity (Table 9.2). Council tenants also had a higher risk than owner occupiers when analysis was limited to parous women. This difference widened only slightly when age at FFTP was included in the model (Table 9.2).

Table 9.2 Breast cancer incidence for married women aged under 60 at Census by housing tenure, before and after adjusting for parity and age at first full-term pregnancy?

Housing tenure	Rate ratio	(95% CL)	χ^2 heter	degrees of freedom
Owner occupiers	1		2.71	(2)
Council tenants	1.03	(0.89-1.17)		
Private rented	0.87	(0.71–1.05)		
Owner occupiers*	1		3.25	(2)
Council tenants	1.04	(0.90-I .20)		
Private rented	0.86	(0.71-1.04)		
Owner occupiers+	1		4.31	(2)
Council tenants	1.02	(0.88-1.18)		
Private rented	0.81	(0.65-l .01)		
Owner occupiers+*	1		4.43	(2)
Council tenants	1.05	(0.90-I .22)		
Private rented	0.83	(0.67-I .03)		

† *Owner occupiers are taken as the baseline group in all models.*
‡ *Controlling for parity.*
4 *Only parous women.*
* *Controlling for age at FFTP.*

Incidence differences among housing tenure groups were wide for *cervical cancer,* both in situ and invasive. Council tenants had a rate ratio of 2.23 for in situ and 1.73 for invasive cancer, when compared with owner occupiers. The rate ratio for invasive cancer was only slightly reduced to 1.67 after adjusting for parity (Table 9.3). The high incidence rates observed for all married council tenants were also seen when analysis was limited to parous women (Table 9.3). Results were altered when age at FFTP was taken into account. The rate ratio for council tenants fell by approximately 20 per cent from 1.67 to 1.54. From these results it appears that the wide socio-economic differentials in cervical cancer incidence can only be partly ascribed to socio-economic differences in reproductive history.

Differences among housing tenure groups were not wide for cancers of the *colon, corpus uteri* and *ovary* and rate ratios did not change very much when adjusting for reproductive history.

9.2 Survival

Housing tenure was not significantly associated with *breast cancer* survival (Table 9.4). In different models including parity, housing tenure and age at FFTP, changes of the rate ratios between housing tenure groups were minimal.

Table 9.3 Cervical cancer incidence for married women aged under 60 at Census by housing tenure, before and after adjusting for parity and age at first full-term pregnancy†

Housing tenure	Rate ratio	(95% CL)	χ^2 heterog.	degrees of freedom
Owner occupiers			15.85**	2
Council tenants	1.73	**(1.30-2.30)**		
Private rented	1.62	(1.13-2.32)		
Owner occupiers*	1		14.49**	2
Council tenants	1.67	(1.25-2.24)		
Private rented	1.63	(1.14-2.33)		
Owner occupiers+	1		12.63**	2
Council tenants	1.67	(1.09–2.37)		
Private rented	1.61	(1.23-2.26)		
Owner occupiersϕ§	1		8.84 *	2
Council tenants	1.54	(1.13–2.09)		
Private rented	1.52	(1.03-2.24)		

† *Owner occupiers are taken as the baseline group in all models.*
‡ *Controlling for parity.*
ϕ *Only parous women.*
§ *Controlling for age at FFTP.*
* $= 0.01<p<0.05$
** $= p<0.01$

Table 9.4 Case-fatality rate ratios for breast cancer survival in married women aged less than 60 at Census, by housing tenure†

Housing tenure	Rate ratio	(95% CL)	χ^2	degrees of freedom
Owner occupiers	1		4.31	(2)
Council tenants	0.96	(0.78–1.18)		
Private rented	1.30	(0.99-l .71)		

t Owner occupiers were taken as the baseline group.

Survival differences between housing tenure groups were statistically significant for married women with *ovarian cancer* ($\chi^2 = 11.32$ with 2 degrees of freedom, p – value <0.001). Women in privately rented housing and council tenants had higher case-fatality rates than owner occupiers (Table 9.5), but only for the first group was the rate ratio significantly raised (RR = 2.26, 95% CL 1.45–3.53). Analysis by parity and age at FFTP did not identify any significant alteration in these results.

Table 9.5 Case-fatality rate ratios for ovarian cancer in married women aged less than 60 years at Census, by housing tenure†

Housing tenure	Rate ratio	(95% CL)	χ^2	degrees of freedom
Owner occupiers	1		11.32*	(2)
Council tenants	1.27	(0.88-1.84)		
Private rented	2.26	(1.45-3.53)		

† *Owner occupiers were taken as the baseline group.*
* $= p<0.001$

No significant results were identified for *cervical cancer* survival for housing tenure, reproductive factors or their cross-classification.

Concluding remarks

Reproductive factors do not seem to explain a large part of socio-economic differences in cancer incidence. Only for cervical cancer did the rate ratio of council tenants compared with owner occupiers fall by approximately 20 per cent when differences in age at FFTP were taken into account.

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10 Discussion

10.1 Socio-economic differences in incidence

10.1.1 Housing tenure and social class

Men and women of low socio-economic groups had higher SIRs for all neoplasms than high socio-economic groups, with differences being more pronounced among men. Socio-economic differences in incidence were examined for all major cancers using two socio-economic classifications: housing tenure and social class.

Male council tenants had significantly higher rates than owner occupiers for cancers of the buccal cavity, oesophagus, stomach, larynx, lung and urinary bladder; female council tenants had significantly higher rates for cancers of the stomach, lung and especially cervix uteri (invasive and in situ). For cancers of the liver and gall-bladder, differences between housing tenure groups were significant, with owner occupiers having the lowest SIR and those in private rented accommodation the highest. Only for ovarian cancer did owner occupiers have significantly higher SIRs than the lower socio-economic groups.

A similar pattern of incidence differentials emerged in the social class analysis. This was to an extent expected. Both classifications separate the population into large socio-economic groups and persons who in one of the classifications are at one end of the social scale, are most likely to be classified similarly in the other classification.[1,2] As with housing tenure groups, the widest differences between social classes were observed in men for lung cancer and in women for cervical cancer. Significant increases in incidence were also found among men in manual occupations for stomach, bladder and rectal cancer. Women were classified by their own occupation and married women were also classified by their husband's occupation; both social class classifications seemed to differentiate women similarly. Women in manual social classes had higher rates in most cancer sites, but only for cervical cancer were significant results obtained irrespective of the socio-economic index used.

The picture emerging is of an excess among lower socio-economic groups principally in smoking related cancers and, for men, in alcohol related cancers. Smoking is an important causal factor for cancers of the buccal cavity, oesophagus, larynx, lung and urinary bladder.[3] It probably accounts also for a considerable part of cervical cancer incidence.[4] Alcohol is related to cancers of the buccal cavity, oesophagus, larynx and liver.[5] Combining data for cancers with common aetiological factors indicated the fundamental importance of smoking for socio-economic differences in cancer incidence. Prevalence of smoking in England and Wales is higher among men working in manual occupations and among married women whose husband is in a manual occupation, compared with non-manual occupations. Among professionals, 33 per cent of men and women were smokers in 1972 (Table 10.1), compared with 64 per cent in men and 42 per cent in women in Social Class V (unskilled workers).[6] Prevalance of smoking has been falling since the early 1970s in England and Wales in all social classes, but the decrease is much steeper in non-manual social classes.[7] Those in manual social classes have also been found to smoke more hazardous cigarettes (high tar, plain). Passive smoking can also be expected to exert a more important effect among manual social classes because, in the first place, more people smoke in these classes, and also, because of their poorer housing conditions. In women, social class differences in smoking patterns, although evident, are less pronounced than in men (Table 10.1) and this is reflected in the incidence differentials which are more pronounced in men than in women.

Table 10.1 Percentage of current smokers by sex and social class, 1972

Social class	Men	Women
Professionals	31.5	28.9
Administrative	42.6	35.8
Clerical	45.6	38.5
Skilled manual	56.1	44.9
Semi-skilled manual	51.4	44.1
Unskilled	65.1	46.6

Source: General Household Survey, 1972, (Reference 6)

Differences in alcohol consumption between social classes, although not as wide as smoking, are also apparent.[8] About a quarter of men in manual occupations were classified as heavy drinkers in 1975 compared with around 10 per cent among men in non-manual occupations. Women in manual occupations are more likely to abstain or to be occasional drinkers than women in non-manual social classes.

In many sites in which wide socio-economic differences in incidence were observed, risk factors other than smoking and drinking could have been expected to differ in their prevalence between social classes. A summary of known risk factors for those sites for which significant differences were found is presented below (Table 10.2).[9,10] In most cases, the prevalence of these risk factors is higher in low socio-economic groups.[7,11]

Table 10.2 Risk factors for cancers for which wide socio-economic differences in incidence were observed

Cancer site	Risk factors
Buccal cavity	Tobacco; alcohol; occupation: steel industry, asbestos; Vitamin A deficiency
Oesophagus	Tobacco; alcohol; occupation: asbestos; diet: low fruit intake
Stomach	Smoked foods; pickled vegetables; Vitamin A deficiency; occupation: asbestos, coal miners; (protective factors: fresh fruit and vegetables)
Liver	Alcohol; hepatitis B; cirrhosis; aflatoxins
Lung	Tobacco; passive smoking; retinoid deficiency; air pollution; occupation: asbestos, radiation, chemical agents, iron and steel foundries, nickel, chromium, etc.
Cervix	Sexual habits; venereal agents; tobacco; oral contraceptives
Ovary	Obesity (?); (protective factors: high parity, oral contraceptive use;)
Bladder	Tobacco; Vitamin A deficiency; occupation: dyes, rubber industry, coke workers etc.

In both housing tenure and social class classifications, differences for colon and rectal cancers went in opposite directions. However, risk factors for both sites are believed to be to a large extent similar and neither of these sites have been consistently associated with specific socio-economic circumstances. In some studies, beer consumption was exclusively related with rectal cancer incidence,[5] something which could have contributed to the higher risk among low socio-economic groups. Colon and rectal cancers are among a few sites for which a high degree of misclassification was found in studies evaluating death certification.[12] In this analysis, a high percentage (15 per cent) of cases registered with rectal cancer were coded on the death certificate as dying from another cancer. A grouped statistic was therefore calculated for colorectal cancer, indicating a slightly increased risk among low socio-economic groups.

Differences in incidence between socio-economic groups have been frequently reported for a number of other sites. A review on this subject is included in an earlier LS report[2] and is therefore not replicated here. As in most other studies,[13] breast cancer incidence in women was found here to be higher in high socio-economic groups. However, differences were small and by the end of the follow-up, women in low socio-economic groups had higher incidence. This was primarily due to high relative incidence at younger ages. A detailed analysis and possible explanations for these time trends are presented elsewhere.[14] High incidence rates for cancer of the corpus uteri have been frequently but not consistently[15] found among high socio-economic groups. In the LS, owner occupiers had clearly higher SIRs than the two other housing tenure groups although differences were not significant. Overall rates for uterine cancers could be affected by frequency of hysterectomy and correct rates should be calculated for 'uteri at risk'. Differential hysterectomy rates by social class have not been reported for England and Wales,[16] and in any case, frequency of hysterectomy is still low in this country[17] compared at least to the USA. It would be unlikely that an important bias is introduced in this data because of such a problem.

Similarly, for cancers of the testis, the brain, malignant melanomas and the leukaemias,[15] many studies have found higher incidence rates in high rather than in low socio-economic groups. However, results were not as clear in the LS and in most sites owner occupiers were in an intermediate position.

Less privileged socio-economic groups in the LS had higher cancer incidence overall and also higher incidence in most specific cancers. Similar patterns have been described in other studies on cancer.[15] Results may not always entirely agree, but overall, low social classes consistently appear to be in a position of disadvantage as far as the occurrence of cancer is concerned. Widening the perspective from cancer, such differences between social classes have been found for all cause mortality and for mortality from many other diseases, in men and women, different ages, different time periods and different countries.[18] Explanations of incidence differentials should ultimately take into consideration the appearance of such generalised patterns. The risk factors mentioned above probably intervene in the occurrence of socio-economic differentials observed in the LS population. How much of the excess can be attributed to each risk factor, or to the total of them, could vary between cancer sites (see also section 9.1 for breast and cervical cancer). Few studies have measured the effect of known risk factors on socio-economic differences in health and reference has to be made to studies dealing with diseases other than cancer, like, for example, the Whitehall Study[19] associating employment grade with coronary heart disease mortality, or the Alameda County Human Population Laboratory in California.[20]

Identifying intervening variables that contribute to the occurrence of socio-economic differences may lead to important public health benefits. However, specific risk factors may not account for all, and maybe not even the major part of, mortality differentials. Psychosocial factors may contribute to the general increase in physical illness among low socio-economic groups, although the evidence from studies on psychological factors and cancer has not been as convincing as that from studies of overall mortality or mortality from cardiovascular diseases.[21]

10.1.2 Unemployment

Unemployed men had significantly higher incidence for all neoplasms than employed men. Among the nine major cancers analysed, unemployed men had higher incidence in all but one, stomach cancer. Differences were wide for cancers of the colon, lung, bladder and the leukaemias; significant differences were found only

for lung cancer because of the small number of unemployed men in the 1971 Census. Among the quarter of a million men in the LS population in 1971, only 5,861 (3.6 per cent) were classified as 'seeking work', that is unemployed. Depending on their state of health, unemployed men could possibly be classified into two other categories of economic position: those 'temporarily out of work sick' and those 'permanently sick'.

Studies on unemployment in recent periods and in the pre-war recession have shown without doubt that becoming unemployed is associated with stress related behaviour and that the unemployed have worse mental and physical health than those employed.[22-26]

Analysis of mortality data in the LS[24] showed that the unemployed had high overall mortality (SMR = 136) and especially high SMRs for suicides and lung cancer. Three explanations were given, '. . . men's health may suffer as a result of unemployment, perhaps owing to a fall in income and social status, increased stress and consequent behaviour. Secondly, men in poor health may be more likely to become unemployed, and the raised mortality of unemployed men may simply reflect their health status before unemployment. Thirdly, the high mortality may reflect the social distribution of unemployed men before unemployment and the strong relation between mortality and measures of socio-economic status.' Standardisation by age and social class reduced slightly the SMRs, but the increase in mortality among the unemployed remained high and statistically significant.

Economic status was not analysed with any other socio-economic classification. However, comparing SIRs for the unemployed with SIRs for men in manual social classes and in Social Class V showed that unemployed men had higher incidence than even the least privileged group of employed men.

