APPENDICES

APPENDIX I. DESIGN AND CONDUCT OF STUDIES CITED IN THE TEXT

APPENDIX IA

THE BRITISH DOCTORS STUDY

This prospective study of the health effects of smoking started in 1951. The first report appeared in 1954 (Doll & Hill, 1954) and was followed at regular intervals by the results of further follow-up (Doll & Hill, 1956, 1964; Doll & Peto, 1976, 1978; Doll *et al.*, 1957, 1980). Members of the medical profession in the United Kingdom were asked to fill in a simple questionnaire, which was sent out on 31 October 1951 to 59 600 men and women on the Medical Register.

The questionnaire was intentionally kept short and simple to encourage a high proportion of replies. The doctors were asked to classify themselves into one of three groups – (1) whether they were, at the time, smoking; (2) whether they had smoked but had given up; or (3) whether they had never smoked regularly (that is, had never smoked as much as one cigarette a day, or its equivalent in pipe tobacco, for as long as one year). Present smokers and ex-smokers were asked additional questions. The former were asked the age at which they had started smoking and the amount of tobacco that they were currently smoking, and the method by which it was consumed. The ex-smokers were asked similar questions but relating to the time just before they had given up smoking.

In a covering letter, the doctors were invited to give any information on their smoking habits or history that might be of interest, but, apart from that, no information was sought on previous changes in habit (other than the amount smoked prior to last giving up, if smoking had been abandoned). The decision to restrict questions on amount smoked to current smoking habits was based mainly on the results of the earlier case-control study (Doll & Hill, 1950, 1952), based on interviews with nearly 5000 patients. This study had shown that the classification of smokers according to the amount that they had most recently smoked gave almost as sharp a differentiation between the groups of patients with and without lung cancer as the use of smoking histories over many years – theoretically more relevant statistics, but clearly based on less accurate data.

The results of ten years' follow-up were published in 1964 (Doll & Hill, 1964), in which a description of the cohort and its representativeness for all British doctors was described. The results of ten years' follow-up for men was published in 1976 (Doll & Peto, 1976) and of 22 years' follow-up for women in 1980 (Doll *et al.*, 1980).

During the study, further questionnaires were sent out on three separate occasions to men (see Table IA.1) and on two occasions to women. The purpose was partly to obtain detailed information on smoking habits, in particular giving up smoking, and

Table IA.1. Response to questionnaires

	Second questionnaire	Third questionnaire	Fourth questionnaire
Survey period	November 1957–31 Oct. 1958	March–31 Oct. 1966	July–31 Oct. 1972
Known to have died before end of survey period	3 122	7 310	10 634
Presumably alive at end of survey period	31 318	27 139	23 806
Replied by end of survey period (and % of men then alive)	30 810 (98.4)	26 163 (96.4)	23 299 (97.9)
Reasons for nonresponse:			
Too ill	31	65	21
Refused	36	63	102[a]
Address not found	72	403	22
Unknown and other reasons	369	445	362

[a] Includes all men who refused previously

also to ask additional questions, the relevance of which had emerged during the period of follow-up. Degree of inhalation was asked in these questionnaires, and the use of filter-tipped or plain cigarettes asked in the last questionnaire.

From the 59 600 individuals approached initially, 40 637 replies were received that were sufficiently complete to be used – 34 445 from men and 6192 from women. From a one-in-ten random sample of the register, it was estimated that this represented answers from 69% of the men and 60% of the women alive at the time of the inquiry. The degree of self-selection in those who replied was assessed in terms of the overall mortality using this one-in-ten sample. The standardized death rate of those who replied to the first questionnaire was only 63% of the death rate for all doctors in the second year of the inquiry, and 85% in the third year. In the fourth to tenth years the proportion varied about an average of 93%, and there was no evidence of any regular change with the further passage of years. Evidently the effect of selection did not entirely wear off, but after the third year it had become slight. One factor in this favourable mortality was the presence among those who replied of a relatively large number of nonsmokers and a relatively small number of heavy cigarette smokers, demonstrated by a small inquiry undertaken in 1961. Two small samples were drawn of (1) those who had replied in 1951 and (2) those who had not. Eliminating those who had died between 1951 and 1961, there were 267 previous 'answerers' and 213 previous 'nonanswerers'. They were asked about their smoking habits in 1961, and 261 (98%) of the answerers and 179 (84%) of the nonanswerers responded. Comparison of these two groups shows 21% (answerers) and 6% (nonanswerers) nonsmokers and 15% (answerers) and 28% (nonanswerers) as moderate or heavy cigarette smokers (15 or more daily).

The numbers of men replying to the subsequent questionnaires and the numbers not replying for different reasons are shown in Table IA.1. Further questionnaires were not

sent to doctors who had been struck off the Medical Register nor to those who had refused to answer previously or had asked not to be written to again, although their mortality was still monitored. The proportions of survivors who did not reply in 1957, 1966, and 1972 were, respectively, 1.6%, 3.6%, and 2.1%.

Information about the death of doctors was obtained at first directly from the Registrars-General of the United Kingdom, who provided particulars of every death identified as referring to a medical practitioner. Later, lists of deaths were obtained from the General Medical Council, and these were complemented by reference to the records of the British Medical Association and other sources at home and abroad. Some deaths came to light in response to the questionnaires. Others were discovered in the course of following up doctors who had not replied to or who had not been sent subsequent questionnaires. Of the 34 440 men studied, 10 072 were known to have died before 1 November 1971, 24 265 were known to have been alive at that date, and 103 (0.3%) were not yet traced.

Many of the 103 untraced doctors were not British, and 67 (65%) were known to have gone abroad. It was felt unlikely that more than about a dozen deaths relevant to the study could have been missed.

Information on the underlying cause of death in the 10 072 doctors known to have died before 1 November 1971 was obtained for the vast majority from the official death certificates. Except for deaths for which lung cancer was mentioned, the certified cause was accepted and (unless otherwise stated) the deaths classified according to the underlying cause. (In only four cases was no evidence of the cause obtainable.) The underlying causes were classified according to the seventh revision of the *International Classification of Diseases* (World Health Organization, 1957), except that a separate category of 'pulmonary heart disease' was created.

Cancer of the lung, including trachea or pleura, was given as the underlying cause of 467 deaths and as a contributory cause in a further 20. For each of these 487 deaths, confirmation of the diagnosis was sought from the doctor who had certified the death and, when necessary, from the consultant to whom the patient had been referred. Information about the nature of the evidence was thus obtained in all but two cases. Doubtful reports were interpreted by an outside consultant, with no knowledge of the patient's smoking history. As a result, carcinoma of the lung was accepted as the underlying cause of 441 deaths and as a contributory cause of 17. Twenty-six deaths were considered to be due to other underlying causes and three to other contributory causes.

The results for female doctors were published later, in 1980, and for 22 rather than 20 years of follow-up. The methods of enquiry were similar to those used for male doctors except that only three questionnaires were sent, in 1951, 1961 and 1973.

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APPENDIX IB

THE ATOMIC BOMB SURVIVORS – THE LIFE-SPAN STUDY

A vast programme of studies has been conducted under the aegis of the Radiation Effects Research Foundation (RERF) and its predecessor, the Atomic Bomb Casualty Commission (ABCC), investigating both the short- and long-term effects of the radiation exposure suffered by the survivors of the atomic bomb explosions in Japan. These effects include:

Early somatic effects:
- acute radiation sickness
- abortion
- impaired fertility
- maldevelopment of the embryo and foetus

Late somatic effects:
- impairment of growth and stature
- cataract of the lens of the eye
- impairment of fertility
- cytogenetic abnormalities
- cancer
- other diseases
- effects on ageing
- effects on immunity

Genetic effects:
- stillbirths, changes in sex ratio, reduced birth weight, neonatal mortality, birth defects
- cytogenetic abnormalities
- protein polymorphisms

The main results on cancer mortality have come from the Life-span Study, the original description of which is given in a paper by Beebe *et al.* (1962). A feature of the Life-span Study has been the regular publication of technical reports by the RERF, with analyses of updated results.

The study was set up as a systematic search for any mortality differential associated with radiation, one aim being to ensure that effects would not be missed merely because they were not specifically looked for at the right time. It was intended that any new mortality differential uncovered by the Life-span Study could be pursued by pathologists and clinical investigators in a more definitive fashion. A portion of the mortality sample was the subject of a continuing clinical investigation embracing

standard physical and laboratory investigations every two years, plus a wide variety of short-term, special studies.

The cohort for the Life-span Study was intended to include all survivors who had received appreciable radiation exposure, together with survivors more distant from the hypocentres of the explosions, who received lower doses. In the absence of suitable sampling frames established shortly after the bombs fell, the 1950 national census was used as a basis for cohort definition. In that census, 284 000 survivors were enumerated, of whom 195 000 lived in one of the bombed cities. The Japanese citizens among this latter group, with place of family registration in the city or nearby, constituted the sampling base. It was decided to include all individuals in this group who had received appreciable radiation, and a stratified sample of the remainder. At the time the sample was constructed, the air dose as a function of distance from the hypocentre of the bombs was estimated to be about 100 rads at 1500 metres, 15 rads at 2000 metres and 3 rads at 2500 metres. All eligible individuals who were within 2500 metres were therefore included. A comparison group was formed from among those more distally located at the time of the bomb, of the same size as the group exposed less than 2000 metres and of the same age and sex composition. Matching was done separately for people of each sex by single year of age.