To evaluate whether those unemployed in the 1971 Census lost their jobs because of health problems, Moser *et al*[24] examined SMRs throughout the period of follow-up assuming that if high mortality was principally due to ill-health selection, then relative mortality of the unemployed should decrease over time. However, mortality differentials widened over time, giving only limited support to the ill-health selection hypothesis. The same conclusion was reached by a Danish study following similar methodology.[26]

Analysis of cancer incidence differentials over time indicated that unemployment, either directly or indirectly had adversely affected the health of unemployed men. Incidence differentials between employed and unemployed men for all neoplasms were wider in the second five-year period 1976-81. When the unemployed were compared with those *employed in manual occupations,* once again differences were wider in the second five-year period. More specific analysis by individual year of follow-up showed an initial fall of SIRs for unemployed men which was followed by a continuous and marked increase. The main part of the increase among unemployed men was observed in the late high risk period. This U shaped pattern of risk suggests the presence of a small effect of ill-health selection initially while the subsequent increase reflects probably the adverse effect of unemployment in health.

The discussion on the adverse effects of unemployment has focused on this question of ill-health selection as a major reason for the high morbidity and mortality among the unemployed. An alternative approach suggests that ill-health selection among the unemployed is part of a cycle that includes spells of employment and unemployment.[27,28] Workers at high risk of unemployment have an increased likelihood of being employed in hazardous and intermittent jobs, apart from suffering health hazards associated with long-term unemployment. The available LS data does not provide specific work histories for each unemployed man. The higher risk of unemployed men compared with unskilled workers, the appearance of a small effect of ill-health selection, and the subsequent rise in incidence when ill-health would not be expected to be important, all seem to support the proposition of a 'poverty complex' as an explanation of available data on unemployment and health.

10.1.3 Region of residence

A South East to North West increasing gradient in mortality was identified in England and Wales as early as 1840. Although important changes in relative mortality occurred during the last century especially in London, Wales and the North, this gradient has remained relatively stable.[29] As in previous mortality and cancer incidence analyses of LS data,[2,29] the nine standard regions of England and Wales (as defined by the 1974 re-organisation of local government) were grouped into three bigger regions: the North and West, Central, and the South and East. Grouped regions can portray better the existence or not, of any regional gradient and allow a more meaningful analysis with other socio-economic variables. More detailed regional analyses using smaller geographical units have been performed elsewhere, but the number of cancer cases available in the LS does not provide such a possibility.[30]

Higher cancer incidence of all neoplasms was found for men and women living in the North and West grouped region and SIRs gradually declined from North West to South East. In men, the widest differentials were seen for lung cancer and for cancers of the digestive tract. In women, those living in the North and West had considerably higher incidence of stomach cancer and considerably lower SIRs for cancer of the corpus uteri. Differences in incidence between regions were, in general, not as wide as those found in socio-economic classifications. It should be noted that, within each grouped region, SIRs were not always homogeneous.

Regional differences in health are not only a problem of a north-south divide, but they also reflect the different

social class distribution in the population of the regions. Big inequalities in health have been found within regions.[31,32] Analysis of cancer incidence by housing tenure and region indicated that for most sites, housing tenure differentials were also replicated within each grouped region. This might partly explain both the heterogeneity of SIRs within grouped regions and also the narrower differences found among regions than among housing tenure groups. However, residual regional effect was evident in many cases even after adjusting for housing tenure, and in some sites regional variation was more pronounced than housing tenure. Poisson regression was applied in order to distinguish between a regional and a socio-economic component in the variation of cancer incidence in the population. This approach identified in men, oesophageal, lung and bladder cancer and in women, lung and cervical cancer as primarily related to socio-economic status. Cancers of the digestive tract in men were primarily related to regional factors. The distinction between specific sites which are clearly class related corresponds to what is known about the prevalence of smoking between social classes and regions; differences have been found to be more pronounced between social classes than between regions (Table 10.3, see also Table 10.1).[6]

Table 10.3 Percentage of current smokers by region of residence, 1972

Region of residence	Men	Women
North and West		
North	52	47
North West	54	43
Wales	56	43
Central		
Yorks & Humberside	53	40
East Midlands	50	36
West Midlands	52	42
South and East		
East Anglia	48	37
South East	51	40
South West	48	36

Source: General Household Survey, 1972 (Reference 6)

Occupational exposures could be another factor which is mainly class related and which cause a considerable proportion of lung and bladder cancer among manual workers. Contrary to this, existence of more pronounced dietary differences between regions rather than between social classes, could explain better the patterns observed in stomach, colon and rectal cancer in men. These results are in contrast to the small dietary regional differences found in the National Food Survey and also to the documented different dietary habits between social classes.[11] However, a recent detailed study of dietary habits in three English towns revealed differences between regions but not between social classes.[33]

Accuracy and completeness of cancer registration varies throughout England and Wales and has undergone changes during 197 1-8 1. Methodological studies on cancer registration have shown that a small number of cancer registries had clearly inaccurate coverage, at least during some years of the follow-up period for this study.[34,35] This may have affected comparisons of regional variation in incidence. The extent of incomplete registration among socio-economic groups is not known. Analysis of LS incidence and survival data indicated that accuracy of registration does not vary much among the major socio-economic groups (see section 2.2). Similarly, there is no tendency for inaccurate registration to occur in specific parts of the country, for example, the North and West. The use of grouped regions would consequently tend to attenuate any registration problems that occurred in specific cancer registries. Leon[2] compared the five-year follow-up cancer incidence data by region with two sets of area mortality data[30,36] and did not find important discrepancies between them. A similar comparison for the ten-year follow-up data (not shown) also indicated that regional differences in mortality do not vary much from incidence differences.

10.1.4 Marital Status

Mortality differences between marital status groups are well documented and consistently found in different time periods and in societies with varying cultures.[37–40] Married people have usually been found to have the lowest mortality, and among non-married people, the single have better health than the widowed and divorced. Various reasons have been proposed for this. Marital status is related to life-style and environmental exposures, while on the other hand health might have a direct effect on marital status through a process of selection of those married or of those remaining married.[41] Being married is associated with a higher availability of social support[42] and provides the individual with a well accepted social role.[43] Widowhood is associated with stress of bereavement.[44] Finally, sexual activity and childbearing, which are associated with marital status, have a clear association with the occurrence of some cancers.[45,46]

Analysis of LS data for cancer incidence of all neoplasms by marital status shows a marked contrast between the divorced and other marital status categories. Only the divorced had clearly higher incidence at all ages. Contrary to other studies, in the LS population, single men and women had the lowest rates, although differences with the married were small. Patterns for specific cancer sites differ from overall patterns, as the prevalence of specific risk factors differs between marital status groups. Single men and women had the lowest lung cancer rates, while divorced men and women had markedly high rates. Smoking in England and Wales is known to be less common among single people[6] and possibly more common among the divorced.[2] There are no clear reasons why widowed men had high stomach cancer rates and single men high rates of pancreatic cancer. A possible explanation for the latter may lie in the higher prevalence of heavy drinkers among single men. However, the association of alcohol with the occurrence of cancer of the pancreas, although biologically plausible, has not yet been well documented.[47,48] Contrary to studies conducted in the

USA,[39,49] incidence of prostate cancer was found to be higher among single men, although results were not significant. Increased numbers of sexual partners and other sexual habits have been incriminated as risk factors for prostate cancer[50] and could be of relevance for explaining these patterns. However, there is inadequate understanding of sexual habits among different marital status groups, especially at younger ages.

Possibly the first documented observation of differences in cancer incidence by marital status was that done in 1842 by Rigoni-Stern on breast and uterine cancer. The pattern he described, of single women having low rates of uterine and high rates of breast cancer, has consistently been found thereafter. Sexual habits and possibly infectious agents, in the case of cervical cancer, and childbearing in breast cancer could explain this pattern. Further discussion of this subject is carried out in section 10.4.1.

Confounding of socio-economic status has been postulated as a possible factor contributing to the occurrence of differences among marital states[2] and was examined in this study for women. Adjustment of women's marital status with own social class did not modify rate ratios of either classification much. The most important difference occurred for invasive cervical cancer. The inclusion of marital status and own social class in a model indicated a correlation between widowed/divorced and people with inadequately described occupations and a subsequent decrease in rate ratios for the latter rather than for widowed/divorced.

Some studies comparing marital status groups have been criticised as being susceptible to numerator/denominator bias.[51] Cases or deaths in these studies were derived from death certification or cancer registration while the denominator was derived from census data. A similar problem was encountered in England and Wales with the mortality analysis by social class.[52] The LS, although smaller in numbers avoids this bias because of its design.

10.1.5 Time trends in incidence, 1971-81

Differences in incidence between high and low socio-economic groups widened throughout the ten-year follow-up period in men and possibly also in women. This pattern was evident in nearly all age-groups, indicating a generalised phenomenon rather than one confined to a specific disease or cohort. Analysis of mortality data for the whole England and Wales population comparing the periods 1970-72 and 1980-82, showed similar and even more pronounced widening of differentials between non-manual and manual social classes.[53] Results on cancer incidence confirm this previous analysis.

Differences in incidence widened over time for most specific cancers. However, random fluctuation of rates could be expected to be more important in the analysis by individual sites. Time trends for lung cancer in men for the two major housing tenure groups provide a good example. Differences in incidence became slightly narrower with time. However, all the information available for smoking patterns among high and low socio-economic groups indicates that SIRs for these two groups should widen. This was shown to be the case when all smoking related cancers were combined for the housing tenure analysis. This was also the case when other socio-demographic classifications were used, for example social class, region.

These data suggest that socio-economic differences in breast cancer may have narrowed over the period 197 1-8 1. Other recent studies have indicated a similar trend. In the USA, rates for young black women, which were previously lower than those of white women, are now 30 per cent higher.[54] An increase in the proportion of patients with low socio-economic status was also observed among most ethnic groups in Hawaii.[55] In England and Wales, an analysis of time trends since 1931 has indicated that the mortality difference between women with husbands in non-manual and manual social classes has become narrower.[15] Because of relatively small numbers, a definite evaluation of changes over time among socio-economic groups cannot be provided using this data.

10.2 Socio-economic differences in survival

In the majority of cancers, lower socio-economic groups had poorer survival (higher SFRs) than high socio-economic groups. This finding was consistent irrespective of sex, age, cause of death, socio-economic classification or prognosis of the cancer. Council tenants had higher case-fatality rates than owner occupiers in 11 out of 13 major cancer sites in men and in 12 out of 15 major sites in women. Those living in the South and East regions of England had better survival than those living in the North and in Wales.

Common rate ratios for both sexes were estimated for those cancers in which survival differentials showed the same pattern for both men and women. For all seven sites, council tenants had higher rate ratios than owner occupiers, and for cancers of the colon, pancreas, lung, other skin and bladder the excess was significant. In the absence of any indication that factors affecting survival differentials vary in men and women, the calculation of common estimates seems reasonable.

Even though the pattern of survival differentials was similar for both sexes, there were discrepancies in specific sites. In stomach cancer, for example, male council tenants had poorer survival than owner occupiers while female council tenants had better. These discrepancies, either in the direction of the survival differences (stomach, rectum, leukaemias), or in the degree of the differences (colon, pancreas) were shown to be due to registration problems. For cancers of the colon and pancreas, problems of registration were evident in men, resulting probably in an underestimate of the magnitude of the rate ratio.

SFRs were examined in different age-groups, showing that low socio-economic groups generally had worse survival irrespective of age. For a few cancers, patterns varied between young and old age-groups, but only for bladder cancer in men were there *statistical* reasons for believing that a common estimate for all ages was incorrect. For all other sites, presenting a single SFR for all ages therefore seems reasonable. There are no clear reasons why such a pattern occurred for bladder cancer, if this finding is not due to chance. Risk factors for bladder cancer do not vary in adult men by age and the natural history of the disease does not seem to vary by age.

Shorter survival was associated with lower socio-economic status irrespective of the socio-economic classification used, with the exception of colon cancer in men and breast cancer in women. Among men, council tenants, manual workers, and those living in the North and West grouped region had worse survival for colon cancer then owner occupiers, those in non-manual occupations and men living in the South and East. In contrast, unemployed men had better survival than employed men. This was shown to be basically an effect of erroneous registration among the unemployed. In young men, where problems of registration are less evident, the unemployed had worse survival than the employed. In breast cancer, owner occupiers had slightly worse survival than council tenants, while women in non-manual social classes appeared to have better survival than those in manual classes.

In all classifications, a basic core of the population is classified on the same part of the socio-economic scale, irrespective of whether the criteria used are housing tenure, social class, car ownership, education, etc.[1,2] Differences occur with people on the margins of this core who can be classified in different positions depending on the classification used. Housing tenure has been shown to be a good predictor of morbidity and mortality in England and Wales.[2,29] It can be expected that on specific occasions, for example breast cancer survival, health status will not be assessed similarly in all socio-economic classifications. In the case of women classified by social class, it should be noted that employed women constitute 50 per cent of the adult population, while housing tenure refers to the whole female population.

Results from the LS indicate that married people had, in general, the best survival. Contrary to studies on incidence and mortality (see also section 10.1.4), and the little evidence on cancer survival,[56] the survival of single people in this study appears to have been as poor as that of the widowed and divorced, at least for the cancers examined. However, the reasons for these differences are not apparent. Analysis of a large series in New Mexico[56] indicated that married people had the best survival. Among those unmarried, divorced had clearly the highest relative risk of death. Unmarried people tended to present later, but differences persisted even after adjusting for stage at presentation and treatment. In another study, the survival advantage of married women registered with breast cancer compared with widowed women, was found not to be accounted for by differences in stage at presentation.[57] Wilkinson *et al.* did not find any difference for breast cancer survival between marital status groups.

Findings from the LS and from most other studies suggest that cancer survival differences exist between marital status groups, and point to stage at presentation as one of the contributing factors. However, the reasons for late presentation and also for residual differences between marital status groups after controlling for stage and treatment are not clear. Health selection does not seem to be a plausible explanation for cancer survival, as it is for incidence or mortality, although co-morbidity of cancer patients could affect their chance of surviving. However, factors related to social support affecting incidence and mortality might also be affecting survival.

Mortality data has frequently been used to assess the health needs of populations in different geographical regions, and also the quality of health care provision. Potentially, cancer survival could be a much more accurate indicator of health services provision because, unlike mortality, it is not seriously affected by regional differences in incidence. Wide differences were observed in the LS between Regional Health Authorities for the four sites examined (colon, breast, cervix and bladder cancer). Similar differences have been reported by Silman.[58] It can be expected that part of this variation in SFRs can be attributed to random fluctuations of the data. However, survival differences for bladder cancer in men, and colon and breast cancer in women showed a clear and statistically significant trend from north west to south east, similar to well documented regional patterns in mortality.[29] Problems in registration could have affected these comparisons probably more than for any of the other classifications examined. However, grouping RHAs into three large areas overcame this problem, as cancer registries in which major problems in registration occurred are dispersed throughout England and Wales.

Cervical cancer survival by RHA was shown to be significantly associated with median waiting time of cervical cancer patients until admission to hospital, that is, with a direct measure of health services efficacy. Although this result was statistically significant, both variables included in the correlation (SFRs and median waiting time) did not vary much. Survival differences for cervical cancer between RHAs were not significant, while differences in median waiting time ranged from 1.5 to 3 weeks. Therefore, it is difficult to evaluate the importance of this finding.

10.2.1 Case definition

Death has been used as the outcome variable in nearly all studies, since case fatality is high even for cancers regarded as having a good prognosis. Few studies have measured recurrence.[59–61] It is regarded as being more sensitive in measuring the impact of medical inter-

ventions, but is not always related to length of survival. More important, it is more prone to measurement biases.

Deaths of cancer patients from all causes, or alternatively, deaths from the primary cancer, have been used indiscriminately as the outcome variable. Case-fatality rates based on deaths from the primary cancer are not affected by the differences in background mortality which are known to exist between socio-economic groups. The disadvantages of using these case-fatality rates are that first, another source of measurement bias is introduced in the data (i.e. that of death certification) on top of any cancer registration problems, and second, that co-morbidity of cancer patients, which is a variable of interest, is not taken into account. There is no indication, either in the LS or in other studies, that using one or other of the two variables (all causes or primary cancer) have influenced the results.

10.2.2 Survival by prognosis: absolute or relative differences?

In the LS, *absolute differences* in length of survival between socio-economic groups were found to be larger for cancers of good prognosis than those of poor prognosis. This was expected. Survival differentials were clearly not confined to those sites and *relative differences* were large irrespective of prognosis. However, even relative differences tended to be wider for the very good prognosis cancers, although, in women, the widest differences were observed for cancer of the pancreas, a very poor prognosis cancer.

Frequently, the measure of survival has been the percentage of cases surviving a defined period, for example five years. For cancers of poor prognosis, for example pancreas, liver, differences are usually disregarded because all socio-economic groups have very low percentages surviving five years.[62] Berg,[63] and from then onwards other authors, have claimed that survival differentials should be expected mainly in good prognosis cancers (for example breast), and less so in cancers of bad prognosis (for example lung), or in those of very good prognosis (for example skin). Results from studies investigating many cancer sites (including Berg's own study), do not give proof to this claim (Table 10.4).[62–66] Whatever the interpretation or the importance of survival differentials in poor prognosis cancers, high socio-economic groups seem to have longer survival even in those cancers.

Whether one should examine relative, or absolute differences in length of survival depends on what the question is. Wide relative differences for poor prognosis cancers are probably of little interest in health planning, since they indicate minor differences in survival time. However, if the aim is equity in the provision of health services, the appearance of such small differences can be of importance indicating that, even in the worst circumstances, high socio-economic groups still have the advantage. Furthermore, if interest lies in the investigation of the causes of survival differentials, then, as in other epidemiological analytical research, relative differences might provide more insight. The large socio-economic differences in survival for good prognosis cancers are as expected if social class differences in treatment are playing a role. The social class differences in survival for poor prognosis cancers suggest that socio-economic differences in treatment are far from being the most important factor.

Table 10.4 Survival differentials for cancers of bad prognosis among 'high' and 'low' socio-economic groups, as found in five major studies

	Berg[1]	Lipworth[2]	Lipworth[3]	Page[4]	Young[5]
Stomach	40/37	m 25/11 f 0/14	m 39/25 f 47/30	11/10	m 13/14 f 15/14
Pancreas	48/34	–	–	3/1	m 3/2 f 3/4
Lung	40/26	m 7/10 f 5/5	m 38/23 f 35/32	7/7	m 11/9 f 15/13

[1]Proportion surviving at 8 months after diagnosis for stomach, at 4 months for pancreas, and at 9 months for lung cancer. (Reference 63).
[2]Three year relative survival rate (Reference 64).
[3]Proportion surviving 10 months after diagnosis (Reference 65).
[4]5-year relative survival rate (Reference 66).
[5]5-year relative survival rate (Reference 62).

10.2.3 Specific cancers

A review of the literature on socio-economic differences in cancer survival revealed that even though the picture was not homogeneous (varying in time, populations and cancer sites), overall, unprivileged socio-demographic groups had worse survival than the privileged. A similar conclusion was reached for the LS population. In this analysis, relative differences were found to be more pronounced for cancers of the testis, colon, bladder and skin in men, and in pancreas, skin, corpus uteri and bladder in women. In accordance with the findings in the LS, the widest survival differences registered in the SEER Program between blacks and whites were for cancer of the bladder and cancer of the corpus uteri.[62,67] Evidence from other studies for colon cancer is contradictory,[58,63,65,66,78] while there is too little published data on testicular and skin cancer.[63] Differences for cancer of the pancreas, which in this study were pronounced in women, were either absent or of small magnitude in most other studies.[62,63,66]

The major discrepancies between the LS and other studies are for prostate and breast cancer. Contrary to the LS and these other studies,[66] in most studies low socio-economic groups had clearly worse survival for cancer of the prostate[58,62,63,64,65] or of the breast.[58,63,64,65,85] There are no obvious reasons for the occurrence of these specific differences. Most published literature refers to the US population and causal factors might vary in importance in England and Wales. Chance might also explain part of the discrepancies, since for neither of these two cancers were the differences between socio-economic groups in the LS statistically significant. Finally, one should bear in mind that although council tenants had better breast cancer survival than owner occupiers, when women were classified by social class those in manual social classes had worse survival than those in non-manual.

10.2.4 Stage of cancer at presentation

Differences in the stage of cancer at presentation can be one of the causes of survival differentials. Stage of the tumour at presentation is defined by the degree of invasion and extension of the tumour in the host and is a major factor affecting prognosis. Lower socio-economic groups have been found in many studies, most of them conducted in the USA, to present at later stages of their disease than higher socio-economic groups. Controlling for stage in the analysis reduced survival differentials in many studies, but did not abolish them, suggesting that delays in presentation or in treatment can be but one of the causes of the observed survival differentials.[62,63,66]

In England and Wales, high social classes use health services more efficiently than low social classes and make more use of preventive health services.[31] Cervical cancer screening is the only massively available screening programme in England and Wales and women of high socio-economic groups are believed to have a better compliance.[68–70] However, evidence for differential uptake is not abundant and studies quoted (see for example in *The Health Divide,"* p.48) as showing that high socio-economic groups have an increased uptake are clearly non-conclusive.[72] Compliance with breast cancer screening was found to be better among women of high socio-economic groups in the USA[73] and self referral for screening was associated with higher social class in the UK.[74] However, attendance at breast cancer screening clinics was found to be independent of social class in two British studies.[74,75] Diverse results have also been found for colorectal cancer screening.[76,77]

Wegner and his colleagues[78] suggested another way of examining the relationship of stage at presentation to socio-economic status: '. . . Obviously stage of the disease at diagnosis can reflect socio-economic influences in delay in seeking care, but stage of the disease may also reflect socio-economic differences in host resistance... If lower socio-economic status background results in lower resistance, then controlling for stage at diagnosis will eliminate some of the variation in survival which could be accounted for by socio-economic status.' Influences of host characteristics (for example immune response, nutritional status) on the progression of a cancer are well known.[79] The degree to which such characteristics influence socio-economic differences in survival is still questionable. It seems reasonable, however, to examine results on socio-economic differences in survival both before *and* after controlling for stage.

Stage at presentation is likely to be associated with delay at seeking treatment. Short delay has been associated with long survival,[80,81] but findings are contradictory and many studies have found no association of delay neither with stage nor with improved survival.[82,83] Studies that included information on delay, stage, and survival found that any association of delay with length of survival was eliminated when adjusting for stage at presentation[57,84,85] and delay was found to affect survival through its influence upon the extent of disease at diagnosis.[57]

10.2.5 The effect of lead-time bias

Delays at presentation could affect differentials in two ways: a real effect due to better prognosis of a tumour when detected and treated at an earlier stage; or an artefact due to the effect of lead-time bias. Lead-time refers to the time period which is added to survival time not because the natural history is altered, but because diagnosis has taken place earlier in the natural history of the disease. Few of the published papers have considered lead-time as a possible explanation,[67] probably because even though it is important when evaluating screening programmes it has not been regarded as a factor which could much affect survival differentials. Data for stage from the USA indicate that *high socio-demographic groups are diagnosed earlier* and consequently lead-time cannot be exempt as one of the factors contributing to survival differentials.

In the LS, average differences in survival time for poor prognosis cancers were small even when relative differences were wide. For example, differences in median survival for cancer of the pancreas between council tenants and owner occupiers was half a week in men and two weeks in women. For such cancers, there can be no indication whether survival differences are real or are principally due to lead-time. In better prognosis cancers, for example bladder cancer in both sexes and corpus uteri, differences in average survival time or in median survival were more than eight months. In the absence of any screening program for these sites, it is clearly improbable that lead-time could be the sole explanation. Analysis of survival by stage of cancer could *partly* deal with this problem. The National Cancer Registration Scheme in England and Wales, and hence the LS does not include any information on stage.

Therefore, a different approach was followed based on the experience of screening programmes in order to investigate whether lead-time contributed to the observed survival differentials. The basic assumption is that if a screened group has longer survival only due to early detection, then differences in mortality in the initial period of follow-up should be wider than in later periods, because case-fatality rates of the screened grouped would initially be artificially low. When the average lead-time period has passed, case-fatality rates of the early detected group would rise as there would be no real prolongation of survival (see also Chapters 2 and 3 in Morrison 1985).[86]

An example will make the above clearer. Figure 10.1 shows the survival distribution function and hazard rates (case-fatality rates) for two groups as found from a life-table analysis. Case-fatality rates for female owner occupiers registered with breast cancer have been used for group A. Group B is fictitious with half the cases having the breast cancer case fatality of owner occupiers. The other half are assumed to have a lead-time of one year, that is, to have been diagnosed one

Figure 10.1(a) Survival estimates for breast cancer: effect of lead-time bias

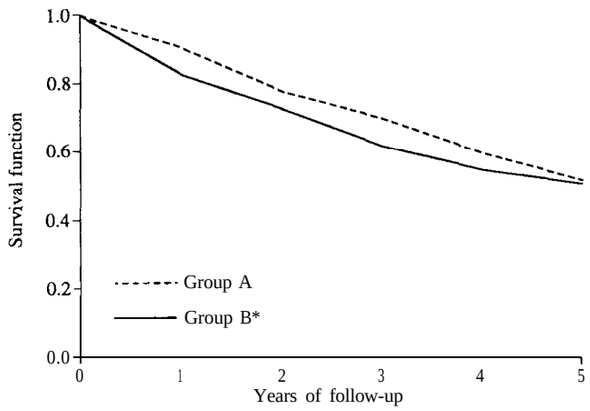
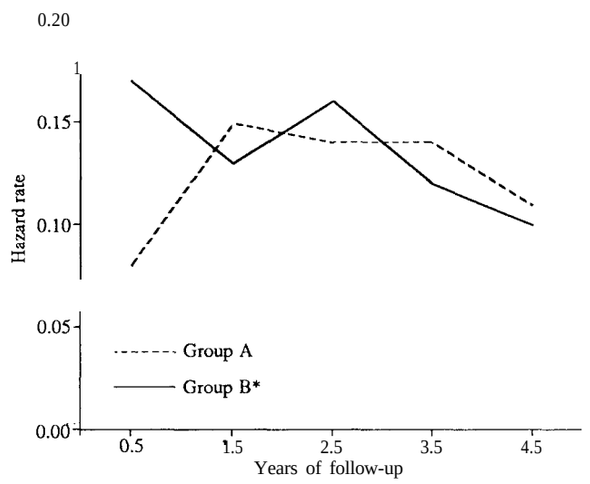


Figure 10.1(b) Hazard estimates for breast cancer survival: effect of lead-time bias



*Half of Group B has one year lead-time

year earlier than all the rest and from then onwards to have similar case fatality to that of owner occupiers. Therefore, in this second half of group B, deaths start to occur after the lead-time period, that is, after one year of follow-up. The total survival experience of group B is a mixture of the two halves. In this case comparison of hazard rates is of more interest than the commonly used survival function since it shows clearly the effect of the transfer in the diagnosis of the disease. During the first year, hazard rates for group B were low, but increased steeply in the second year as an effect of the delayed occurrence of deaths in the second half of the group.

A similar analysis can be carried out when comparing survival of two socio-economic groups, one of which is assumed to have better access to health services. It should be stressed, however, that when comparing socio-economic groups, expected lead-time can only be a fraction of the estimated lead-time in a screening programme.

Analysis of survival curves for some cancers of good prognosis for which wide survival differences were observed between housing tenure groups (cancer of the bladder for both sexes and corpus uteri), indicated that council tenants had much higher case fatality than owner occupiers in the very first period of follow-up. The most plausible explanation for these differences is that a high proportion of council tenants presented at a late stage of their cancer. After the initial period but during the first year of follow-up this pattern reversed, and council tenants had temporarily lower case fatality. This picture is compatible with an effect of lead-time which could also have been one of the factors *partly* contributing to the survival differences.

10.2.6 Other factors explaining survival differences

No information is available in the LS on treatment or on tumour characteristics. Few studies have examined differences in treatment between socio-economic or ethnic groups and most did not identify treatment as an important cause of survival differences. However, these studies did not examine treatment in a detailed way, most of them comparing percentages receiving one or another type of treatment, for example radiotherapy, surgery, etc. This approach leaves the possibility of considerable undetected residual effects. A second factor which might have affected the paucity of positive results is the narrow spectrum of socio-economic circumstances covered in many studies. The fact that medical care has not been identified as a major factor for survival differentials comes as a contradictory statement to a recent evaluation in the USA of hospital differences in treatment. It was claimed that application of 'state of the art' treatment in all hospitals could considerably improve survival of the whole population and reduce cancer mortality rates in the USA by 10 per cent by the year 2000.[87]

Differences in tumour characteristics among socio-economic and mainly among ethnic groups have been proposed, for example different histological types of corpus uteri in black and white Americans. Existing evidence does not indicate that this type of difference could explain a large part of survival differences. It is clear that research is lacking in this field, not only on survival but also on cancer incidence. Research on the possible effects of psychosocial factors is still ambiguous. Berg *et al*,[63] having taken account of differences in quality of care, postulated that host differences accounted for part of the observed survival differentials. Solid quantitative evidence is lacking.