A second control group was formed of people not resident in either of the two cities when the bombs fell, mainly to guard against the risk of missing effects that were not dose-dependent. Most of this group consisted of migrants to the two cities after the war, with considerable differences in background lifestyle. Doubts were raised early on as to the group's comparability, which were later confirmed (Beebe *et al.*, 1971), and little reference is made to it in the more recent reports.

In the original 1950 census, there was an additional group (known as the 'reserve' group) of 9527 survivors exposed within 2500 metres, but whose place of family registration was too distant from the cities to satisfy the initial eligibility criterion. This criterion had been introduced to ensure uniformity in the follow-up procedures (see next section), but experience obtained during the conduct of the study indicated that the family registration system was highly effective for follow-up, and that this exclusion criterion was unnecessary. In the more recent reports, this group was included in the study cohort (Beebe *et al.*, 1971).

Details of the full sample from the 1950 census are given in Table IB.1, which indicates those selected for the Life-span Study.

Follow-up procedures were based on the Japanese Family Registration System. Under the Family Registration Law of Japan (1947), a register is maintained by the mayor or equivalent authority for every family registered in his jurisdiction, and vital events are posted therein. The place of registration corresponds to a legal address for family purposes and is seldom changed even when physical residence changes. Officials responsible for the registration of births and deaths throughout Japan send copies of these vital documents to the places of family registration. Changes in the place of family registration and creation of registers for new families are so effected that knowledge of any one place of registration is a virtual guarantee that the present place of registration can be learned and survival status ascertained.

In connection with the present study, a test was made of the family registration

Table IB.1. The master sample, proper and reserve, by component, exposure category and city[a]

City and comparison group	Total	Proper part		Reserve
		Selected	Not selected	
Hiroshima				
Total	121 100	74 356	16 341	30 403
A 0–1999 m from hypocentre	26 174	21 329	—	4 845
B 2000–2499 m	14 543	11 524	—	3 019
C[b] 2500–9999 m	44 478	21 275	14 748	8 455
D[b] 10 000+ m or not in city	35 905	20 228	1 593	14 084
Nagasaki				
Total	42 620	25 037	10 458	7 125
A 0–1999 m from hypocentre	7 659	6 801	—	858
B 2000–2499 m	5 949	5 144	—	805
C[b] 2500–9999 m	18 151	6 742	8 900	2 510
D[b] 10 000+ m or not in city	10 860	6 350	1 558	2 952
Total				
Total	163 720	99 393	26 799	37 528
A 0–1999 m from hypocentre	33 833	28 130	—	5 703
B 2000–2499 m	20 492	16 668	—	3 824
C[b] 2500–9999 m	62 630	28 017	23 648	10 965
D[b] 10 000+ m or not in city	46 765	26 578	3 151	17 036

[a] From Kato (1984)
[b] Matched by age and sex to group A

system. For the Life-span Study, 20 000 individuals were checked against their family registers, and for only 17 could the register not be found. Investigation showed that nine of these were foreigners not eligible for family registration; for one person a register should have been made but had not been; and only seven, therefore, were really unknown. Since these individuals were being kept under active clinical surveillance, their mortality was known. The family registers returned mortality information on all but nine of the 1300 known deaths, or 99.3%, indicating that the family register approach provides information of nearly perfect completeness.

Information on cause of death was provided from vital statistics death schedules by the National Institutes of Health under official procedures specific to this joint NIH-ABCC study.

The cause of death as given on death certificates has been compared with that given by autopsy findings for those invididuals who came to autopsy – a small overall proportion – as shown in Table IB.2. To achieve comparability with official Japanese vital statistics, cause of death was coded according to the WHO *International Classification of Diseases, Injuries, and Causes of Death.* The 7th, 8th and 9th Revisions were used for the time periods 1950–1967, 1968–1978, and 1979 onwards, respectively

Table IB.2. Accuracy of causes of death – autopsy cases among Life-span Study sample, 1961–1975[a]

Cause of death	Death certificate	Autopsy report	Agreement	Confirmation rate	Detection rate
Tuberculosis	176	226	110	62.5	48.7
Malignant neoplasm of:					
buccal cavity & pharynx	19	17	13	68.4	76.5
oesophagus	50	53	36	72.0	67.9
stomach	444	495	374	84.2	75.6
large intestine	43	54	28	65.1	51.9
rectum	45	46	32	71.1	69.6
liver, gallbladder, bile ducts	42	169	26	61.9	15.4
pancreas	56	81	36	64.3	44.4
breast	40	49	38	95.0	77.6
uterus	70	83	57	81.4	68.7
prostate	13	24	5	38.5	20.8
urinary organs	38	60	30	78.9	50.0
malignant lymphomas	40	56	31	77.5	55.4
leukaemias	42	40	36	85.7	90.0
Benign neoplasms and neoplasms of unspecified nature	65	21	3	4.6	14.3
Disease of blood and blood-forming organs	30	14	12	40.0	85.7
Ischaemic heart disease	265	199	67	25.3	33.7
Gastric, duodenal & peptic ulcer	58	61	24	41.4	39.3
Cirrhosis of liver	153	149	80	52.3	53.7
Nephritis & nephrosis	62	29	11	17.7	37.9

[a] From Kato (1984)

Great efforts have been made to establish the dose received by each member of the Life-span Study group, and also the degree of accuracy of these dose estimates. In the early reports, the radiation dose estimates used were the so-called Tentative 1957 dose (T57D), which were considered to be accurate within a factor of 2. For each survivor included in the Life-span Study, information on location and shielding at the time of the bomb was obtained by interview and, in some cases, by mail questionnaire. These estimates were later revised, to give the T65 dose, which were used in reports on mortality experience up to 1974 (Beebe *et al.*, 1977). A minor change in the location of the hypocentre of the Nagasaki explosion led to some revision of the T65 dose, to give the T65DR estimates used in report number 7 (Kato & Schull, 1982). The average error in these estimates has been evaluated as 30% (Jablon, 1971). Further work has indicated that the T65DR estimates themselves may need major revision, based on a reassessment mainly of exposure to neutrons (Loewe & Mendelsohn, 1981).

Jablon (1984) and Fujita (1984) both discuss dosimetry revisions, in a monograph (Prentice & Thompson, 1984) of great value to those interested in the current status of the follow-up studies of the atomic bomb survivors.

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APPENDIX IC

HEPATITIS B AND LIVER CANCER

A large number of case-control studies and several cohort studies have been undertaken to investigate the association between the hepatitis B surface antigen (HBsAg) carrier state and the development of liver cancer. The first prospective study to report conclusive results was from Taiwan (Beasley *et al.*, 1981), in which male Chinese Government employees were enrolled through routine health care services. Since the term 'liver cancer' on a death certificate may imply secondary liver cancer, and hepatitis B virus (HBV) is related only to primary hepatocellular carcinoma (PHC), the causes of death of the study subjects were investigated in some detail. The study design and procedures were as follows (Beasley *et al.*, 1981).

The study was conducted among male Chinese Government employees (civil servants) in Taiwan whose life and health insurance system provides almost total ascertainment of the fact of death, with excellent determination of cause of death. The study was restricted to men, since the incidence of PHC is three to four times higher in men than in women, and male government employees are on average older and stay in government service longer. Initially, enrolment was restricted to men aged 40 to 59 years; later, because of the general popularity of the project, men of all ages were recruited. Study participants were recruited through two sources:

(1) at the Government Employees' Clinic Centre (GECC) during routine free physical examinations or at selected other clinics (e.g., dental, ear, nose and throat and ophthalmology), where no bias in liver disease status was considered likely (GECC group)
(2) among men recruited from the GECC ten years earlier, when they were 40–59 years old, for a prospective study of cardiovascular disease risk factors; they had been kept under active surveillance since then (CVDS group).

There were 1480 men in the CVDS group and 21 227 men in the GECC group. The CVDS and GECC groups were similar except that the CVDS group was older. It was stated that government employees and the general population were similar with respect to the frequency of HBV infections, the HBsAg carrier rate and the mortality rate from PHC and cirrhosis.

PHC was detected through health and life insurance, mandatory for all government employees and provided by a single large government bureau operating exclusively for this purpose. Insurance was usually retained after retirement and could be cancelled only at the request of the retired person. All deaths of active government employees

and deaths of most retired government employees were thus known to the insurance bureau. Monthly lists of recent deaths and newly retiring employees who had cancelled their insurance were received from the bureau. In the 1981 report, only 643 men had cancelled their insurance (2.8% of study subjects), of whom 569 had been contacted by letter or telephone. Thus, only 74 (0.3%) of the original cohort might have died and the death not be known to the study.

To verify the completeness of the insurance system for the ascertainment of deaths, all HBsAg-positive men (3454) and controls matched for age and province of origin with each HBsAg-positive man were actively followed. This active surveillance involved annual completion of a health questionnaire and retesting for HBV markers. Adherence to follow-up averaged 95% annually. The state of health of those who failed to return for follow-up was determined by telephone or home visit. Contact was lost with only 74 men, whose vital status could not be ascertained. From this active surveillance we were able to verify that among men retaining their insurance all deaths are known to us.

The causes of death of all study subjects were investigated through the records of preceding periods in hospital. Among the 41 deaths due to PHC reported in 1981, 19 (46.3%) were confirmed histologically. Nineteen of the remaining patients had raised serum alpha fetoprotein (AFP) levels and changes on a liver scan, or angiography, or both, interpreted as PHC; one more patient had scans interpreted as PHC but AFP was not measured; and the remaining two patients had raised AFP levels and their clinical picture was interpreted as PHC. The clinical picture, liver scan and angiographic patterns did not differ between histologically confirmed and unconfirmed cases. Deaths attributed to cirrhosis all showed unequivocal clinical evidence of chronic hepatic failure in the presence of portal hypertension and other classical evidence of cirrhosis.