10.2.7 Comparing incidence and survival differences

Patterns of incidence and survival differed for many sites, either in the direction of the differentials (e.g. cancer of the testis), or in their magnitude (e.g. cancer of the lung). Socio-economic differences were most consistent for cancer survival than for cancer incidence (Tables 10.5 and 10.6). This was especially the case for women. Out of 18 cancers examined in incidence, female council tenants had higher SIRs than owner occupiers in 10, while for survival they had higher SFRs

Table 10.5 Classificalion of cancer sites† for incidence and survival in men, according to the housing tenure group with the higher standardised incidence and fatality ratios

Incidence		Fatality	
Owner occupier	Council tenant	Owner occupier	Council tenant
Colon	Oesophagus	Prostate	Oesophagus
Pancreas	Stomach	Leukaemias	Stomach
Testis	Rectum		Colon
Leukaemias	Larynx		Rectum
	Lung		Pancreas
	Prostate		Larynx
	Bladder		Lung
	Other skin		Bladder
	Lymphomas		Testis
			Other skin
			Lymphomas

†*Cancer sites for which data was available for both incidence and fatality.*

Table 10.6 Classificalion of cancer sites† for incidence and survival in women, according to the housing tenure group with the higher standardised incidence and fatality ratios

Incidence		Fatality	
Owner occupier	Council tenant	Owner occupier	Council tenant
Colon	Oesophagus	Stomach	Oesophagus
Pancreas	Stomach	Rectum	Colon
Other skin	Rectum	Breast	Pancreas
Breast	Lung		Lung
Corpus uteri	Malignant melanoma		Malignant melanoma
Ovary	Cervix uteri		Other skin
Bladder	Lymphomas		Cervix uteri
Leukaemias			Corpus uteri
			Ovary
			Bladder
			Lymphomas
			Leukaemias

†*Cancer sites for which data was available for both incidence and fatality.*

in 12 out of 15 cancers analysed. All major cancers were included in the analysis, so this comparison should not be influenced by prior selection of specific cancers.

Several factors may influence the relationship between incidence and survival. Diagnostic patterns have been shown to affect incidence and case-fatality rates[3,88–90] and consequently any relationship can be seen as an artefact. The validity of long-term comparisons of survival rates has been questioned. Increased diagnosis of benign tumours has been associated with improvements in survival especially for prostate cancer and breast cancer, but also for cancer of the bladder and the cervix uteri.

Few specific risk factors have been shown to affect both incidence and survival. Overweight has been associated with incidence of a number of cancer sites, for example cancer of the gall bladder, endometrial cancer[10] and it is believed to affect adversely survival in many sites.[91] It is not clear whether any effect on survival is site specific, or related rather to general health. Reproductive factors, apart from affecting incidence, have been investigated as possible prognostic factors for breast cancer (see section 10.4). Risk factors have been related occasionally to the occurrence of specific histological types or tumour characteristics of a neoplasm, which may have a different natural history or be more amenable to available medical treatments, for example oestrogen receptor status in breast tumours in relation to reproductive factors.

Socio-economic status appears as a powerful predictor of both cancer incidence and cancer survival in this and other populations. To investigate the link between social structure and the forces that affect health (on this occasion cancer incidence and survival) one should focus on the chain of causation: social forces→ life-style and exposure differences→ health differences. It is appropriate to ask what are the intermediaries between social class and disease or death. These links could vary for different periods in the natural history of the disease, for example use of health services affects primarily survival differentials. Exposure to asbestos is related to incidence but not to survival.

Low socio-economic groups seem to be exposed to adverse factors resulting in an non-advantageous overall health outcome compared with high socio-economic groups, irrespective of the phase in the natural history of the disease. Cancer survival, being relatively short, may perhaps depend on fewer risk factors (e.g. stage at presentation, treatment) than the multiplicity of carcinogenic risk factors affecting cancer incidence. Therefore, socio-economic differentials in survival may appear irrespective of the magnitude or direction, of the differentials in incidence. Survival differences may appear in a more consistent pattern than incidence differentials because the same few risk factors affect many cancers. A similar phenomenon happens only partially with cancer incidence with risk factors like, for example, smoking, which is related to the incidence of many cancers.

10.3 Socio-economic differences in mortality: the contribution of incidence and survival

Despite the fact that mortality rates are not necessarily a good measure of the adequacy of health care,[92] research on inequalities in health has often focused only on mortality differentials. These are affected by both disease incidence and survival.

There is evidence that higher socio-economic groups in England and Wales benefit most from existing health services.[31, 71] The question that has to some extent remained unanswered is *how much of the differences in mortality is due to inequalities in the use or efficacy of health services.* For cancer, this may be rephrased in terms of how much do survival differentials contribute to mortality. Is it reasonable to expect that health policies can reduce inequalities in cancer mortality by focusing on equity in the provision of health services? Or should the focus be on prevention?

The National Cancer Institute (NCI) in the USA has recently produced a comprehensive report[87] on the measures needed for reducing cancer mortality in the USA through prevention, early detection, and treatment. In the most ambitious of the scenarios, a 50 per cent reduction in mortality could be achieved by the year 2000, half of it being due to improvements in treatment. These projections have been criticised as putting too much weight on *registered* improvements in survival rates or on *expected* advances in treatment of cancer.[93] Bailar and Smith analysed time trends in cancer mortality in USA and showed that mortality is still rising.[93] They claimed that most improvements in cancer survival have been achieved for less common cancers, and have had no marked effect on overall cancer mortality. Other objections can also be raised, concerning the strength of the evidence for some risk factors, for example the role of fat on cancer incidence.[94] Whatever the feasibility of the projections and the priorities of the NCI, the report is still a useful reference basis as it provides an updated evaluation of current knowledge on cancer aetiology and control. Estimates and projections given in the report for specific major cancers and major risk factors are summarised in Table 10.7.[87]

The construction of the LS makes it possible to compare incidence, survival and mortality data for different socio-economic groups. The approach followed was to compare men and women living in council houses with those in owner occupied accommodation, representing the 'low' and 'high' socio-economic groups respectively. The relative contribution of incidence differentials to mortality differentials was assessed by estimating 'expected deaths' under the assumption that incidence differentials were eliminated. For example, what would happen to lung cancer mortality if council tenants had the incidence rates of owner occupiers, that is if the standardised incidence ratio equalled 100? A similar approach was followed under the assumption that *mortality differentials, that is incidence and fatality differentials, were* eliminated. The difference between these two estimates of expected deaths measures the effect of survival differentials on mortality differentials. Estimates were made for all major cancer sites for which any type of significant intervention was identified in the NCI report.

For some cancers, incidence patterns among housing tenure groups in the LS corresponded to known differences in exposure to recognised risk factors. Cigarette smoking, for example, has been related to social class in England and Wales for many years. In the mid 1970s, around 30 per cent of men and women in Social class I were smokers. Prevalence of smoking rose with decreasing socio-economic status and among unskilled workers, 60 per cent of men and 40 per cent of women were smokers.[7] A decade earlier this pattern was less pronounced but still clearly evident, especially in men. These patterns are clearly reflected in the incidence patterns of all smoking related cancers among men. For women this was also true of lung and oesophageal cancer but no differences were observed for oral cancers and bladder cancer (Table 4.2).

Table 10.7 Cancer control objectives of the NCI†

Prevention

Smoking was identified as a major preventable risk factor for a number of sites:

Lung	91% in men and 77% in women attributable to smoking
Laryngeal	75% attributable in men, 43% in women
Oral	1.2 to 13 times higher mortality in smokers
Oesophageal	1.2 to 12 times higher mortality in smokers
Pancreas	40% attributable in men, 25% in women
Bladder	56% attributable in men, 30% in women
Kidney	1.1 to 5 times higher mortality in smokers

Estimates for the effects of diet are not as precise as those for smoking. Two major recommendations were made: an average reduction of fat consumption from 37-38% to 30% or less of total calories and increase average consumption of fibre from 8–12g to 20–30g per day. These changes could result in a 50% reduction in mortality from colorectal cancer, 25% reduction from breast cancer, 15% reduction for cancers of the prostate, endometrium and gall bladder, and a possible but not quantifiable reduction in a number of other sites.

Screening

Evidence for the effectiveness of screening programmes was judged as definite only for mammography for breast cancer for some age-groups and Papanicolaou test for cervical cancer. A 3% reduction in cancer mortality overall was attributed to a wider implementation of screening for these two sites.

Treatment

Considerable reductions in mortality were estimated for specific sites by the application of the state-of-art treatment to the whole population. Estimates for the per cent reduction by the year 2000 are presented below for major sites:

Cancer	Reduction (%)	Cancer	Reduction (%)
Prostate	42%	Bladder	15%
Breast	14%	Melanoma	*25%*
Colon	*20%*	Cervix uteri	27%
Rectum	39%	Corpus uteri	27%
Lung, small cell	7%	Ovary	8%
Total, all sites	9.1%		

† *See Reference 87.*

The relationship of cancer differences in the LS with known dietary patterns is less clear. Recent data have shown that low social classes in England and Wales have eaten less fruit, less fibre and more sugar, and drunk more alcohol than high socio-economic groups, while fat consumption has not differed much.[11] Apart from fruit consumption, differences in dietary patterns were not as evident in previous decades and this may be reflected in the absence of a clear pattern of socio-economic differences in incidence of some dietary related cancers.

Applying owner occupiers' incidence rates to council tenants has a clear interpretation for lung, oesophageal and bladder cancer as it expresses the effects of differential exposure to smoking and, to a lesser degree, to occupational carcinogens. It is also meaningful for cervical cancer, as far as screening is concerned. However, it does not seem to have a practical meaning for some sites, for example colorectal cancer in women for which council tenants (the group with the low incidence) is the group consuming less of the recommended healthy diet. However, results are presented even for these sites *to avoid over-estimating the extent to which prevention or treatment can reduce the toll of cancer.* If analysis was limited only to sites for which the low socio-economic group had higher

incidence in this data, this would clearly tend to overestimate the magnitude of incidence differentials. A similar reasoning applies to survival.

Overall elimination of incidence differentials *for the sites examined* would result in approximately a 33 per cent reduction in deaths in men and an 8 per cent reduction in women. Elimination of the observed survival differentials would result in approximately a 4 per cent reduction of deaths in men and 2 per cent in women. There was considerable diversity in the relative effects of incidence and survival differentials among cancer sites.

These results suggest that incidence differentials between social classes are far more important than survival differences in the production of the wide social class differences in mortality observed in England and Wales. In particular, this reflects the importance of lung cancer. Elimination of the incidence differentials among social classes in this site would considerably reduce mortality differences in men: there were 331 excess deaths among council tenants due to incidence differentials in lung cancer—in a total of 411 excess deaths for all sites examined. In women, elimination of the incidence differentials would cut down the mortality differences by more than 75 per cent (60 excess deaths due to lung cancer incidence differentials, compared with 73 excess deaths for all nine sites).

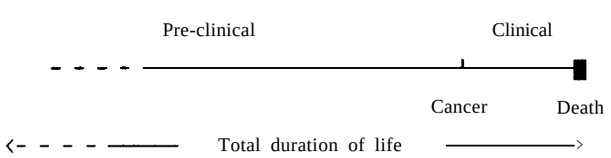
The effect of survival differences depends on:

(i) whether there are observed case fatality differentials or not (prostate cancer, cervical cancer, etc.) and

(ii) the prognosis of the cancer. For lung cancer the elimination of survival differentials would not have a significant effect,

while for cancer of the corpus uteri, elimination of survival differentials would eliminate mortality differentials. This is partly due to the wider survival differences observed for cancer of the corpus uteri but mainly reflects the very poor survival of lung cancer cases. For corpus uteri, median survival was seven years and two months for council tenants and more than ten years for owner occupiers (Table 6.6). For lung cancer cases of all ages, median survival was 90 days for council tenants and 97 days for owner occupiers.

The dependency of survival differentials on both the magnitude of the differentials and the prognosis of the cancer can be illustrated using a simple model. The life period of an individual getting a cancer can be schematically separated into two parts. The first part covers the period before the individual gets a cancer (or any disease), and the second covers the period from onset of clinical disease to death. The total life duration



will be simply the addition of these two periods. On most occasions preventive medicine deals with the first part while therapeutic medicine deals with the second. This relation between incidence, survival and mortality can be easily expressed algebraically in terms of an equation between incidence rates, case-fatality rates and mortality rates (see Statistical Appendix).

If life expectancy after onset of disease is small, as is the case with many cancers, then large relative differences in survival can exist even if in *absolute* terms the differences of survival time are small. For example, the median survival for women with cancer of the pancreas was 4.1 months for owner occupiers and 3.5 months for council tenants. The rate ratio was found to be 1.6. This difference of 2 weeks would contribute little to the overall mortality differentials, which would be determined mainly by incidence differentials. In general the more fatal the disease, the closer are the mortality rates to the incidence rates, for example lung cancer.

By contrast, for cancers with a relatively long duration after onset of disease, survival differentials have a greater influence on mortality differentials. For example, for cancer of the urinary bladder, the case-fatality rate ratio in women was 1.4 among housing tenure groups and represented a considerable absolute difference in life years, that is, more than half a year.

If incidence differences were eliminated, deaths among male council tenants could have been reduced by 33 per cent and in female by 8 per cent. The corresponding figures for survival are 4 per cent fewer deaths in men and 2 per cent in women. These proportions should be regarded as providing an average estimate of the relative impact of survival and incidence differentials on mortality differentials. Both the data and methods used for this analysis are limited. Any effect of lead-time could not be taken into account. If lead-time is important, then calculating the effect of modifying case-fatality rates would result in an overestimation. Incidence data only covers the period 1971–8 1, while survival of these cases extends to 1983. It would have been desirable to have estimates for the same time period.

Estimates of expected deaths as found from the standardisation do not correspond necessarily to the number of deaths that would have occurred among council tenants if they had the mortality of owner occupiers, even if estimates of relative differences are unbiased.[95] It has been shown[96] that when rates are not very high, this correspondence is fairly accurate. Excluding age-groups above 75 years of age at death minimises this problem. An additional gain from excluding older ages is that registration and mortality data are more accurate in younger ages.

When calculating the reduction in mortality differentials through the elimination of survival differentials, the assumption was made that survival differentials could be eliminated by health services alone. This is

optimistic. Host factors that may influence survival, as well as lead-time, have to be taken into account. Psychosocial factors appear to play an important role in the development of disease,[18] and there are biological reasons for speculating that the further progression of clinical disease will be affected by them. However, irrespective of whether all or most of the case-fatality differentials are due to differentials in the use of health services, their elimination would not always lead to decreases in mortality differentials.

Improvements in the provision of health services and consequential reductions in survival differentials have the virtue of making an immediate impact on mortality differentials, even if the overall benefit is small. By contrast, changing life-styles and controlling environmental exposures, even if they have a potentially bigger impact, require a considerable latent period before any effect is apparent.

10.4 Reproductive factors and cancer

Two aspects of the relationship between reproductive factors and cancer were of interest in this study. First, the independent effect of parity and age at first full-term pregnancy (FFTP) on cancer incidence and survival, and second, the role of these factors in socio-economic differences.

10.4.1 Incidence

There has been much debate about the biological mechanisms by which parity affects the occurrence of cancer. Immunological and hormonal pathways have been linked to the incidence of specific cancers and to a generalised effect of pregnancy.[45, 97] The possibility of confounding between reproductive and socio-economic factors has also been suggested, for example for stomach cancer.[45]

The relationship of reproductive factors to breast cancer has been clearly demonstrated.[98–100] Nulliparous women have higher risk than parous, while some studies suggest that there is also an independent protective effect of multiparity. Incidence patterns for breast cancer among parous and nulliparous women in the LS confirm previous findings on the protective effect of parity. A previous analysis of LS data showed that births after the first have an independent effect even after adjustment for age at FFTP.[101]

It has been suggested that any protective effect of pregnancy on breast cancer can be seen only after the menopause;[102, 103] at younger ages parous women (or married women who are presumed to be parous), have frequently been found to have higher incidence and mortality rates than nulliparous or single women. This has been associated with a possible short-term adverse effect of pregnancy on breast cancer risk,[45] and it has also been proposed as evidence for two distinct aetiological pathways leading to breast cancer.[104] The age when the cross-over of risk between parous and nulliparous occurs is not clear. In the LS, nulliparous women had higher incidence than parous at most ages. When women were grouped into those aged under 45 (of whom the majority were pre-menopausal and those aged 45 or over of whom the majority were probably post-menopausal), differences were narrower among younger women but there was no evidence of a cross-over effect. Similarly, these results do not point to a short-term adverse effect of pregnancy. Among young women under 35, the single did have lower incidence than those who were married, but this was shown to be entirely due to the high rates of nulliparous married women. A cautionary note should, however, be added. Although age of the population was measured prospectively, reproductive history was as recorded in the 1971 Census. This does not affect results for the large majority of breast cancer cases, most of whom were old enough to have completed their families before 1971. It could, however, bias results at the younger ages.

Late age of FFTP has been associated with increased risk of breast cancer in nearly all studies published during the last twenty years. Women having a first child after 35 years of age carry a higher risk than nulliparous.[105] However, results from recent large studies, mainly from Scandinavia, were negative, and a more complex relationship of pregnancy to breast cancer risk was surmised.[106–108] In one [108] this association was seen only among parous women under 50 years of age. In the LS, age at FFTP was strongly related to breast cancer risk in all age-groups. Women having their first child over 30 years of age had a marginally higher risk (SIR = 117) than nulliparous (SIR = 113). In terms of statistical significance and magnitude of the rate ratios, age at FFTP seemed a more important factor than parity. As these two variables were not cross-analysed, it was not possible to assess the independent effect of each one.

For ovarian and endometrial cancer, most studies have reported an increased risk among nulliparous women and an inverse association with parity.[109,110] It is unclear whether there is an independent association between age at FFTP and incidence of both these cancers.[9] In the LS population, a negative trend between increasing parity and incidence was evident for endometrial cancer. For ovarian cancer, although parous women had a lower risk such a trend was not consistent and results were not significant. Increased risk of endometrial cancer with an early age (under 20 years) of FFTP has been reported elsewhere,[110] although no decreasing trend was apparent as in the LS population.

Risk of both in situ and invasive cervical cancer in the LS decreased with late age of FFTP and were higher among parous than nulliparous women. A relationship with multiparity was not, however, as clear. These associations have also been found in other studies but in any event they are believed to be spurious, resulting from differing patterns of sexual behaviour.[45,46]

The possibility of a diagnostic transfer from cancers of the uterine cervix to cancer of the corpus, although

possible, should not be considered as a likely explanation. Cancers of the uterus NOS (non-specified) were excluded from the analysis and therefore, if such transfers existed, they would not have affected considerably the results presented in this analysis.

Associations between parity and incidence of a number of other cancer sites have been reported. Colorectal cancer has been studied more than other sites [97,111–113] but literature reports are contradictory. In this analysis, no trend was apparent for colon cancer either in relation to levels of parity or in age of FFTP.

Finally, it should be noted that nulliparous women were found to have higher incidence of all neoplasms. This excess over parous persisted even when cancers of the breast, cervix, corpus uteri and ovaries were excluded. It is unclear whether this excess is due to factors related directly to pregnancy or to differential exposures of other environmental risk factors, for example smoking.

10.4.2 Survival

The impact of reproductive factors on cancer survival has not been as thoroughly investigated as has the impact on cancer incidence. A few studies have reported on breast cancer survival[114–116] and some on other sites.[117–119] Pregnancy could be affecting prognosis of cancers through a generalised pathway, by modifying immunological status, and the effect of pregnancy may lie on the dissemination of the tumour. Pregnancy could also act by altering tumour characteristics of specific cancer sites, for example presence of oestrogen receptors in breast tissue.

Reports on the relationship between nulliparity and breast cancer survival are contradictory. Black has reported that among women aged less than 35, nulliparity is associated with a favourable outcome.[116] The difference could be explained by the distribution of overall node status and by the nuclear grade of the primary tumour, indicating that parity might affect its behaviour. In another report,[114] no association of tumour characteristics with reproductive history were found and significant survival differences between nulliparous and parous with three or more children were confined to post-menopausal women. Papatestas found survival differences irrespective of menopausal status, with the nulliparous having worse survival.[115]

In this analysis, nulliparous women had significantly worse survival for breast cancer than parous. Furthermore, an increasing number of children seemed to carry additional protection. Examining case-fatality rates by age indicated that in women less than 44 years, the nulliparous had better survival, while in older women survival was significantly better for parous women. The better prognosis in young women, contrary to the incidence results, leads again to the hypothesis of different effect of pregnancy according to age. However, confidence limits were wide in the younger age-groups. For parous women, age at FFTP was cross-classified with number of children. Only the former was found to be an independent significant factor related to survival. Women with an early age of FFTP had the worse survival but the trend was U shaped with age. The presence of such a trend could indicate the presence of two factors acting in a different direction or indicate two diseases. The small numbers available and the corresponding confidence limits do not exclude a linear trend.

Several biological pathways could explain an effect of reproductive history on breast cancer survival. Presence of oestrogen receptors in the breast tissue have been related to age at FFTP and to parity. It is probable that late FFTP is associated with the occurrence of rich oestrogen receptor positive tumours.[120–122] These carry a better prognosis than oestrogen receptor negative. Early FFTP produces a long-term decrease in serum prolactin levels[123] and high levels of serum prolactin have been associated with poor prognosis of breast cancer.[124] Obesity has been related to multiparity and to poor prognosis.[125] It is difficult to present a coherent explanation for these findings as little is known about many of the relevant factors.

Parous women were found to have worse survival than nulliparous for ovarian cancer and better survival for cervical cancer. In both cases results were not significant. In a British case-control study on ovarian cancer (M Booth, personal communication), pathology review indicated that cancers among nulliparous women carried better prognosis (i.e. lower grade and higher differentiation) than in parous. In 51 per cent of nulliparous women, (n = 59) the grade of the tumour was 1 or 2, while among parous women (n = 176) only 31 per cent were of a low grade. In the same study, 41 per cent of nulliparous women had highly differentiated tumours compared with 22 per cent of parous. However, there was no clear correlation with age at FFTP.

For ovarian and cervical cancer, case-fatality rates by age of FFTP were also U shaped. It is interesting to compare these findings to the U shaped pattern described for mortality data comparing parous and nulliparous women by age. Whether the similarity between patterns could indicate a short-term adverse effect of first pregnancies on survival is uncertain.

10.4.3 Socio-economic differences

High socio-economic groups have consistently been found to have raised breast cancer incidence[13] although the excess over low socio-economic groups was never pronounced. This pattern has been attributed to different reproductive patterns between socio-economic groups, but the extent to which such factors explain all the difference is questionable.[126] In England and Wales, low social classes have earlier FFTP, bigger families and a lower proportion of nulliparous women than high social classes.[127] In the LS, council tenants had clearly different reproductive patterns to owner occupiers (Table 9.1). Although council tenants had more children, were likely to be nulliparous and more likely to have an early FFTP, they had slightly higher

rates of breast cancer than owner occupiers. Adjustment for parity or age of FFTP in the analysis of socio-economic differences had little effect on rate ratios. Information on other variables of interest, for example age of menarche, menopause, oral contraceptive use, was not available.

Analysis of time trends showed that breast cancer rates increased most among the low socio-economic group over the years 1971–81. Over recent years, mean family size has considerably decreased in England and Wales and more first marriages are taking place above the age of 30. However, at the same time more first marriages take place under the age of 20. Despite these overall changes, reproductive differences between social classes persist. Similar increases in incidence among women of low socio-economic groups have been noted elsewhere.[54,55] The most striking was observed in the USA in young black American women who now have around 30 per cent higher incidence than whites. These findings suggest additional risk factors for breast cancer incidence apart from those associated with reproduction.

In cervical cancer age at FFTP explained only part (around 20 per cent) of the wide socio-economic differences, reducing the rate ratio of council tenants from 1.67 to 1.53. The magnitude of this decrease, although considerable, leaves most of the differential unexplained. Age at FFTP is often taken as a proxy for age of first coitus. Women of all socio-economic groups with early FFTP had high rates of cervical cancer and a linear trend with age at FFTP was evident. Council tenants with FFTP after age 30 had a lower incidence (SIR = 75) than all owner occupiers (SIR = 80). Age at FFTP appears in this and other studies[46] to be strongly correlated with more than one aspect of sexual behaviour. However, a considerable residual effect of sexual behaviour, for example number of sexual partners, cannot be taken into account by measuring fertility history. Brown,[128] reviewing the existing evidence on differences in sexual habits among social classes, pointed out that they are poorly understood and that the limited evidence does not identify distinct patterns. Any associations with mortality remain to be proved.[46] Whether other additional factors (for example occupational exposures, sexual hygiene, smoking or husband's sexual life), contribute to social class differences in cervical cancer also remains to be proved.

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11 Conclusions

This volume examines the relationship between socio-economic status and cancer, focusing mainly on cancer survival. Differences in cancer survival between socio-economic or ethnic groups have been examined primarily in the USA. Variation in the timing of cancer detection has been the most frequently incriminated cause for the occurrence of survival differences. Differences in treatment, tumour characteristics, genetic factors and psychological influences have also been investigated as contributing causes.

The LS provides the opportunity of measuring, in a prospective way, socio-economic differences in health for a large representative sample of the population of England and Wales. This study examined, for the first time on such a large scale, survival differences in England and Wales. It demonstrates how, by using routine statistics (cancer registration, mortality records, and census records), our understanding of socio-economic differences in health can be greatly extended.

Large survival differences were observed for the population of England and Wales. Low socio-economic groups had worse survival for all neoplasms. This was partly due to the increased risk among them of poor prognosis cancers, and especially of lung cancer. A detailed analysis of survival data indicated that survival differences were apparent for most specific cancers, irrespective of sex, age, socio-economic classification, or cause of death. The north west to south east trend in England and Wales identified in mortality and incidence studies was also observed here.

For cancers of poor prognosis, differences between socio-economic groups in average survival time were small, for example one week difference in median survival for male owner occupiers and council tenants for lung cancer. In some good prognosis cancers, these differences were wide, for example more than two years between owner occupiers and council tenants for cancer of the corpus uteri. However, survival differences appeared irrespective of prognosis of the cancer, and in women the widest *relative* differences were observed for cancer of the pancreas. The appearance of differentials for cancers for which effective treatment is not available and early detection not common, indicates that factors other than treatment and differences in stage at presentation may be of relevance. Information on stage at presentation was not available. Analysis of survival curves indicated that low socio-economic groups frequently had very high case fatality rates in the initial follow-up period, which probably reflects late presentation.

Cancer mortality data were examined in relation to incidence and survival. Overall elimination of incidence differentials would result in a reduction of approximately 33 per cent of cancer deaths in men and 8 per cent in women. Elimination of the observed survival differentials would result in a reduction of approximately 4 per cent of deaths in men and 2 per cent in women. There was a considerable diversity of the relative effects of incidence and survival differentials among cancers. These results suggest that incidence differentials between social classes are far more important than survival differences in the production of the wide social class differences in mortality observed in England and Wales.

Appendices

Statistical appendix: relationship between incidence, case fatality and mortality rates

A first approach on the relationship between incidence, case fatality and mortality was presented in Chapter 7, and was based on a simple equation

$$\frac{1}{M} = \frac{1}{I} + \frac{1}{F}$$

where M is the mortality rate, I the incidence rate and F the case-fatality rate. This requires an assumption for a population being in a steady state situation.

In this appendix, the relationship between incidence, case fatality and mortality is examined assuming real conditions for a cohort. Methods for estimating the effect that changes in case fatality would have on mortality are also investigated, depending on different assumptions for the state of the cohort.

1 Main equations

If N_i is the number of incident cases, and
N_m the number of deaths,
Y_i are the person years of observation for incidence,
Y_f the person years of observation for case fatality, and
Y_m the person years of observation for mortality, then

the Incidence rate $I = \frac{N_i}{Y_i}$

the Case-fatality rate $F = \frac{N_m}{Y_f}$

and the Mortality rate $M = \frac{N_m}{Y_m}$

The person years of observation for mortality equals the person years of observation for incidence plus the person years of observation for case fatality, i.e. $Y_m = Y_i + Y_f$. This leads to an expression of the mortality rate as

$$M = \frac{N_m}{Y_i + Y_f} = \frac{F\,I\,\bar{T}_f}{1 + I\,\bar{T}_f} \qquad (1)$$

where $\bar{T}_f = \frac{Y_f}{N_i}$

Three different situations can be identified in a cohort study depending on whether prevalent cases are included in the start of the follow-up and also, on whether cases are withdrawn alive at the end of the follow-up period. $\bar{T}_f$ has a different interpretation in each one of them.

Situation A

In a healthy cohort which is followed to extinction of cases, the number of cases N_i equals the number of deaths N_m. $\bar{T}_f$ is consequently equal to the reciprocal of the case-fatality rate which in this case is synonymous to the *mean survival time* of cases.

Situation B

If the follow-up of a healthy cohort is not to extinction but some cases are withdrawn alive, then $\bar{T}_f$ can be identified as the *actual mean observation time* of incident cases until *death or censoring.*

Situation C

If the cohort includes prevalent cases at the start of the follow-up, then relationship (1) still holds true but $\bar{T}_f$ has neither of the above interpretations.

2 Substitution of rates

Under assumption (A), $\bar{T}_f$ equals the reciprocal of the case-fatality rate $1/F$ and using equation (1), the mortality rate equals

$$M = \frac{F\,I}{F+I}$$

This can also be expressed as $\frac{1}{M} = \frac{1}{I} + \frac{1}{F}$

or as

$$\begin{matrix}\text{mean time}\\ \text{to death}\end{matrix} = \begin{matrix}\text{mean time}\\ \text{to disease}\end{matrix} + \begin{matrix}\text{mean time from}\\ \text{disease to death}\end{matrix}$$

Under assumption (A) , substitution of case-fatality rates is easy. If case-fatality rate changed for a socio-economic group from F to F^*, then the expected mortality rate M^* would be

$$M^* = \frac{I\,F^*}{I+F^*}$$

and the mortality rate ratio M^*/M,

$$\frac{M^*}{M} = \frac{F^*}{F}\,\frac{I+F}{I+F^*}$$

The relationship between the three rates is more complex under assumption (B) because cases are allowed to be censored. $\bar{T}_f$ equals Y_f/N_i which represents the *actual mean observation time* and which is *not* equal to the reciprocal of the case-fatality rate. The substitution of the rates shown above can still be done using equation (1), but expected person years of survival must also be re-calculated.