All recruitment and follow-up specimens were tested for HBsAg, alanine aminotransferase and AFP. Anti-HBs and anti-HBc (hepatitis B core antigen) testing were too expensive to undertake on all 19 253 HBsAg-negative subjects. All 1020 HBsAg-negative men from the CVDS group and controls matched for age and province of origin with each HBsAg-positive subject in the GECC group were selected from among the HBsAg-negative subjects for anti-HBs testing; 3661 men were tested for anti-HBs. Of these, all the 615 who were anti-HBs-negative were tested for anti-HBc. The anti-HBs and anti-HBc rates derived from the above sample were then used to project the frequency of these markers for the entire study population.

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APPENDIX ID

CANCER IN NICKEL WORKERS – THE SOUTH WALES COHORT

The risk of nasal sinus and lung cancer associated with nickel refining had been established in the late 1930s. In 1949, both diseases were prescribed as occupational diseases in the United Kingdom when they occurred in men 'working in a factory where nickel is produced by decomposition of a gaseous nickel compound'.

The principal cohort study of the South Wales cohort was first reported in 1970 (Doll *et al.*, 1970) and an extension of the study in 1977 (Doll *et al.*, 1977). Further analyses have been published since (Peto *et al.*, 1984; Kaldor *et al.*, 1986).

The aims of the study were succinctly described by Doll *et al.* (1970):

'Men employed in a nickel refinery in South Wales were investigated to determine whether the risk of developing carcinoma of the bronchi and nasal sinuses, which had been associated with the refining of nickel, are still present. The data obtained were also used to compare the effect of age at exposure on susceptibility to cancer induction and to determine the rate of change of mortality after exposure to a carcinogenic agent has ceased.'

The cohort was identified using the weekly paysheets of the company, on which all men receiving an hourly wage were listed by name and works' reference number. Initially, paysheets were inspected for the first week in April of the years 1934, 1939, 1944 and 1949, and all men were included whose names and numbers were recorded on any two of the sheets, unless they were noted on one of the two sheets as having been in the Armed Forces or transferred elsewhere for war work. By this means, the population was limited to men who were likely to have been employed for at least five years, and follow-up was facilitiated.

The names of all the men included in the study were identified in the company's register of new employees. This gave the year when they were first employed and much other information that helped in tracing them. From 1902 to 1933 the register of new employees also gave the men's ages; in later years this was sometimes omitted, in which case it had to be obtained from other sources, such as pension records or death certificates.

The study was later extended by examining the paysheets for the first week in April 1929. It is therefore effectively restricted to men employed for at least five years who were still employed in 1934 or later. The follow-up has been continued until 31 December 1981, by which time 788, or 81%, of the original cohort of 968 had died. Only 18 (2%) of the cohort were lost to follow-up.

Copies of the death certificates were obtained for all who were known to have died, and the cause of death was classified according to the Seventh Revision of the *International Classification of Diseases* (World Health Organization, 1957). The use of these rules for all periods rather than the ones that were current at the time of death has no effect on the estimated numbers of deaths attributed to cancers of the lung and nose.

Because of the method of selection, no one came under observation until 1934. The man-years at risk were, therefore, calculated for the period 1934–1981. Observed and expected deaths were calculated only up to age 85, at least in the last two reports (Peto *et al.*, 1984; Kaldor *et al.*, 1986), to minimize the effects of misclassification on the death certificates in old age. The numbers of deaths that would have been expected if the men had suffered the normal mortality in England and Wales as a whole were calculated by multiplying the man-years at risk in each five-year age group and each calendar period (1934–1938, 1939–1943, 1944–1948, 1949–1953, 1953–1958, 1959–1963 and 1964–1971) by the corresponding national mortality rates. Nasal cancer rates were not available before 1940, and the rates for 1940 were used for the earlier years.

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APPENDIX IE

THE MONTANA STUDY OF SMELTER WORKERS

Earlier reports had indicated an excess risk of respiratory cancer among long-term metal miners. Among the agents possibly responsible for this increase were airborne radiation and arsenic compounds. The purpose of the Montana smelter study was to investigate the role of arsenic in the development of respiratory cancer, since smelters have negligible exposure to airborne radiation and higher exposure to arsenic. The original report was published in 1969 (Lee & Fraumeni, 1969) covering the mortality experience of the cohort in the period 1 January 1938 to 31 December 1963. The follow-up was later extended to 30 September 1977 (Lee–Feldstein, 1983). Further analyses of parts of the data have appeared (Lubin *et al.*, 1981; Brown & Chu, 1983), the latter structuring the analysis in terms of multistage models of carcinogenesis (see Chapter 6).

The study population comprised 8045 white men who had been employed as smelter workers for 12 or more months before 31 December 1956. Of this group, one-third was initially employed before 1938, one-third during 1938–1946, and one-third in 1947–1955.

Company records provided for each individual the date and place of birth, social security number, time and place of employment for each job held within a smelter before 1964, year last known alive, and the date and place of death for most decedents. In addition, follow-up information was obtained from death registers of state health departments, social security claims records of the Bureau of Old Age and Survivors Insurance, and other governmental agencies. The mortality experience of the group has been followed from 1 January 1938 to 30 September 1977 (Lee–Feldstein, 1983).

Death certificates were obtained for the smelter workers known to have died during the 26-year period, 1938–1963. Information on mortality and follow-up for the period 1964–1977 was obtained from company records, the Social Security Administration and death registers of various health departments. Underlying causes of death were classified according to the *International Classification of Diseases* appropriate for the calendar year of death and later, for convenience, were converted into the Seventh Revision code (World Health Organization 1957)

The follow-up status on 30 September 1977, together with the follow-up status given in the first report as of 31 December 1963, is shown in Table IE.1.

The study group was compared with the white male population of the same states through the use of expected deaths obtained by multiplying the age- and cause-specific mortality rates for the states by the person-years at risk for each cohort of smelter workers.

Table IE.1 Follow-up status of study group

Total study group, 1977		Follow-up status, 31 December 1963		
		Known to be living	Known to be deceased	Vital status not known
Known to be living	3707[a]	3342	0	365[b]
Known to be deceased	3522	1534	1877	111
Vital status not known	816	520	0	296
Total, 1963	8045[c]	5396	1877	772

[a] Includes 442 men still employed at the smelter on 30 September 1977

[b] Approximately half of the men reported lost to follow-up by Lee and Fraumeni (1969) were found to be alive on 30 September 1977.

[c] Two persons in the original study group of 8045 were women; they have been deleted from the present study.

The study group was categorized by exposure to varying levels of arsenic, sulfur dioxide and other chemicals. From measurements made in the smelters, each work area was rated on a scale from 1 to 10 with respect to the relative amount of arsenic trioxide in the atmosphere. Jobs in three areas, commonly known as the arsenic kitchen, cottrell, and arsenic roaster, afforded 'heavy' arsenic exposure (8–10 on the relative scale). 'Medium' arsenic exposure was associated with four work areas: converter, reverberatory furnace, ore roaster and acid plant, and casting (4–7 on the relative scale). Persons in all other areas had 'light' arsenic exposure (1–3 on the scale). Measurements in work areas may have varied over time, but it seems reasonable to assume that relative exposure in terms of these three broadly defined categories remained fixed. Most men had worked in several different areas, so, to be conservative, an individual was classified into one of the three arsenic groups based on his maximum (heaviest) exposure for the analyses reported by Lee and Fraumeni (1969).

The work areas were also categorized with respect to the level of sulfur dioxide, and study members were classified into one of the three exposure groups. 'Heavy' sulfur dioxide areas consisted of the reverberatory furnace and the converter, whereas 'medium' areas consisted of arsenic roaster, brickyard, ferromanganese plant, lead shop, cottrell, casting, ore roaster and acid plant, and phosphate plant. Finally, the work areas were rated by the levels of exposure to silicon dioxide (silica), lead fumes and ferromanganese.

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APPENDIX IF

ASBESTOS EXPOSURE AND CIGARETTE SMOKING

Several cohorts of asbestos-exposed individuals have been studied in order to determine the joint effect of asbestos and cigarette smoking on the risk of lung cancer. The largest such study is that of the North American insulators, started in 1966. It has given rise to a number of publications, both on the effect of asbestos and on the combined effect of asbestos and smoking (Selikoff *et al.*, 1973; Hammond & Selikoff, 1973; Hammond *et al.*, 1979; Selikoff *et al.*, 1979, 1980). The study was based on the complete 1966 membership list of the International Association of Heat and Frost Insulators and Asbestos Workers, which has about 120 locals in the USA and Canada. Much of the material handled by these insulation workers contained asbestos, so that all of the members can be considered as asbestos workers. In 1966, each member was approached with a request to complete a questionnaire containing a number of questions, including those on his smoking habits and his use (or nonuse) of protective masks (11 656 completed the questionnaire). Date of birth and date of entry into the trade were ascertained from union records. All of these men were traced through 31 December 1976 and copies of the death certificates of those who died obtained. Some of the men on the 1966 membership list died before 1 January 1967, leaving 17 800 alive at that date. Altogether, 2271 died in the ten-year period 1 January 1967–31 December 1976; the number of man-years of observation totaled 166 853; and the average age of the men during the ten-year period was 44.4.