Existing data can be used to estimate the potential mean observation time, and working backwards case-fatality rates can be substituted following a similar methodology as in situation (A) . In an exponential

distribution with hazard rate β and T the potential observation time, and conditional upon survival time t less than the potential observation time T (i.e. death observed), the density function $f(t)$ is

$$f(t) = \frac{e^{-\beta t}}{1-e^{-\beta T}} \qquad O < t < T$$

The expectation of the distribution for those *dying* is

$$\mathrm{E}(t|t< T) = \int_{O}^{T} \frac{\beta t e^{-\beta t}}{1-e^{-\beta T}} \mathrm{d}t = \frac{1}{\beta} - \frac{Te^{-\beta T}}{1-e^{-\beta T}}$$

The observation time for a member of the cohort who dies before T equals the survival time, while for a survivor it equals the potential observation time T. The mean observation time can be found by multiplying the probability of death before T, $(1-e^{-\beta T})$, by $\mathrm{E}(t|t<T)$, plus the probability of surviving until T, $(e^{-\beta T})$, multiplied by T.

$$\mathrm{E}(t|T) = (1-e^{-\beta T})\left\{\frac{1}{\beta} - \frac{Te^{-\beta T}}{1-e^{-\beta T}}\right\} + e^{-\beta T}T$$

$$= \frac{1}{\beta}(1-e^{-\beta T})$$

Thus, the mean value of the observation time $E(t)$ is

$$\mathrm{E}(t) = \frac{1}{\beta}\left\{1 - \mathrm{E}(e^{-\beta T})\right\} \qquad (2)$$

which is approximately equal to

$$E(t) \doteq \frac{1}{\beta}(1-e^{-\beta \bar{T}})$$

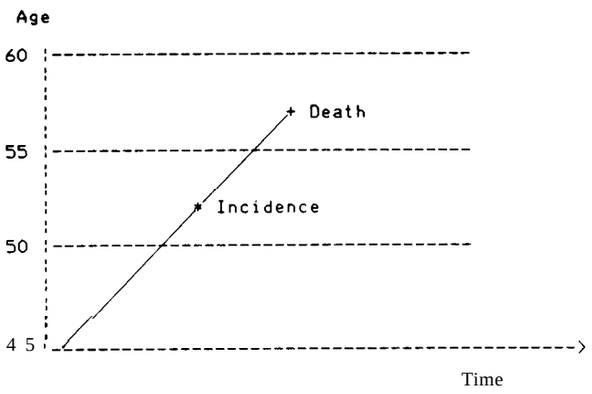
where $\bar{T}$ is the mean of the potential observation time in the cohort

Given β (case-fatality rate) and the actual mean observation time Y_f/N_i, we can use equation (2) backwards to get the mean potential time $\bar{T}$.

$$\bar{T} = -\frac{1}{\beta}\log\left\{1-\beta\,(\text{actual mean observation time})\right\}$$

Given $\bar{T}$ and a new case-fatality rate β^* we can predict the expected person years for case fatality, and using equation (1) a new mortality rate can be calculated.

Under assumption C (a cohort including prevalent cases), calculations become more complex depending on the prevalence of the disease at the start of the study. This can become more evident by the use of a Lexis diagram. Each age-group is regarded for the purposes of the analysis as a separate cohort and age-specific incidence, case fatality and mortality rates are calculated. Death of a case may occur in a later age-group than the one in which the case was registered (see diagram). In this situation cases entering a new age-group alive should be regarded as prevalent cases. However, changing age-specific case-fatality rates F to F^* changes also the prevalence in each cell. This has to be taken into account in the calculations.



In such a situation the effect that changes in case fatality or incidence rates would have on mortality, although not conceptually difficult to estimate, is computationally laborious. For each age and period specific cell, the denominator of the mortality rate equals the person years of individuals without the disease, plus person years of cases occurring at the specific cell until death or transfer to the next cell, plus person years of prevalent cases. If either incidence or case fatality changes, new rates can be applied in each cell and a simulation of the flow of the population with time could provide new estimates for mortality.

Appendix A: Tables

Appendix Table 2.1 Deaths in men and women having the same date of registration and death, over total registrations, by Regional Health Authority

Regional health authority		Men		Women		
		Colon	Bladder	Colon	Breast	Cervix
England and Wales	**R**	**545**	**591**	752	2,043	358
	D	49	19	65	71	4
	%	9	3	9	3	1
North	R	44	40	51	121	19
	D	7	0	5	4	0
	%	16	0	10	3	0
Yorkshire	R	40	45	59	136	34
	D	5	1	1	3	1
	%	13	2	2	3	3
Trent	R	47	60	74	198	38
	D	2	2	11	6	0
	%	4	3	15	3	0
East Anglia	R	19	21	39	88	13
	D	1	0	1	0	0
	%	5	0	3	0	0
NW Thames	R	35	43	39	130	21
	D	3	4	2	10	0
	%	9	9	5	8	0
NE Thames	R	32	44	45	139	25
	D	8	4	9	15	0
	%	25	9	20	11	0
SE Thames	R	40	57	62	147	24
	D	3	3	3	4	0
	■	8	5	5	3	0
SW Thames	R	39	27	48	129	24
	D	2	1	4	2	0
	%	5	4	8	2	0
Wessex	R	22	43	34	117	17
	D	0	1	2	2	0
	%	0	2	6	2	0
Oxford	R	20	18	42	83	7
	D	0	0	3	1	0
	%	0	0	7	1	0
South Western	R	32	41	47	154	22
	D	4	1	7	4	0
	%	13	2	15	3	0
West Midlands	R	64	59	60	211	28
	D	6	0	5	2	0
	%	9	0	8	1	0
Mersey	R	25	29	42	86	18
	D	0	0	3	1	1
	%	0	0	7	1	16
North Western	R	55	37	78	176	42
	D	2	1	7	11	1
	%	4	3	9	6	2
Wales	R	31	27	32	128	26
	D	6	1	2	6	1
	■	19	4	6	5	4

Appendix Table 2.2 Cancers for which incidence data were analysed by socio-demographic classification

(a) **Males**

Cancer of registration	Socio-demographic classification					
	Housing tenure	Social class	Region residence	Housing tenure by grouped region	Economic position	Marital status
All neoplasms	x	x	x	x	x	x
Buccal cavity	x					
Oesophagus	x			x	x	x
Stomach	x	x	x	x	x	x
Colon	x	x	x	x	x	x
Rectum	x	x	x	x	x	x
Pancreas	x			x	x	x
Liver & gallbladder	x					
Larynx	x					
Lung	x	x	x	x	x	x
Other skin	x					
Prostate	x	x	x	x	x	x
Bladder	x	x	x	x	x	x
Kidney & pelvis	x					x
Testis	x					
Brain	x					x
Lymphomas	x					x
Leukemias	x			x	x	x

(b) **Females**

Cancer of registration	Socio-demographic classification					
	Housing tenure	Marital status by own social class by husband's social class	Region residence	Housing tenure by grouped region	Parity by housing tenure	Age at first pregnancy by housing tenure
All neoplasms	x	x	x	x	x	x
Buccal cavity	x					
Oesophagus	x					
Stomach	x	x	x	x		
Colon	x	x	x	x	x	x
Rectum	x			x		
Pancreas	x			x		
Lung	x	x	x	x		
Malignant melanoma	x					
Other skin	x					
Breast	x	x	x	x	x	x
Cervix uteri	x	x	x	x	x	x
Corpus uteri	x			x	x	x
Ovary	x	x	x	x	x	x
Bladder	x					
Brain	x					
Lymphomas	x					
Leukemias	x			x		
Cervix in situ	x	x	x	x	x	x

Appendix Table 2.3 Cancers for which survival data was analysed by socio-demographic classifications

(a) **Males**

Cancer site	Socio-demographic classification				
	Housing tenure	Social class	Regional Health Authority	Housing tenure by marital status	Economic position
All neoplasms	x				
Oesophagus	x				
Stomach	x				
Colon	x	x	x	x	x
Rectum	x				
Pancreas	x				
Larynx	x				
Lung	x	x			x
Other skin	x				
Prostate	x			x	
Bladder	x	x	x		
Testis	x				
Lymphomas	x				
Leukemias	x				

(b) **Females**

Cancer site	Socio-demographic classification			
	Housing tenure	Marital status by own social class by husband's social class	Regional Health Authority	Age at first pregnancy by parity and housing tenure
All neoplasms	x			
Oesophagus	x			
Stomach	x			
Colon	x	x	x	
Rectum	x			
Pancreas	x			
Lung	x			
Malignant melanoma	x			
Other skin	x			
Breast	x	x	x	x
Cervix uteri	x	x	x	x
Corpus uteri	x			
Ovary	x			x
Bladder	x			
Lymphomas	x			
Leukemias	x			

Appendix Table 4.1 Standardised incidence ratios for men by social class, for stomach, colon, rectum, bladder and prostate, 1971-81

Social class		Stomach	Colon	Rectum	Bladder	Prostate
I	Obs	6	22	9	15	27
	Exp	28	19.8	17.7	21.7	23.4
	SIR	21	111	51	69	115
II	Obs	125	96	85	92	132
	Exp	139.6	98.4	87.2	107.8	126.3
	SIR	90	96	97	85	105
III NM	Obs	65	66	40	57	92
	Exp	83.1	59.3	52.1	64.5	78.8
	SIR	78	111	77	88	117
III M	Obs	236.3	165	162	205	193
	Exp	251	166.0	147.7	182.5	202.9
	SIR	106	99	110	112	95
IV	Obs	156	102	77	111	121
	Exp	141.8	100.1	88.3	109.4	131.2
	SIR	110	102	87	101	92
V	Obs	95	34	58	96	75
	Exp	71.6	51.1	44.7	55.4	69.8
	SIR	133	67	130	96	107
Armed forces	Obs	0	0	2	3	2
	Exp	2.3	1.8	1.6	1.9	2.2
	SIR	0	0	127	159	90
Inadequately described	Obs	48	45	38	46	61
	Exp	48.0	37.5	31.6	39.0	69.5
	SIR	100	120	120	118	88
Unoccupied	Obs	21	15	10	13	14
	Exp	16.4	11.o	10.1	12.8	12.8
	SIR	128	136	99	101	109
χ^2 heter. 5 degrees of freedom		32.84 p<0.001	6.77 p = 0.23	14.04 p = 0.015	8.16 p = 0.15	4.54 p = 0.47
χ^2 trend 1 degree of freedom		23.58 p<0.001	2.08 p = 0.15	4.01 p = 0.045	2.99 p 0.08 p = 0.08	0.95 NS

Chi-squares are calculated only for the six social classes.

Appendix Table 4.2 Standardised incidence ratios (SIR) for men, by region of residence, 1971-81

Region of residence		All neoplasms	Stomach	Colon	Rectum	Lung	Bladder	Prostate
North	Obs	652	42	45	35	216	45	42
	Exp	603.5	50.2	35.8	31.5	177.5	39.0	46.6
	SIR	108	84	126	111	122	115	90
North West	Obs	1,334	113	84	74	420	70	97
	Exp	1,210.9	100.7	71.3	63 .O	357.9	78.0	91.4
	SIR	110	132	118	117	117	90	106
Wales	Obs	562	64	31	27	157	27	46
	Exp	521.8	43.6	30.9	27.3	153.8	33.7	40.8
	SIR	108	147	100	99	102	80	113
Yorkshire and Humberside	Obs	895	77	49	55	284	57	51
	Exp	893.2	74.4	52.8	46.6	264.0	57.7	68.2
	SIR	100	103	93	118	108	99	75
East Midlands	Obs	649	54	38	39	176	47	59
	Exp	637	53.0	37.7	33.3	187.1	41.1	49.2
	SIR	102	102	101	117	94	114	120
West Midlands	Obs	947	85	64	63	271	59	60
	Exp	915.9	75.9	53.6	47.4	270.1	58.7	67.3
	SIR	103	112	119	133	100	101	89
East Anglia	Obs	357	25	19	15	95	21	31
	Exp	338.1	28.3	20.4	17.8	98.7	22.1	27.9
	SIR	106	88	93	84	96	95	111
South East	Obs	3,045	220	179	125	895	217	252
	Exp	3,301	275.7	196.6	173.1	968	214	261.4
	SIR	92	80	91	72	92	101	96
South West	Obs	755	67	37	48	190	52	79
	Exp	774.5	65.1	46.8	41.0	226.9	50.6	64.2
	SIR	97	103	79	117	84	103	123

Appendix Table 4.3 Standardised incidence ratios (SIR) for women, by region of residence, 1971-81

Region of residence		All neoplasms	Stomach	Colon	Lung	Breast	Cervix uteri	Cervix in situ	Ovary
North	Obs	574	44	55	41	129	20	36	34
	Exp	574.1	32.0	49.8	48.0	136.3	23.8	21.8	27.9
	SIR	100	138	110	85	95	84	165	122
North West	Obs	1,265	84	123	116	269	61	44	52
	Exp	1,215.4	68.2	105.9	102.0	287	49.9	45.8	58.7
	SIR	104	123	116	114	94	122	96	89
Wales	Obs	520	31	32	30	130	26	17	28
	Exp	487.5	27.1	42.3	41.0	115.6	20.2	18.1	23.7
	SIR	107	114	76	73	112	129	94	118
Yorkshire and Humberside	Obs	844	56	79	71	187	44	32	32
	Exp	842.3	46.6	72.1	70.6	200.7	35.3	32.7	41.1
	SIR	100	120	109	101	93	125	98	78
East Midlands	Obs	593	28	62	34	147	28	37	26
	Exp	562.4	30.9	48.6	46.7	134.4	24	23.5	27.4
	SIR	105	91	128	73	109	117	157	95
West Midlands	Obs	810	40	60	57	211	28	35	32
	Exp	817.3	43.6	69.0	68.2	198.2	36	35.2	40.6
	SIR	99	92	87	84	106	78	99	79
East Anglia	Obs	342	15	39	22	88	13	13	19
	Exp	302.3	17.3	27.0	25.0	70.9	12.2	11.0	14.3
	SIR	113	87	144	88	124	107	118	133
South East	Obs	2,955	147	246	297	702	110	80	157
	Exp	3,124.2	176.2	274.6	259.9	738	128.9	120.7	149.9
	SIR	95	83	90	114	95	85	73	105
South West	Obs	749	39	59	54	187	29	32	38
	Exp	726.4	42.1	65.1	60.6	169	28.7	25.2	34.3
	SIR	103	93	91	89	111	101	127	111

Appendix Table 4.4 Standardised incidence ratios (SIR) for men by housing tenure and period of registration, 1971-81

Cancer sites	Period of registration		Owner occupiers	Council tenants	Cancer sites	Period of registration		Owner occupiers	Council tenants
All neoplasms	**1971-75**	**Obs**	**1,973**	**1,297**	Pancreas	1971-75	Obs	56	29
		Exp	**2,178.7**	**1,129.7**			Exp	60.6	30.9
		SIR	**91**	**115**			SIR	92	94
	1976-81	**Obs**	**2,311**	**1,585**		1976-81	Obs	81	35
		Exp	2,623.0	**1,352.3**			Exp	80.8	41.5
		SIR	88	**117**			SIR	100	84
Buccal cavity	1971-75	Obs	39	24	Larynx	1971-75	Obs	23	17
		Exp	47.1	24.5			Exp	27.1	14.8
		SIR	82	98			SIR	85	115
	1976-8 1	Obs	32	30		1976-81	Obs	22	32
		Exp	44.1	23.3			Exp	35.6	19.0
		SIR	**73**	**129**			SIR	62	168
Oesophagus	1971-75	Obs	49	28	Lung	1971-75	Obs	487	470
		Exp	46.1	23.2			Exp	642.9	336.7
		SIR	103	121			SIR	76	140
	1976-81	Obs	41	37		1976-81	Obs	575	546
		Exp	52.0	26.5			Exp	765.8	401.0
		SIR	79	140			SIR	75	136
Stomach	1971-75	Obs	183	115	Prostate	1971-75	Obs	158	76
		Exp	195.3	100.8			Exp	157	73.4
		SIR	94	114			SIR	101	104
	1976-8 1	Obs	174	120		1976-81	Obs	222	109
		Exp	205.6	104.4			Exp	222.9	105.0
		SIR	85	115			SIR	100	104
Colon	1971-75	Obs	138	51	Bladder	1971–75	Obs	124	85
		Exp	129.8	65.7			Exp	142.9	73.2
		SIR	106	78			SIR	87	116
	1976-81	Obs	151	83		1976-81	Obs	154	100
		Exp	156.7	79			Exp	168.4	86.0
		SIR	96	**105**			SIR	91	116
Rectum	1971-75	Obs	107	61	Leukaemias	1971-75	Obs	49	20
		Exp	117.2	59.9			Exp	43.1	23 .O
		SIR	91	102			SIR	114	87
	1976-81	Obs	128	80		1976-81	Obs	54	24
		Exp	135.2	67.9			Exp	50.2	26.5
		SIR	95	118			SIR	108	**91**

Appendix Table 4.5 Standardised incidence ratios (SIR) for women by housing tenure and period of registration, 1971-81

Cancer sites	Period of registration		Owner occupiers	Council tenants	Cancer sites	Period of registration		Owner occupiers	Council tenants
All neoplasms	**1971-75**	**Obs**	2,004	**1,150**	Breast	1971-75	Obs	503	257
		Exp	**2,016.2**	**1,102.8**			Exp	485.0	267.0
		SIR	99	**104**			SIR	104	96
	1976-81	**Obs**	2,316	**1,354**		1976-81	Obs	571	314
		Exp	**2,376.5**	**1,282.6**			Exp	568.7	309.7
		SIR	97	**106**			SIR	100	101
Stomach	1971-75	Obs	110	73	Cervix uteri	1971-75	Obs	53	78
		Exp	115.1	60.4			Exp	89.6	51.2
		SIR	96	122			SIR	59	152
	1976-81	Obs	113	84		1976–81	Obs	80	62
		Exp	127.2	66.6			Exp	94.5	53.3
		SIR	89	126			SIR	85	116
Colon	1971-75	Obs	184	90	Corpus uteri	1971-75	Obs	80	51
		Exp	180.1	95.9			Exp	80.3	44.6
		SIR	102	94			SIR	100	114
	1976-81	Obs	203	107		1976-81	Obs	103	43
		Exp	199.9	104.7			Exp	90.3	49.8
		SIR	102	102			SIR	114	86
Rectum	1971-75	Obs	98	43	Ovary	1971-75	Obs	133	45
		Exp	89.7	47.7			Exp	106.8	61.1
		SIR	109	90			SIR	125	74
	1976-81	Obs	93	62		1976–81	Obs	110	60
		Exp	95.2	50.1			Exp	106.0	58.8
		SIR	98	124			SIR	104	102
Pancreas	1971-75	Obs	48	14	Bladder	1971-75	Obs	45	25
		Exp	46.8	24.6			Exp	46.5	25.1
		SIR	103	57			SIR	97	100
	1976-81	Obs	68	31		1976-81	Obs	65	32
		Exp	65.2	34.3			Exp	62.3	33.1
		SIR	104	90			SIR	104	97
Lung	1971-75	Obs	124	112	Cervical cancer in situ	1971-75	Obs	47	49
		Exp	156.8	86.8			Exp	62.7	32.4
		SIR	79	129			SIR	75	151
	1976-81	Obs	180	134		1976-81	Obs	73	98
		Exp	209.9	114.3			Exp	108.8	61.2
		SIR	86	117			SIR	67	160

Appendix Table 4.6 Standardised incidence ratios (SIR) for men by grouped social class and period of registration, 1971-81

Cancer sites	Period of registration		Non-manual	Manual
All neoplasms	**1971-75**	**Obs**	**1,203**	2,506
		Exp	**1,334.0**	**2,431.4**
		SIR	90	103
	1976-81	**Obs**	1,497	3,071
		Exp	**1,655.2**	**2,923.6**
		SIR	90	105
Stomach	1971-75	Obs	93	242
		Exp	120.2	219.6
		SIR	77	110
	1976-81	Obs	103	260
		Exp	130.3	229.6
		SIR	79	113
Colon	1971-75	Obs	90	130
		Exp	79.2	143.6
		SIR	114	91
	1976-81	Obs	94	171
		Exp	98.3	173.6
		SIR	96	99
Rectum	1971-75	Obs	60	135
		Exp	71.8	131.7
		SIR	84	103
	1976-81	Obs	74	162
		Exp	85.2	149.3
		SIR	87	109
Lung	1971-75	Obs	315	805
		Exp	397.3	732.4
		SIR	79	110
	1976-81	Obs	366	980
		Exp	489.1	869.2
		SIR	75	113
Prostate?	1971-75	Obs	101	150
		Exp	92.7	136.1
		SIR	109	110
	1976-81	Obs	155	234
		Exp	165.8	238.8
		SIR	93	98
Bladder	1971-75	Obs	71	168
		Exp	87.5	159.3
		SIR	81	105
	1976-81	Obs	93	201
		Exp	106.5	188.0
		SIR	87	107

† *SIRs for both groups in 1976–81 are under 100 because of the high SIRs of residual groups.*

Appendix Table 6.1 Crude survival rates of cancer cases by sex and housing tenure. 1971-83

Cancer of registration	Housing tenure*	Men			Women		
		survival rate %			survival rate %		
		1 yr	3 yrs	5 yrs	1 yr	3 yrs	5 yrs
All neoplasms	0 0	47	**31**	26	63	49	43
	CT	40	26	21	58	43	36
Oesophagus	**0 0**	16	7	5	30	11	11
	CT	14	3	3	22	2	2
Stomach	0 0	22	7	4	17	8	6
	CT	17	6	5	21	10	8
Colon	0 0	50	30	25	49	32	26
	CT	40	18	13	42	32	25
Rectum	0 0	55	34	27	50	28	24
	CT	48	29	20	60	37	33
Pancreas	0 0	9	3	3	11	4	4
	CT	9	4	4	5	–	–
Larynx	0 0	80	58	53	–	–	–
	CT	80	51	48	–	–	–
Lung	0 0	18	7	6	24	9	8
	CT	17	8	5	18	3	3
Other skin	0 0	96	85	75	97	90	80
	CT	94	85	75	92	85	75
Malignant melanoma	0 0	–	–	–	92	83	69
	CT	–	–	–	91	72	55
Breast	0 0	–	–	–	84	63	50
	CT	–	–	–	85	66	52
Cervix uteri	0 0	–	–	–	75	58	54
	CT	–	–	–	76	59	53
Corpus uteri	0 0	–	–	–	81	70	65
	CT	–	–	–	80	60	54
Ovaries	0 0	–	–	–	49	30	26
	CT	–	–	–	42	24	19
Prostate	0 0	62	33	21	–	–	–
	CT	67	34	25	–	–	–
Testis	0 0	85	71	65	–	–	–
	CT	76	67	67	–	–	–
Bladder	0 0	73	53	43	65	55	49
	CT	69	49	38	58	38	33
Lymphomas	0 0	61	44	36	59	42	34
	CT	55	38	32	57	47	38
Leukaemias	0 0	39	20	19	45	23	**17**
	CT	**41**	23	18	39	**18**	13

* *00 = owner occupiers; CT= council tenants.*

Appendix Table 6.2 Standardised case-fatality ration (SFR) for men by site of registration, age and housing tenure, 1971-83

Cancer site		Owner occupiers		Council tenants	
		Age (years)		Age (years)	
		Under 65	65 and over	Under 65	65 and over
All neoplasms	**Obs**	936	**2,195**	850	**1,348**
	Exp	**1,037.0**	**2,382.2**	787.9	**1,217.6**
	SFR	90	92	108	**111**
Oesophagus	Obs	26	53	26	30
	Exp	24.5	60.0	30.9	23.4
	SFR	106	88	84	128
Stomach	Obs	101	212	91	119
	Exp	107.3	217.5	81.9	115.8
	SFR	94	97	111	103
Colon	Obs	49	**158**	32	77
	Exp	61.9	171.5	22.8	62.6
	SFR	79	92	140	123
Rectum	Obs	48	127	29	82
	Exp	52.3	137.5	26.3	75.3
	SFR	92	92	110	109
Pancreas	Obs	46	84	18	37
	Exp	45.4	89.5	18.5	33.1
	SFR	101	94	97	112
Larynx	Obs	10	16	6	23
	Exp	7.6	19.3	6.9	17.4
	SFR	132	83	87	132
Lung	Obs	315	607	385	504
	Exp	321.0	639.7	369.6	488.0
	SFR	98	95	104	103
Other skin	Obs	19	164	17	86
	Exp	22.4	179.7	15.2	75.3
	SFR	85	91	112	114
Prostate	Obs	24	271	15	121
	Exp	24.3	262.0	13.2	130.8
	SFR	99	103	114	93
Testis	Obs	**15**	0	8	0
	Exp	15.2	0	5.1	0
	SFR	99	–	157	–
Bladder	Obs	33	140	28	94
	Exp	30.5	158.7	29.8	80
	SFR	108	88	94	118
Lymphomas	Obs	33	43	29	17
	Exp	34.5	40.3	22.0	17.7
	SFR	96	107	132	96
Leukaemias	Obs	37	49	18	17
	Exp	37.9	43.7	17.1	19.3
	SFR	98	112	105	88

Appendix Table 6.3 Standardised case-fatality ratios (SFR) for women by site of registration, age and housing tenure, 1971-83

Cancer site		Owner occupiers		Council tenants	
		Age (years)		Age (years)	
		Under 65	65 and over	Under 65	65 and over
All neoplasms	**Obs**	**587**	**2,132**	454	**1,147**
	Exp	**659.4**	**2,243.1**	425.9	**1,095**
	SFR	**89**	95	107	**105**
Oesophagus	Obs	9	45	4	37
	Exp	10.0	48.4	2.1	33.2
	SFR	90	93	190	111
Stomach	Obs	17	**165**	20	106
	Exp	13.9	165.2	21.4	109.5
	SFR	122	100	93	97
Colon	Obs	42	237	26	107
	Exp	45.1	258.4	26.2	104.5
	SFR	93	92	99	102
Rectum	Obs	13	123	13	54
	Exp	13.2	117.1	12.9	65.9
	SFR	98	**105**	101	82
Pancreas	Obs	10	86	8	**31**
	Exp	15.7	84.1	3.9	23.0
	SFR	64	**102**	205	135
Lung	Obs	59	206	73	147
	Exp	63.3	219.0	70.0	136.6
	SFR	93	94	104	108
Malignant Melanoma	Obs	6	10	7	**11**
	Exp	8.2	11.6	4.3	10.6
	SFR	73	86	163	104
Other skin	Obs	3	122	2	69
	Exp	3.9	138.0	2.1	54.8
	SFR	77	88	95	**126**
Breast	Obs	190	415	104	198
	Exp	200.2	409.9	107.1	203.6
	SFR	95	101	97	97
Cervix uteri	Obs	34	38	40	32
	Exp	37.4	38.1	39.6	34.8
	SFR	91	100	101	92
Corpus uteri	Obs	5	70	7	40
	Exp	8.6	79.7	3.9	35.2
	SFR	58	88	179	114
Ovary	Obs	51	125	37	44
	Exp	65.4	122.5	31.6	43.8
	SFR	78	102	117	100
Bladder	Obs	7	52	8	29
	Exp	9.8	61.5	4.6	27.0
	SFR	71	85	174	107
Lymphomas	Obs	14	44	16	18
	Exp	12.7	49.6	14.2	15.1
	SFR	**110**	89	113	119
Leukaemias	Obs	18	54	**14**	19
	Exp	23.2	51.4	10.9	17.9
	SFR	78	**105**	128	106

Appendix Table 6.4 **Standardised case-fatality ratios (SFR) for men living in non-private households by cause of death, 1971-83**

Cancer site		All cause fatalities	Fatalities from primary cancer	Fatalities from causes other than cancer
All neoplasms	**Obs**	**164**	**125**	39
	Exp	**145.7**	**116.9**	28.2
	SFR	**113**	**107**	138
Oesophagus	Obs	4	4	0
	Exp	5.9	4.9	0.9
	SFR	68	81	0
Stomach	Obs	18	16	2
	Exp	16.4	14.0	1.4
	SFR	110	114	143
Colon	Obs	12	12	0
	Exp	9.0	6.2	0.7
	SFR	133	194	0
Rectum	Obs	7	5	2
	Exp	4.0	2.8	0.8
	SFR	175	179	250
Pancreas	Obs	7	7	0
	Exp	4.3	3.1	0.4
	SFR	163	189	0
Larynx	Obs	1	1	0
	Exp	0.5	0.3	0.1
	SFR	200	333	0
Lung	Obs	39	37	2
	Exp	41.6	37.5	2.9
	SFR	94	99	69
Other skin	Obs	16	0	14
	Exp	11.5	0.1	9.0
	SFR	139	0	156
Prostate	Obs	18	8	9
	Exp	13.2	7.9	4.8
	SFR	136	101	188
Testis	Obs	0	0	0
	Exp	0.3	0.1	0.2
	SFR	0	0	0
Bladder	Obs	6	3	3
	Exp	6.7	4.3	1.7
	SFR	90	70	176
Lymphomas	Obs	4	3	1
	Exp	5.1	3.4	1.0
	SFR	78	88	loo
Leukaemias	Obs	6	5	1
	Exp	8.0	7.0	0.7
	SFR	75	71	143