Since the aim of the study was to examine the joint effects of asbestos exposure and cigarette smoking and since the entire study group was taken to be exposed to asbestos, it was necessary to construct a special control group, not exposed to asbestos, for which the smoking history of the individuals was known. This group was obtained from the long-term prospective epidemiological study of the American Cancer Society (Hammond, 1966). Starting on 1 October 1959, 468 688 men and 610 206 women had been enrolled. All of them were over 30 years old at that time and most of them were over 40. Upon enrolment, each subject answered a detailed questionnaire; most of the survivors answered subsequent questionnaires distributed in 1961, 1963 and 1965. During that time, death certificates were obtained for those who died; and when cancer was mentioned on a death certificate, the doctor who signed the certificate was requested to supply additional information on the cause of death and the basis of the diagnosis. Follow-up was then discontinued for six years. Tracing of the subjects was resumed on 1 October 1971 and was continued through 30 September 1972. Because of the extremely large number of deaths after 1965, it was not feasible to request doctors to supply additional information on cause of death.

The socioeconomic distribution of the prospective study cohort differs markedly from that of the asbestos workers. To improve comparability, a selected subgroup of the overall cohort was taken as the control group, consisting of all male subjects who met the following criteria: white, not a farmer, no more than high-school education, a history of occupational exposure to dust, fumes, vapours, gases, chemicals or radiation and alive as of 1 January 1967 and traced thereafter. There were 73 763 such subjects. They were classified according to their smoking histories, and the age-specific death rates of each such class were computed.

There was a problem. Death rates in the control group were known for the period 1 January 1967 through 30 September 1972, while members of the asbestos insulation workers union were traced during the period 1 January 1967–31 December 1976. According to official mortality statistics, death rates of the general population of the USA changed somewhat during the second five-year period 1 January 1972–31 December 1976 compared with the first, 1 January 1967–31 December 1971, increasing for some diseases and declining for others. Under the assumption that these changes probably also applied to the control group, the death rates of the control group were extrapolated to take this into account. The principal effect of the extrapolation was to increase the death rates from lung cancer and decrease the death rates from heart disease during the last five years as compared with the first five years.

In this study, further information was obtained on the asbestos workers who died, including, in many instances, clinical data, histological sections and X-ray films. On the basis of this information, the cause of death as given on the death certificate could be reclassified, using the best available information. Table 1.11 gives a comparison between the cause of death as given on the death certificate and that based on the best available information. An equivalent review of the cause of death in the control group was not attempted, the number of deaths being too large. Care was taken to ensure that comparisons between the insulation workers and the control group were based on comparable information.

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APPENDIX II

CORRESPONDENCE BETWEEN DIFFERENT REVISIONS OF THE INTERNATIONAL CLASSIFICATION OF DISEASES (ICD)

Comparison of the three digit codes used in the 7th , 8th and 9th Revisions of the International Classification of Diseases

Code	ICD7	ICD8	ICD9
140	Lip	Lip	Lip
141	Tongue	Tongue	Tongue
142	Salivary gland	Salivary gland	Salivary gland
143	Floor of mouth	Gum	Gum
144	Other parts of mouth; mouth unspecified	Floor of mouth	Floor of mouth
145	Oral mesopharynx	Other and unspecified parts of mouth	Other and unspecified parts of mouth
146	Nasopharynx	Oropharynx	Oropharynx
147	Hypopharynx	Nasopharynx	Nasopharynx
148	Pharynx unspecified	Hypopharynx	Hypopharynx
149	—	Pharynx unspecified	Pharynx unspecified
150	Oesophagus	Oesophagus	Oesophagus
151	Stomach	Stomach	Stomach
152	Small intestine	Small intestine	Small intestine
153	Large intestine, excl. rectum, incl. intestine NOS	Large intestine, excl. rectum, incl. intestine NOS	Colon (incl. large intestine NOS)
154	Rectum and rectosigmoid junction	Rectum and rectosigmoid junction	Rectum, rectosigmoid[1] and anus
155	Biliary passages incl. gallbladder and liver specified as primary	Liver and intrahepatic bile ducts specified as primary	Liver and intrahepatic bile ducts incl. liver not specified as primary or secondary
156	Liver secondary and unspecified	Gallbladder and extrahepatic bile duct	Gallbladder and extrahepatic bile duct
157	Pancreas	Pancreas	Pancreas
158	Peritoneum	Peritoneum and retroperitoneal tissue	Peritoneum and retroperitoneum
159	Unspecified digestive organs	Unspecified digestive organs	Other and ill-defined[2] sites within the digestive organs and peritoneum, incl. intestine NOS

[1] Skin of anus is coded to skin in all three Revisions, and the anal canal coded to rectum. Anus NOS, however, is coded to skin in the 7th and 8th Revisions, but to rectum in the 9th.

[2] Intestinal tract NOS is coded to 153 in ICD7 and ICD8, but to 159 in ICD9.

Code	ICD7	ICD8	ICD9
160	Nose, nasal cavities, middle ear and accessory sinuses (excl. skin and bone of nose in all three Revisions)	Nose, nasal cavities, middle ear and accessory sinuses	Nasal cavities, middle ear and accesscry sinuses
161	Larynx	Larynx	Larynx
162	Trachea, bronchus and lung (specified as primary)	Trachea, bronchus and lung	Trachea, bronchus, lung
163	Lung (unspecified whether primary or secondary)	Other and unspecified respiratory organs	Pleura
164	Mediastinum	—	Thymus, heart and mediastinum
165	Thoracic organs (secondary)	—	Other and ill-defined sites within the respiratory system and intrathoracic organs
170	Breast (male and female)	Bone and articular cartilage	Bone and articular cartilage
171	Cervix uteri	Connective and other soft tissues	Connective and other soft tissues
172	Corpus uteri	Melanoma of skin[3]	Melanoma of skin[3]
173	Other parts of uterus incl. chorionepithelioma	Other malignant[3] neoplasms of skin	Other malignant[3] neoplasms of skin
174	Uterus unspecified	Breast (male and female)	Breast – female
175	Ovary, fallopian tube and broad ligament	—	Breast – male
176	Other and unspecified female genital organs	—	—
177	Prostate	—	—
178	Testis	—	—
179	Other and unspecified male genital organs	—	Uterus, part unspecified
180	Kidney	Cervix uteri	Cervix uteri
181	Bladder and other urinary organs	Chorionepithelioma	Chorionepithelioma
182	—	Other malignant neoplasms of uterus, incl. uterus unspecified	Body of uterus
183	—	Ovary, fallopian tube and broad ligament	Ovary and other uterine adnexa
184	—	Other and unspecified female genital organs	Other and unspecified female genital organs
185	—	Prostate	Prostate
186	—	Testis	Testis
187	—	Other and unspecified male genital organs	Other and unspecified male genital organs
188	—	Bladder	Bladder
189	—	Other and unspecified urinary organs (incl. kidney)	Kidney and other and unspecified urinary organs
190	Melanoma of skin[3]	Eye	Eye

[3] Excludes skin of genital organs. ICD7 and ICD8 also exclude skin of breast (coded to breast).

Code	ICD7	ICD8	ICD9
191	Other malignant neoplasms of skin[3]	Brain	Brain
192	Eye	Other parts of nervous system	Other and unspecified parts of nervous system
193	Brain and other parts of nervous system	Thyroid	Thyroid
194	Thyroid	Other endocrine glands	Other endocrine glands
195	Other endocrine glands	Ill-defined sites	Other and ill-defined sites
196	Bone	Secondary and unspecified malignant neoplasms of lymph nodes	Secondary and unspecified malignant neoplasms of lymph nodes
197	Connective tissue	Secondary malignant neoplasm of respiratory and digestive system (incl. liver unspecified as primary or secondary)	Secondary malignant neoplasm of respiratory and digestive system
198	—	Other secondary malignant neoplasms of other specified sites	Secondary malignant neoplasms of other specified sites
199	Other and unspecified sites	Malignant neoplasm without specification of site	Malignant neoplasm without specification of site
200	Lymphosarcoma and reticulosarcoma	Lymphosarcoma and reticulum cell sarcoma	Lymphosarcoma and reticulosarcoma
201	Hodgkin's disease	Hodgkin's disease	Hodgkin's disease
202	Other forms of lymphoma	Other lymphoid tissue	Other lymphoid and histiocytic tissue
203	Multiple myeloma	Multiple myeloma	Multiple myeloma and immunoproliferative neoplasm
204	Leukaemia and aleukaemia	Lymphatic leukaemia	Lymphoid leukaemia
205	Mycosis fungoides[4]	Myeloid leukaemia	Myeloid leukaemia
206	—	Monocytic leukaemia	Monocytic leukaemia
207	—	Other and unspecified leukaemia	Other specified leukaemia
208	—	Polycythemia vera[5]	Leukaemia of unspecified cell type
209	—	Myelofibrosis[5]	—

[4] Mycosis fungoides is coded under 202 (as 202.1) in ICD8 and ICD9.

[5] Polycythemia vera and myelofibrosis are not coded as malignant neoplasms in ICD7 and ICD9.

Note

1. Uterus unspecified is coded with corpus uteri in ICD8, but given a separate 3-digit rubric in ICD7 and ICD9.
2. Other and unspecified urinary organs are coded with bladder in ICD7, but with kidney in ICD8 and ICD9.