Appendix Table 6.5 **Standardised case-fatality ratios (SFR) for women living in non-private households by cause of death, 1971-83**

Cancer site		All cause Fatalities	Fatalities from primary cancer	Fatalities from causes other than cancer
Ad neoplasms	**Obs**	**142**	**108**	34
	Exp	**131.2**	**104.4**	26.5
	SFR	**108**	**103**	128
Oesophagus	Obs	3	3	0
	Exp	0.9	0.8	0.1
	SFR	333	375	0
Stomach	Obs	11	10	1
	Exp	10.9	9.2	1.4
	SFR	101	109	71
Colon	Obs	19	13	3
	Exp	13.6	10.3	2.3
	SFR	140	126	130
Rectum	Obs	5	4	1
	Exp	3.0	2.3	0.4
	SFR	167	174	250
Pancreas	Obs	6	4	2
	Exp	9.4	8.5	0.7
	SFR	64	47	285
Lung	Obs	14	10	3
	Exp	20.8	17.7	2.8
	SFR	67	56	107
Malignant melanoma	Obs	2	1	1
	Exp	0.1	0.1	0
	SFR	2,000	1,000	–
Other skin	Obs	9	0	5
	Exp	5.7	0.7	4.4
	SFR	158	0	114
Breast	Obs	33	19	13
	Exp	34.3	21.8	11.4
	SFR	96	87	114
Cervix uteri	Obs	3	2	0
	Exp	2.2	1.7	0.1
	SFR	136	118	0
Corpus uteri	Obs	3	3	0
	Exp	1.1	0.5	0.4
	SFR	273	600	0
Ovary	Obs	3	2	1
	Exp	4.5	4.0	0.2
	SFR	67	50	500
Bladder	Obs	3	2	1
	Exp	4.3	3.3	0.9
	SFR	70	61	111
Lymphomas	Obs	3	2	0
	Exp	6.0	5.2	0.6
	SFR	50	38	0
Leukaemias	Obs	5	4	1
	Exp	4.8	4.5	0.2
	SFR	104	89	500

Appendix Table 6.6 Crude survival rates of male cancer cases, by grouped social class, 1971-83

Cancer of registration		Crude survival rate %		
		1 year	3 years	5 years
Colon	Non-manual	52	34	27
	Manual	44	23	19
Lung	Non-manual	18	8	6
	Manual	18	7	5
Bladder	Non-manual	74	59	48
	Manual	70	49	38

Appendix Table 6.7 Standardised case-fatality ratios (SFR) for lung and colon cancer in employed and unemployed men by age, 1971-83

Age		Employed	Unemployed
Lung cancer			
15-64	Obs	787	51
	Exp	813.1	41
	SFR	97	124
65 and over	Obs	665	32
	Exp	672.8	34.2
	SFR	99	94
Colon cancer			
15–64	Obs	92	4
	Exp	99.2	2.7
	SFR	93	148
65 and over	Obs	109	5
	Exp	120.7	10.4
	SFR	90	48

Appendix Table 6.8 Case-fatality rate ratios for women in non-manual and manual social classes registered with breast cancer, by marital status, 1971-83†

Variable in the model	Rate ratio	(95% CL)	χ^2	degrees of freedom
Marital status			3.28	(2)
Married	1			
Single	1.03	(0.82-I .30)		
Widowed and divorced	1.24	(0.99-1 .57)		
Own social class			5.37*	(1)
Non-manual	1			
Manual	1.24	(1.03-1.48)		

†*Married women and women in non-manual social class are taken as the baseline group in all models.*
* $= 0.01 < p < 0.025$.

Appendix Table 6.9 Standardised case-fatality ratios (SFR) based on fatality from the primary cancer only, for men by Regional Health Authority, 1971-83

Regional Health Authority		Colon	Bladder
All males	**Obs**	288	253
Northern	Obs	24	24
	Exp	21.3	14.8
	SFR	115	162
Yorkshire	Obs	23	18
	Exp	19.5	19.3
	SFR	118	93
Trent	Obs	29	28
	Exp	22.2	22.1
	SFR	131	127
East, Anglia	Obs	12	11
	Exp	9.3	10.3
	SFR	129	107
NW Thames	Obs	18	12
	Exp	18.9	21.8
	SFR	95	55
NE Thames	Obs	12	20
	Exp	14.8	16.7
	SFR	81	120
SE Thames	Obs	23	20
	Exp	16.5	25.6
	SFR	139	78
SW Thames	Obs	23	11
	Exp	23.5	11.1
	SFR	98	99
Wessex	Obs	12	19
	Exp	13.7	18.6
	SFR	88	102
Oxford	Obs	11	5
	Exp	13.0	10.1
	SFR	85	50
South Western	Obs	13	16
	Exp	20.6	18.7
	SFR	63	86
West Midlands	Obs	35	25
	Exp	34.1	28.0
	SFR	103	89
Mersey	Obs	12	13
	Exp	15.8	11.4
	SFR	76	114
North Western	Obs	29	16
	Exp	28.0	14.7
	SFR	104	109
Wales	Obs	12	15
	Exp	16.8	9.8
	SFR	71	153

Appendix Table 6.10 Standardised case-fatality ratios (SFR) based on fatality from the primary cancer only, for women by Regional Health Authority

Regional Health Authority		Colon	Breast	Cervical
All females	**Obs**	**411**	882	**152**
Northern	**Obs**	30	55	IO
	Exp	24.4	51.4	6.9
	SFR	123	107	145
Yorkshire	Obs	32	61	16
	Exp	34.9	60.4	10.3
	SFR	92	101	155
Trent	Obs	44	87	13
	Exp	33.6	86.2	16.8
	SFR	131	101	77
East Anglia	Obs	18	34	8
	Exp	27.2	39.9	7.6
	SFR	66	85	105
NW Thames	Obs	27	57	10
	Exp	21.5	53.4	10.5
	SFR	126	107	95
NE Thames	Obs	18	54	8
	Exp	19.6	57.6	9.8
	SFR	92	94	82
SE Thames	Obs	36	71	11
	Exp	36	59.5	11.0
	SFR	100	119	100
SW Thames	Obs	24	44	7
	Exp	32.5	61.1	9.7
	SFR	74	72	72
Wessex	Obs	15	44	6
	Exp	18.6	53.6	9.9
	SFR	81	82	61
Oxford	Obs	20	39	3
	Exp	25.6	38.7	4.1
	SFR	78	101	73
South Western	Obs	22	62	8
	Exp	27.4	69.7	8.8
	SFR	80	89	91
West Midlands	Obs	38	100	16
	Exp	27.4	93.8	13.0
	SFR	139	107	123
Mersey	Obs	22	41	8
	Exp	23.2	38.0	7.4
	SFR	95	108	108
North Western	Obs	46	76	19
	Exp	41.5	70.8	17.0
	SFR	111	107	112
Wales	Obs	19	57	9
	Exp	17.6	47.9	9.2
	SFR	108	119	98

Appendix Table 8.1 Breast cancer incidence for married women aged under 60 at census by parity and age at first full-term pregnancy (FFTP) before and after adjusting for housing tenure?

	Rate ratio	(95% CL)	χ^2 heter	d.f.	χ^2 trend
Parity					
0	1		5.79	2	4.97*
1	0.99	(0.80-l .22)			
2+	0.85	(0.70-l .02)			
Parity*					
0	1		6.33*	2	
1	0.98	(0.80-1.21)			
2+	0.84	(0.69-l .01)			
Age at FFTP					
Under 20	1		8.37*	2	8.27**
20-29	1.28	(0.95-l .70)			
30+	1.53	(1.12-2.10)			
Age at FFTP*					
Under 20	1		8.49*	2	
20-29	1.27	(0.96-1.71)			
30+	1.54	(1.12-2.12)			

† *Nulliparous and women with age of FFTP less than 20 are taken as the baseline group in all models.*
‡ *Controlling for housing tenure.*
* *= 0.01 < p < 0.05.*
** *=p < 0.01.*

Appendix Table 8.2 Cervical cancer incidence for married women aged under 60 at census by parity and age at first full-term pregnancy, before and after adjusting for housing tenure†

	Rate ratio	(95% CL)	χ^2 heter.	d.f.	χ^2 trend
Parity					
0	1		5.19	2	
1	0.97	(0.60-I .58)			
2+	1.35	(0.89-2.05)			
Parity*					
0	1		3.80	2	
1	0.93	(0.57-1.52)			
2 t	1.26	(0.83-l .92)			
Age at FFTP					
Under 20	1		18.28*	2	17.31*
20-29	0.49	(0.34-0.70)			
30+	0.33	(0.19-0.56)			
Age at FFTP*					
Under 20	1		14.49*	2	
20-29	0.53	(0.36–0.76)			
30+	0.37	(0.21-0.63)			

†*Nulliparous and women with age of FFTP less than 20 are taken as the baseline group in all models.*
**Controlling for housing tenure.*
* *= p < 0.01.*

Appendix Table 8.3 Case-fatality rate ratios for cervical cancer in married women aged less than 60 at census, by parity and age at first full-term pregnancy (FFTP)†

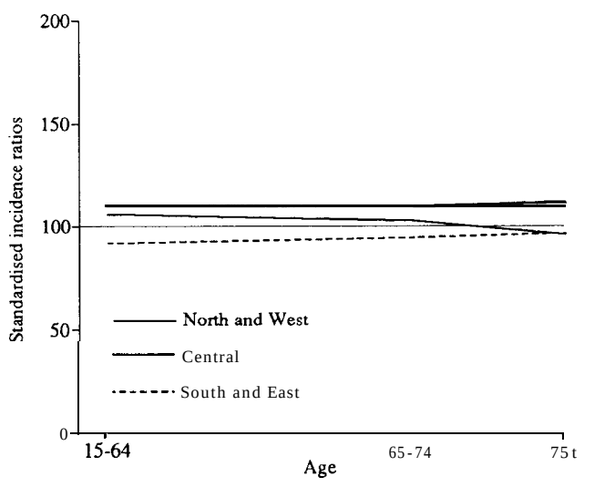
	Rate ratio	(95% CL)	χ^2	(d.f.)
Parity			0.30	(1)
Nulliparous				
Parous	A.83	(0.43-l .60)		
Age at FFTP			1.26	(2)
Under 20	1			
20-29	0.72	(0.39-1.31)		
30 and over	0.86	(0.40-I .97)		

†*Nulliparous and women with age of FFTP less than 20 years were taken as the baseline group.*

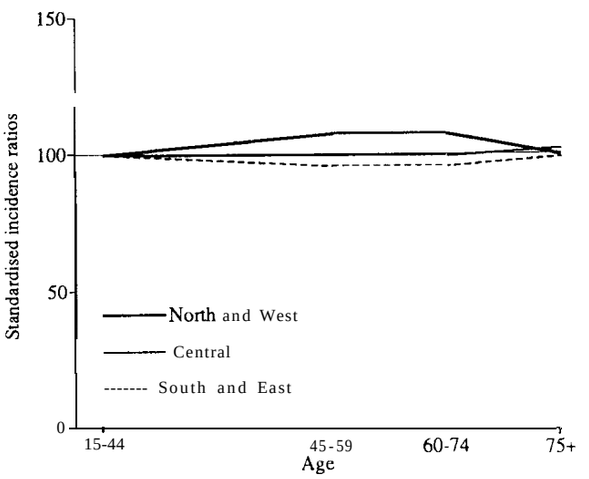
Appendix B: Figures

Appendix Figure 4.1 Incidence of all neoplasms in employed and unemployed men by age, 1971-81

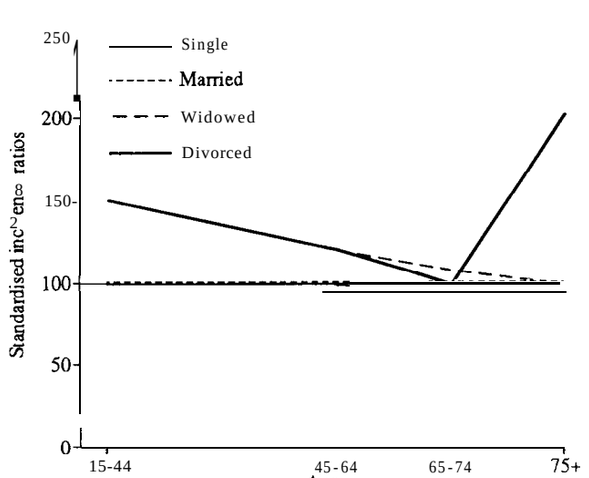
Appendix Figure 4.2 Incidence of all neoplasms in men, by age and grouped region of residence, 1971-81



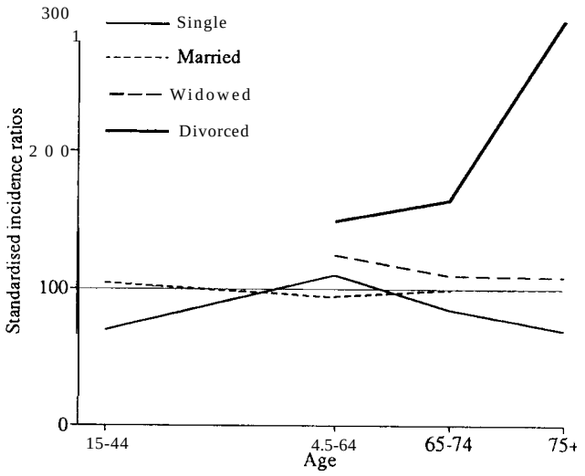
Appendix Figure 4.3 Incidence of all neoplasms in women, by age and grouped region of residence, 1971-81



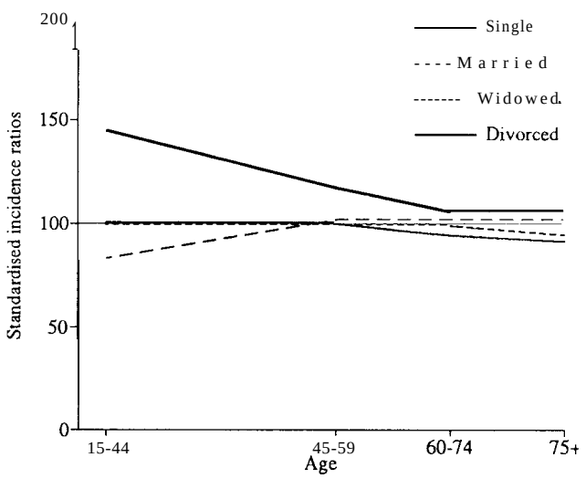
Appendix Figure 4.4 Incidence of all neoplasms in men by age and marital status, 1971-81



Appendix Figure 4.5 Incidence of lung cancer in men by age and marital status, 1971-81



Appendix Figure 4.6 Incidence of all neoplasms in women by age and marital status, 1971-81



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