APPENDIX III

U.S. NATIONAL DEATH RATES: WHITE MALES (DEATHS/PERSON-YEAR ×1000)

(a) All causes of death

Age group	1935-1939	1940-1944	1945-1949	1950-1954	1955-1959	1960-1964	1965-1969	1970-1974	1975-1979
0	15.090155	12.355103	9.633718	6.558825	6.537868	5.783995	4.944682	4.386003	3.683013
5	1.512075	1.123687	0.874162	0.640673	0.545455	0.490712	0.465096	0.435708	0.394271
10	1.354305	1.014955	0.828392	0.637076	0.549600	0.490108	0.482238	0.456612	0.433030
15	2.050257	1.735458	1.516066	1.347363	1.292953	1.215401	1.398888	1.472626	1.444567
20	2.725204	2.653871	2.151549	1.828221	1.787832	1.642321	1.837639	1.950797	1.894999
25	3.019979	2.541757	2.007412	1.684009	1.526650	1.486029	1.614999	1.694225	1.688568
30	3.606030	2.982105	2.398892	1.944711	1.767349	1.725782	1.800920	1.782359	1.694902
35	4.754416	4.039859	3.434303	2.782188	2.540642	2.498610	2.600209	2.484212	2.302031
40	6.878378	5.803823	5.172174	4.603532	4.221951	4.048614	4.135886	3.956904	3.635268
45	10.073833	8.836923	8.022261	7.493196	6.980722	6.833429	6.832890	6.501418	6.060059
50	14.405272	13.664108	12.908051	12.032722	11.623889	11.350258	11.280571	10.452522	9.713320
55	21.268906	20.694916	19.890091	18.537674	17.721161	17.542206	18.007660	16.720734	15.346365
60	30.761307	29.590622	28.714554	27.490128	27.061432	26.633423	27.203171	25.941437	24.437134
65	45.490067	42.773224	40.112122	40.288498	40.272156	40.383881	40.723648	38.572983	35.908997
70	65.333893	65.087128	60.756485	58.464386	57.640198	57.502396	59.767563	56.867615	54.622162
75	107.729950	98.246872	93.384598	87.799576	86.163193	84.236496	85.541626	85.420258	82.535858
80	163.118042	153.192078	134.480942	134.709656	133.321854	129.775757	125.819809	123.481873	118.320343
85	243.538437	238.410248	227.047104	204.860550	208.932007	230.693619	211.043625	186.255356	182.579224

Appendix III (cont'd)

(b) All malignant neoplasms

Age group	1935-1939	1940-1944	1945-1949	1950-1954	1955-1959	1960-1964	1965-1969	1970-1974	1975-1979
0	0.093430	0.110568	0.120175	0.125489	0.115679	0.084387	0.086541	0.072836	0.060039
5	0.057093	0.074363	0.081757	0.087156	0.091421	0.086692	0.082350	0.070881	0.060803
10	0.050084	0.057305	0.064863	0.067139	0.070663	0.067645	0.066173	0.055943	0.049658
15	0.071351	0.082535	0.095017	0.096333	0.095904	0.091542	0.091451	0.078406	0.071215
20	0.087208	0.110808	0.127404	0.124357	0.121628	0.112515	0.115589	0.111952	0.094780
25	0.118623	0.139066	0.153178	0.152257	0.147415	0.149026	0.143850	0.138268	0.125170
30	0.174696	0.193988	0.217294	0.207333	0.208630	0.210442	0.209528	0.194685	0.182164
35	0.290465	0.310748	0.335970	0.324324	0.326654	0.330676	0.350294	0.324935	0.293988
40	0.558559	0.553414	0.578648	0.594595	0.595899	0.599316	0.639675	0.634476	0.595643
45	1.020630	1.032964	1.062090	1.127988	1.127623	1.144600	1.193992	1.236712	1.243178
50	1.745554	1.849772	1.976320	2.017418	2.127339	2.137941	2.239856	2.257088	2.249419
55	2.832692	3.071470	3.323395	3.405025	3.478723	3.578072	3.837873	3.891954	3.782340
60	4.403046	4.542109	4.928676	5.149756	5.444480	5.528496	5.937672	6.154709	6.197082
65	6.509923	6.495900	6.750687	7.210414	7.692063	8.022576	8.574032	8.892487	8.872980
70	8.925286	9.278425	9.534017	9.638390	9.976719	10.286403	11.407393	11.981841	12.487869
75	12.638927	12.385037	13.181828	12.793587	12.871528	12.842813	12.337729	15.561729	16.167923
80	14.496526	15.194854	15.491899	16.084656	16.450943	15.862476	16.534668	18.353394	19.233383
85	15.146151	15.625639	17.797379	17.458130	17.702240	18.491318	18.790619	19.065338	20.466278

Appendix III (cont'd)

(c) Cancer of respiratory system

Age group	1935-1939	1940-1944	1945-1949	1950-1954	1955-1959	1960-1964	1965-1969	1970-1974	1975-1979
0	0.001746	0.001760	0.001251	0.001044	0.000942	0.000672	0.000646	0.000696	0.001040
5	0.001364	0.001501	0.001532	0.000917	0.000640	0.000467	0.000175	0.000382	0.000405
10	0.002420	0.001968	0.002505	0.000746	0.000906	0.000511	0.000368	0.000551	0.000228
15	0.004402	0.004043	0.005176	0.002604	0.001941	0.001082	0.001369	0.001561	0.001551
20	0.005787	0.007117	0.006789	0.004921	0.004115	0.003553	0.002832	0.002816	0.002190
25	0.008078	0.009520	0.008441	0.006886	0.007270	0.006986	0.005599	0.006204	0.006109
30	0.015083	0.016771	0.016744	0.017662	0.022139	0.023715	0.023521	0.021660	0.020351
35	0.032326	0.038453	0.045177	0.045509	0.054820	0.063577	0.075042	0.072661	0.065353
40	0.072322	0.089750	0.108127	0.126835	0.140732	0.161982	0.194655	0.215500	0.204149
45	0.148208	0.191795	0.232995	0.291139	0.332762	0.365263	0.420767	0.480238	0.502846
50	0.239424	0.331631	0.454028	0.564001	0.673495	0.741631	0.841064	0.913504	0.952510
55	0.331169	0.497759	0.727187	0.925482	1.137177	1.279813	1.456527	1.593035	1.597188
60	0.399714	0.594480	0.910775	1.258339	1.638880	1.895671	2.217393	2.485404	2.604812
65	0.433002	0.618815	0.930043	1.404181	1.960340	2.440346	2.971354	3.364429	3.477328
70	0.425743	0.613909	0.928421	1.383901	1.907932	2.490834	3.304993	3.992129	4.393531
75	0.453689	0.583911	0.886391	1.268537	1.736111	2.235025	3.158079	4.152960	4.643902
80	0.371528	0.525424	0.769048	1.116935	1.490533	1.872944	2.604069	3.678414	4.315789
85	0.323077	0.358974	0.643979	0.980080	1.194174	1.508670	1.945685	2.595173	2.981785

Appendix III (cont'd)

(d) All diseases of circulatory system

Age group	1935-1939	1940-1944	1945-1949	1950-1954	1955-1959	1960-1964	1965-1969	1970-1974	1975-1979
0	0.136651	0.089558	0.053331	0.051135	0.044999	0.037605	0.044222	0.060552	0.071630
5	0.077747	0.055734	0.035816	0.024465	0.017157	0.012852	0.012110	0.012789	0.012971
10	0.115249	0.084218	0.059499	0.037300	0.025064	0.019400	0.017336	0.015479	0.017198
15	0.157190	0.135348	0.103946	0.076806	0.054358	0.043296	0.036297	0.036922	0.037656
20	0.190581	0.181583	0.137757	0.109595	0.091907	0.071851	0.061590	0.061738	0.054995
25	0.262118	0.250540	0.197035	0.174063	0.150243	0.128281	0.110740	0.100867	0.094217
30	0.421207	0.425313	0.374947	0.357074	0.327580	0.300518	0.268933	0.225143	0.194408
35	0.779535	0.849473	0.848756	0.810016	0.773912	0.755144	0.715122	0.614382	0.528856
40	1.582577	1.670425	1.716481	1.837835	1.736228	1.673374	1.610294	1.443150	1.293776
45	2.938919	3.180255	3.307198	3.556956	3.369588	3.291026	3.173170	2.870263	2.591364
50	4.999078	5.617871	6.000265	6.318288	6.112041	5.898450	5.733212	5.115329	4.624130
55	8.361725	9.335401	9.850962	10.313844	9.847697	9.558846	9.591788	8.584021	7.741709
60	13.494988	14.318038	14.987144	15.914903	15.651752	15.182182	15.030571	13.840800	12.676222
65	21.380875	21.907501	21.995682	24.384079	24.282242	23.961594	23.530701	21.445801	19.344696
70	32.592224	34.847290	34.343796	37.063736	36.646530	35.840851	36.244812	33.286133	30.824768
75	55.897934	54.124817	54.808228	58.076111	57.631912	55.443085	54.658951	52.635254	49.210434
80	87.256897	86.440613	80.873764	92.443512	93.149704	89.922211	85.324646	81.058289	75.077774
85	128.546097	133.326874	136.821915	143.462128	151.346207	159.260071	150.262863	131.068344	125.710373

APPENDIX IV

ALGORITHM FOR EXACT CALCULATION OF PERSON-YEARS[1]

We denote by $\mathbf{t}$ a multivariate time variable, for example, t_1 = age, t_2 = calendar time and t_3 = number of years since first exposure to a given risk factor. Entry into the study occurs at $\mathbf{t} = \mathbf{e}$ and exit at $\mathbf{t} = \mathbf{e} + f\mathbf{1}$, where $\mathbf{1}$ is a vector of 1s and f is the total duration of follow-up. Thus, if a subject entered at age 26.3 years on 1 January 1950 having been initially exposed some 4.9 years earlier, and was followed for 23.7 years, we would have entry at $\mathbf{e} = (26.3, 1950.0, 4.9)$ and exit at $(50.0, 1973.7, 28.6)$.

To start the algorithm, we set $\mathbf{t} = \mathbf{e}$ and determine the cell, denoted by a vector $\mathbf{I}$ of indices for each time variable, in which $\mathbf{t}$ lies. The designation $\mathbf{I} = (3, 1, 2)$ in the example would mean that entry into the study occurred in the third age group, first calendar period, and second category of duration since initial exposure. The procedure is then as follows:

A If $\mathbf{u}_I$ are the upper boundaries of the cell indexed by $\mathbf{I}$ (e.g., 30 years of age, calendar year 1955 and ten years since initial exposure), determine the contribution of the individual to this cell, C_I, as the smallest element of the vector $\mathbf{u}_I - \mathbf{t}$ *or* as the remaining follow-up time, if even smaller.

B Set $\mathbf{t} = \mathbf{t} + C_I\mathbf{1}$.

C Add C_I to cell I of the person-years cross-classification.

D Check each element of $\mathbf{t}$ against the cell boundaries. For each element such that t_i is at the upper boundary, increase the corresponding element of $\mathbf{I}$ by 1.

E Repeat until all follow-up is accounted for.

In the above example, the contributions to the first cell $\mathbf{I} = (3, 1, 2)$ would be $3.7 = \min(30–26.3, 1955–1950.0, 10–4.9)$, $\mathbf{t}$ would change to $(30, 1953.7, 8.6)$ and the next cell to consider would be $\mathbf{I} = (4, 1, 2)$.

[1] From Clayton (1984)

APPENDIX V

GROUPED DATA FROM THE MONTANA SMELTER WORKERS STUDY USED IN CHAPTERS 2–4

Age group	Calendar period	Period of hire	Arsenic exposure	Person-years	Numbers of deaths from:			
					All causes	Respiratory cancer	All cancer	Circulatory disease
1	1	1	1	3075.27	15	2	5	5
1	1	1	2	485.83	2	0	0	0
1	1	1	3	478.18	5	0	1	2
1	1	1	4	337.29	5	0	0	1
1	1	2	1	3981.61	27	2	2	10
1	1	2	2	656.06	5	1	2	1
1	1	2	3	190.34	2	0	0	1
1	1	2	4	12.46	1	0	0	1
1	2	1	1	936.75	4	0	1	2
1	2	1	2	194.58	1	1	1	0
1	2	1	3	164.87	2	1	1	0
1	2	1	4	121.00	0	0	0	0
1	2	2	1	10740.68	85	2	4	32
1	2	2	2	1696.77	9	1	2	4
1	2	2	3	870.52	14	0	1	6
1	2	2	4	224.00	0	0	0	0
1	3	2	1	12451.29	101	7	13	38
1	3	2	2	2511.97	15	0	2	5
1	3	2	3	868.35	12	0	2	5
1	3	2	4	291.78	4	0	1	2
1	4	2	1	7151.03	39	1	4	18
1	4	2	2	1341.63	18	3	3	8
1	4	2	3	419.81	6	0	1	2
1	4	2	4	160.61	2	0	0	1
2	1	1	1	2849.76	51	2	8	21
2	1	1	2	390.45	5	0	1	4
2	1	1	3	333.04	3	1	2	1
2	1	1	4	626.72	14	4	5	5
2	1	2	1	1912.89	30	4	7	15
2	1	2	2	202.69	4	0	0	1
2	1	2	3	90.50	3	0	0	3
2	1	2	4	14.96	1	0	0	1
2	2	1	1	2195.59	49	3	9	18
2	2	1	2	346.17	14	2	2	7
2	2	1	3	287.79	8	1	1	4
2	2	1	4	349.53	11	3	4	6
2	2	2	1	5624.50	109	5	15	48
2	2	2	2	933.45	26	7	9	9
2	2	2	3	410.94	8	1	4	0
2	2	2	4	75.41	6	2	2	1

Appendix V: Grouped Data from Montana Study (cont'd)

Age group	Calendar period	Period of hire	Arsenic exposure	Person-years	Numbers of deaths from:			
					All causes	Respiratory cancer	All cancer	Circulatory disease
2	3	1	1	747.77	24	3	4	8
2	3	1	2	142.13	3	0	0	1
2	3	1	3	127.51	2	1	1	0
2	3	1	4	142.33	5	1	1	2
2	3	2	1	9194.02	164	13	26	78
2	3	2	2	1919.44	42	5	6	18
2	3	2	3	902.38	20	2	2	8
2	3	2	4	487.17	12	3	4	2
2	4	2	1	8494.53	126	8	21	58
2	4	2	2	1896.43	39	6	8	21
2	4	2	3	688.03	12	3	4	4
2	4	2	4	425.13	9	0	0	7
3	1	1	1	2085.43	70	2	15	26
3	1	1	2	194.49	6	1	3	2
3	1	1	3	291.77	13	1	2	6
3	1	1	4	672.09	32	9	15	10
3	1	2	1	657.75	16	1	2	9
3	1	2	2	70.65	3	0	1	2
3	1	2	3	33.42	2	0	0	0
3	2	1	1	1675.91	63	7	12	28
3	2	1	2	225.40	14	2	5	3
3	2	1	3	209.68	13	1	4	6
3	2	1	4	441.10	20	7	7	7
3	2	2	1	1945.95	75	6	13	33
3	2	2	2	203.50	3	0	0	2
3	2	2	3	156.38	3	1	1	1
3	2	2	4	38.13	3	0	1	2
3	3	1	1	1501.73	68	10	16	33
3	3	1	2	234.83	10	4	4	5
3	3	1	3	190.86	8	3	5	3
3	3	1	4	244.82	13	3	5	7
3	3	2	1	4088.70	155	12	28	80
3	3	2	2	712.76	34	7	12	13
3	3	2	3	390.72	15	3	4	9
3	3	2	4	190.84	6	2	3	1
3	4	1	1	440.21	15	1	2	9
3	4	1	2	101.32	4	3	3	0
3	4	1	3	100.80	3	1	1	2
3	4	1	4	100.64	4	1	1	2
3	4	2	1	5100.05	184	19	40	93
3	4	2	2	1052.78	43	6	13	18
3	4	2	3	621.84	25	4	10	13
3	4	2	4	419.09	13	0	2	7
4	1	1	1	833.61	67	3	10	29
4	1	1	2	110.26	14	0	1	5

Appendix V: Grouped Data from Montana Study (cont'd)

Age group	Calendar period	Period of hire	Arsenic exposure	Person-years	Numbers of deaths from:			
					All causes	Respiratory cancer	All cancer	Circulatory disease
4	1	1	3	158.70	15	0	0	10
4	1	1	4	277.25	25	1	4	9
4	1	2	1	114.15	12	0	1	4
4	1	2	2	4.25	2	0	0	0
4	1	2	3	9.00	0	0	0	0
4	2	1	1	973.32	79	6	10	39
4	2	1	2	54.57	10	1	2	2
4	2	1	3	108.28	13	1	4	3
4	2	1	4	268.27	32	2	8	14
4	2	2	1	358.35	38	1	8	20
4	2	2	2	38.37	3	0	0	3
4	2	2	3	39.16	4	1	1	3
4	2	2	4	10.62	1	0	1	0
4	3	1	1	1027.12	77	6	13	47
4	3	1	2	105.58	7	2	2	2
4	3	1	3	54.74	5	0	0	3
4	3	1	4	197.20	24	1	5	13
4	3	2	1	1097.92	87	5	22	37
4	3	2	2	127.62	13	0	0	10
4	3	2	3	68.54	11	0	0	6
4	3	2	4	45.38	5	1	1	3
4	4	1	1	674.44	54	6	10	29
4	4	1	2	97.14	10	1	2	2
4	4	1	3	94.00	3	2	2	0
4	4	1	4	92.75	10	2	3	2
4	4	2	1	1763.50	141	14	22	86
4	4	2	2	324.74	15	2	5	7
4	4	2	3	180.22	6	0	1	4
4	4	2	4	114.36	5	0	1	4

GROUPED DATA ON NASAL CANCER DEATHS AMONG WELSH NICKEL WORKERS

Appendices VI and VII present grouped data derived from the Welsh nickel refinery cancer mortality study. Person-years (PY) and observed deaths were summed for all persons (N) with positive person-year contribution to each cell cross-classified by age first employed (AFE), year first employed (YFE), exposure index (EXP), and time since first employed (TFE). Expected deaths were based on national death rates for England and Wales in five-year age and calendar year strata (see Appendix IX). Of 400 possible cells in the four-way classification (Appendix VII), 242 had positive person-year contributions. The three-way classification (Appendix VI) was obtained by collapsing the four-way data over the EXP dimension. Of 80 possible cells in the three-way classification 72 had positive person-year contributions.

The categories of the four classification variables are:

AFE	YFE	EXP	TFE
1 = <20.0	1 = 1902–1910	1 = 0.0	1 = 0.0–19.9
2 = 20.0–27.4	2 = 1910–1914	2 = 0.5–4.0	2 = 20.0–29.9
3 = 27.5–34.9	3 = 1915–1919	3 = 4.5–8.0	3 = 30.0–39.9
4 = 35.0–54.4	4 = 1920–1924	4 = 8.5–12.0	4 = 40.0–49.9
		5 = 12.5 +	5 = 50.0 +

APPENDIX VI

NASAL SINUS CANCER MORTALITY IN WELSH NICKEL REFINERY WORKERS: SUMMARY DATA FOR THREE-WAY CLASSIFICATION

AFE	YFE	TFE	Nasal cancer deaths	Person-years	AFE	YFE	TFE	Nasal cancer deaths	Person-years
1	1	2	0	19.406	2	1	2	1	174.418
1	1	3	0	70.000	2	1	3	2	521.768
1	1	4	0	52.836	2	1	4	0	304.922
1	1	5	0	33.209	2	1	5	2	142.282
1	2	1	0	2.166	2	2	1	0	3.831
1	2	2	1	175.294	2	2	2	1	528.066
1	2	3	0	179.501	2	2	3	4	497.481
1	2	4	1	121.217	2	2	4	2	279.542
1	2	5	0	77.877	2	2	5	2	97.982
1	3	1	0	71.400	2	3	1	0	82.886
1	3	2	0	267.774	2	3	2	0	253.653
1	3	3	0	267.714	2	3	3	0	206.343
1	3	4	0	210.773	2	3	4	2	111.541
1	3	5	0	157.445	2	3	5	0	45.434
1	4	1	0	279.472	2	4	1	0	1021.139
1	4	2	0	344.109	2	4	2	1	1088.072
1	4	3	0	315.170	2	4	3	0	869.314
1	4	4	0	267.320	2	4	4	3	585.779
1	4	5	0	176.503	2	4	5	0	250.398

Appendix VI: Three-way Classification of Welsh Data (cont'd)

AFE	YFE	TFE	Nasal cancer deaths	Person-years	AFE	YFE	TFE	Nasal cancer deaths	Person-years
3	1	2	3	116.939	4	1	2	0	14.773
3	1	3	1	262.567	4	1	3	0	36.570
3	1	4	1	151.760	4	1	4	0	17.290
3	1	5	1	32.238	4	2	1	0	3.176
3	2	1	0	3.824	4	2	2	2	164.801
3	2	2	3	330.710	4	2	3	5	56.130
3	2	3	2	265.273	4	2	4	0	7.258
3	2	4	3	90.851	4	3	1	0	34.540
3	2	5	0	19.540	4	3	2	2	124.253
3	3	1	0	49.453	4	3	3	1	68.881
3	3	2	2	169.654	4	3	4	0	4.382
3	3	3	1	111.962	4	4	1	1	354.720
3	3	4	0	55.060	4	4	2	3	319.077
3	3	5	1	0.840	4	4	3	0	141.845
3	4	1	0	679.445	4	4	4	0	17.203
3	4	2	0	686.531					
3	4	3	1	458.838					
3	4	4	1	183.701					
3	4	5	0	42.665					

APPENDIX VII

LUNG AND NASAL SINUS CANCER MORTALITY IN WELSH NICKEL REFINERY WORKERS: SUMMARY DATA FOR FOUR-WAY CLASSIFICATION

AFE	YFE	EXP	TFE	N	PY	Observed deaths			Expected deaths		
						Lung cancer	Nasal cancer	All causes	Lung cancer	Nasal cancer	All causes
1	1	2	2	1	1.8302	0	0	0	0.000501	0.000009	0.015749
1	1	2	3	1	10.0000	0	0	0	0.005548	0.000101	0.131953
1	1	2	4	1	0.8739	0	0	1	0.001180	0.000013	0.015226
1	1	3	2	3	7.1989	0	0	0	0.001972	0.000036	0.061946
1	1	3	3	3	30.0000	0	0	0	0.018695	0.000324	0.416487
1	1	3	4	3	26.0055	0	0	1	0.056554	0.000433	0.777975
1	1	3	5	2	21.9968	0	0	1	0.104245	0.000680	1.954394
1	1	4	2	3	7.6071	1	0	1	0.001647	0.000031	0.055648
1	1	4	3	2	20.0000	0	0	0	0.012367	0.000183	0.233173
1	1	4	4	2	15.9562	0	0	1	0.032319	0.000249	0.379826
1	1	4	5	1	7.2151	0	0	1	0.029605	0.000176	0.367500
1	1	5	2	1	2.7699	0	0	0	0.000759	0.000014	0.023835
1	1	5	3	1	10.0000	0	0	0	0.006666	0.000113	0.143022
1	1	5	4	1	10.0000	0	0	0	0.024173	0.000175	0.328920
1	1	5	5	1	3.9973	0	0	1	0.015579	0.000107	0.239810
1	2	1	1	2	0.9700	0	0	0	0.000066	0.000001	0.004107
1	2	1	2	6	49.0261	0	0	1	0.007615	0.000130	0.269025
1	2	1	3	5	50.0000	0	0	0	0.041582	0.000406	0.484250
1	2	1	4	5	50.0000	0	0	0	0.143042	0.000739	1.220072
1	2	1	5	5	35.8170	0	0	5	0.194630	0.000844	1.978039
1	2	2	1	2	0.9098	0	0	0	0.000056	0.000001	0.003699
1	2	2	2	10	80.7788	0	1	1	0.014266	0.000236	0.469375
1	2	2	3	9	81.6233	1	0	1	0.074494	0.000744	0.878157
1	2	2	4	8	46.0958	4	1	5	0.124914	0.000664	1.052235
1	2	2	5	3	27.1653	0	0	3	0.168732	0.000736	1.746187
1	2	3	1	1	0.2507	0	0	0	0.000017	0.000000	0.001062
1	2	3	2	4	35.4891	0	0	0	0.006504	0.000108	0.209898
1	2	3	3	4	37.8781	1	0	1	0.036124	0.000358	0.420860
1	2	3	4	3	22.3508	0	0	1	0.073292	0.000369	0.651239
1	2	3	5	2	14.8944	1	0	2	0.094093	0.000421	1.058619
1	2	4	1	1	0.0356	0	0	0	0.000002	0.000000	0.000151
1	2	4	2	1	10.0000	0	0	0	0.001438	0.000023	0.050957
1	2	4	3	1	10.0000	0	0	0	0.009036	0.000083	0.096519
1	2	4	4	1	2.7699	0	0	1	0.005879	0.000038	0.048107
1	3	1	1	17	50.1519	0	0	0	0.001557	0.000046	0.163907
1	3	1	2	20	181.0278	0	0	1	0.024588	0.000357	0.779594
1	3	1	3	21	190.5669	1	0	3	0.162638	0.001259	1.536345
1	3	1	4	17	146.8630	1	0	6	0.417245	0.001816	3.195433
1	3	1	5	11	107.9049	0	0	7	0.669160	0.002895	7.170720
1	3	2	1	7	17.0204	0	0	0	0.000706	0.000017	0.060004
1	3	2	2	7	66.7466	0	0	1	0.010052	0.000151	0.318440

Appendix VII: Four-way Classification of Welsh Data (cont'd)

AFE	YFE	EXP	TFE	N	PY	Observed deaths			Expected deaths		
						Lung cancer	Nasal cancer	All causes	Lung cancer	Nasal cancer	All causes
1	3	2	3	6	57.1471	0	0	1	0.053508	0.000438	0.515681
1	3	2	4	5	48.6658	0	0	1	0.150893	0.000654	1.195361
1	3	2	5	4	36.4930	0	0	3	0.226919	0.000998	2.619424
1	3	3	1	2	4.2274	0	0	0	0.000139	0.000004	0.013942
1	3	3	2	2	20.0000	0	0	0	0.002756	0.000041	0.092147
1	3	3	3	2	20.0000	0	0	0	0.018094	0.000149	0.173137
1	3	3	4	2	15.2439	0	0	1	0.042914	0.000196	0.324807
1	3	3	5	1	13.0465	0	0	1	0.085828	0.000377	0.859574
1	4	1	1	28	228.3376	0	0	1	0.007570	0.000157	0.747508
1	4	1	2	29	284.1088	0	0	2	0.063526	0.000719	1.132030
1	4	1	3	27	261.8770	0	0	3	0.297499	0.001698	2.385268
1	4	1	4	24	227.1940	2	0	4	0.762530	0.003367	5.741814
1	4	1	5	20	145.6633	1	0	9	0.878630	0.003459	8.045273
1	4	2	1	6	51.1345	0	0	0	0.001747	0.000038	0.166843
1	4	2	2	6	60.0000	0	0	0	0.013561	0.000153	0.239631
1	4	2	3	6	53.2930	0	0	1	0.056786	0.000323	0.458292
1	4	2	4	5	40.1261	0	0	1	0.133655	0.000590	0.992480
1	4	2	5	4	30.8396	0	0	2	0.189426	0.000740	1.730875
2	1	1	2	16	27.2839	0	1	1	0.011266	0.000258	0.363285
2	1	1	3	18	153.8885	2	0	5	0.116749	0.002275	3.592233
2	1	1	4	13	103.6338	1	0	5	0.207416	0.002433	5.494106
2	1	1	5	8	46.3060	0	0	6	0.157220	0.001916	5.416975
2	1	2	2	14	38.7660	0	0	0	0.015033	0.000335	0.477216
2	1	2	3	18	134.5756	3	0	8	0.111145	0.001899	2.727597
2	1	2	4	10	72.1631	1	0	6	0.183005	0.001500	3.319514
2	1	2	5	4	26.3951	0	1	3	0.115229	0.000944	2.855752
2	1	3	2	15	52.3291	0	0	1	0.021893	0.000503	0.703564
2	1	3	3	16	127.4445	2	1	5	0.109387	0.001829	2.714684
2	1	3	4	11	76.5519	2	0	5	0.172606	0.001661	3.731743
2	1	3	5	6	47.2267	0	1	3	0.189374	0.001729	5.178221
2	1	4	2	8	27.7354	1	0	1	0.011825	0.000274	0.378824
2	1	4	3	7	58.6919	1	0	2	0.055861	0.000864	1.298165
2	1	4	4	5	34.5167	2	0	2	0.093303	0.000770	1.757753
2	1	4	5	3	12.6444	0	0	2	0.049216	0.000461	1.422127
2	1	5	2	7	28.3033	0	0	0	0.011928	0.000275	0.380667
2	1	5	3	7	47.1670	2	1	4	0.042131	0.000702	1.073977
2	1	5	4	3	18.0565	1	0	2	0.044786	0.000420	1.003884
2	1	5	5	1	9.7096	0	0	0	0.033644	0.000408	1.270299
2	2	1	1	4	1.6687	0	0	0	0.000223	0.000004	0.009193
2	2	1	2	17	126.8835	0	0	1	0.047188	0.000908	1.305475
2	2	1	3	16	147.3439	2	0	4	0.210102	0.002145	3.088371
2	2	1	4	12	104.1298	0	1	4	0.386300	0.002357	5.133400
2	2	1	5	8	35.3401	1	0	7	0.204165	0.001159	3.459515
2	2	2	1	2	0.5453	0	0	0	0.000120	0.000002	0.004024
2	2	2	2	22	147.3027	3	0	4	0.054442	0.001098	1.595543
2	2	2	3	18	143.4004	0	0	5	0.183965	0.002064	2.944180

Appendix VII: Four-way Classification of Welsh Data (cont'd)

AFE	YFE	EXP	TFE	N	PY	Observed deaths			Expected deaths		
						Lung cancer	Nasal cancer	All causes	Lung cancer	Nasal cancer	All causes
2	2	2	4	13	86.5511	4	0	8	0.289411	0.001929	4.148711
2	2	2	5	5	38.0643	0	0	4	0.198582	0.001299	3.865778
2	2	3	1	2	0.7700	0	0	0	0.000167	0.000003	0.005635
2	2	3	2	21	155.1765	2	0	3	0.059191	0.001171	1.688422
2	2	3	3	18	134.5986	3	2	9	0.177506	0.001967	2.815660
2	2	3	4	9	51.4711	1	1	6	0.166513	0.001160	2.503561
2	2	3	5	3	18.5302	0	1	3	0.096347	0.000661	1.951160
2	2	4	1	1	0.4357	0	0	0	0.000101	0.000002	0.003334
2	2	4	2	10	74.6497	0	1	1	0.029773	0.000606	0.859406
2	2	4	3	9	59.6384	2	1	4	0.073933	0.000864	1.208902
2	2	4	4	5	37.3904	1	0	3	0.127317	0.000809	1.791119
2	2	4	5	2	6.0479	1	1	2	0.028994	0.000242	0.617074
2	2	5	1	1	0.4110	0	0	0	0.000113	0.000002	0.003537
2	2	5	2	3	24.0533	0	0	0	0.010351	0.000207	0.288814
2	2	5	3	3	12.4993	1	1	3	0.011295	0.000171	0.218863
2	3	1	1	10	32.7654	0	0	0	0.004667	0.000090	0.187169
2	3	1	2	12	105.3328	0	0	1	0.050795	0.000720	0.974806
2	3	1	3	11	88.2396	1	0	4	0.178689	0.001285	1.821627
2	3	1	4	7	54.1711	1	0	4	0.248082	0.001225	2.745999
2	3	1	5	3	12.5214	1	0	3	0.083994	0.000401	1.061039
2	3	2	1	13	39.9615	0	0	0	0.006060	0.000114	0.236859
2	3	2	2	13	130.0000	0	0	0	0.062156	0.000916	1.245923
2	3	2	3	14	108.1035	3	0	5	0.208017	0.001592	2.260874
2	3	2	4	9	47.3701	1	2	7	0.196524	0.000959	1.976272
2	3	2	5	2	28.4575	0	0	0	0.192905	0.000924	3.032250
2	3	3	1	2	10.1591	0	0	0	0.001217	0.000023	0.053197
2	3	3	2	2	18.3206	1	0	1	0.008768	0.000109	0.148577
2	3	3	3	1	10.0000	0	0	0	0.020875	0.000138	0.180384
2	3	3	4	1	10.0000	0	0	0	0.048323	0.000205	0.453334
2	3	3	5	1	4.4547	0	0	1	0.030170	0.000136	0.357358
2	4	1	1	75	636.6534	2	0	4	0.071267	0.001203	2.971809
2	4	1	2	72	677.4666	2	0	7	0.448932	0.004415	5.434327
2	4	1	3	65	568.3325	7	0	17	1.398524	0.007470	11.370510
2	4	1	4	48	379.5499	1	2	21	1.983351	0.008526	18.568737
2	4	1	5	27	167.9702	1	0	13	1.260037	0.005626	16.864193
2	4	2	1	41	335.2416	0	0	1	0.035677	0.000598	1.533288
2	4	2	2	41	369.7211	4	1	7	0.228690	0.002257	2.835229
2	4	2	3	32	289.4706	3	0	7	0.683183	0.003685	5.486624
2	4	2	4	25	196.2285	0	1	13	1.005349	0.004282	9.197350
2	4	2	5	12	78.6426	0	0	6	0.588204	0.002591	7.778345
2	4	3	1	7	49.2441	1	0	1	0.006178	0.000107	0.251981
2	4	3	2	6	40.8844	3	0	4	0.022000	0.000252	0.329680
2	4	3	3	2	11.5106	0	0	1	0.030754	0.000173	0.257286
2	4	3	4	1	10.0000	0	0	0	0.057345	0.000246	0.565400
2	4	3	5	1	3.7848	1	0	1	0.027976	0.000128	0.376292
3	1	1	2	8	30.9646	0	0	0	0.018602	0.000471	0.713553

Appendix VII: Four-way Classification of Welsh Data (cont'd)

AFE	YFE	EXP	TFE	N	PY	Observed deaths			Expected deaths		
						Lung cancer	Nasal cancer	All causes	Lung cancer	Nasal cancer	All causes
3	1	1	3	10	90.0610	0	0	1	0.085716	0.001714	3.700508
3	1	1	4	9	56.2800	1	0	6	0.099375	0.002043	5.033322
3	1	1	5	3	8.9761	0	0	1	0.023529	0.000424	1.434741
3	1	2	2	9	31.6553	0	0	1	0.018436	0.000466	0.673323
3	1	2	3	8	51.9076	1	0	5	0.047123	0.000913	1.805143
3	1	2	4	3	20.0629	0	0	1	0.044301	0.000682	1.609779
3	1	2	5	2	5.1459	0	0	1	0.014674	0.000236	0.813623
3	1	3	2	6	16.3969	0	0	1	0.010044	0.000253	0.406400
3	1	3	3	6	40.4081	0	0	4	0.032798	0.000709	1.420403
3	1	3	4	2	20.0000	0	0	0	0.039630	0.000762	1.912668
3	1	3	5	2	7.8320	0	0	1	0.021646	0.000365	1.142771
3	1	4	2	8	24.7081	0	2	2	0.013860	0.000347	0.503048
3	1	4	3	7	57.9165	0	0	1	0.055881	0.001028	2.061535
3	1	4	4	6	44.3951	1	1	3	0.097585	0.001371	3.243989
3	1	4	5	3	9.9196	0	0	3	0.027750	0.000459	1.264412
3	1	5	2	4	13.2140	0	1	1	0.006939	0.000172	0.236301
3	1	5	3	4	22.2736	0	1	2	0.025715	0.000367	0.662605
3	1	5	4	2	11.0219	1	0	1	0.030305	0.000317	0.764719
3	1	5	5	1	0.3643	0	1	1	0.001214	0.000016	0.037614
3	2	1	2	8	46.6960	0	0	2	0.025929	0.000617	0.880928
3	2	1	3	7	62.5234	0	0	2	0.088777	0.001137	2.325517
3	2	1	4	5	41.1809	0	1	1	0.130443	0.001382	3.439777
3	2	1	5	4	17.9314	1	0	1	0.069279	0.000702	2.589557
3	2	2	1	3	1.5001	0	0	0	0.000411	0.000008	0.012909
3	2	2	2	15	115.0914	1	1	3	0.066007	0.001451	2.027447
3	2	2	3	12	96.5497	0	2	8	0.149251	0.001705	3.341032
3	2	2	4	4	18.7769	0	1	4	0.060148	0.000552	1.348683
3	2	3	1	5	2.3235	0	0	0	0.001001	0.000023	0.031400
3	2	3	2	14	112.6292	2	1	4	0.071390	0.001567	2.278342
3	2	3	3	10	75.9399	2	0	8	0.115621	0.001421	2.970081
3	2	3	4	2	13.9891	0	0	1	0.044356	0.000496	1.395872
3	2	3	5	1	1.6083	0	0	0	0.005966	0.000063	0.248098
3	2	4	2	5	29.2269	0	0	3	0.016492	0.000379	0.509995
3	2	4	3	2	10.8987	1	0	1	0.020291	0.000195	0.401675
3	2	4	4	1	8.2767	0	0	1	0.029040	0.000284	0.693576
3	2	5	2	4	27.0659	0	1	1	0.015363	0.000358	0.503703
3	2	5	3	3	19.3617	1	0	2	0.029631	0.000342	0.690170
3	2	5	4	1	8.6274	0	1	1	0.031483	0.000278	0.679248
3	3	1	1	5	15.5463	0	0	0	0.004545	0.000091	0.144929
3	3	1	2	5	50.0000	0	0	0	0.038182	0.000619	0.815164
3	3	1	3	5	40.6248	0	0	1	0.105821	0.000753	1.476069
3	3	1	4	4	36.9518	0	0	2	0.167498	0.001175	3.079530
3	3	1	5	2	0.8402	0	1	2	0.003834	0.000026	0.120626
3	3	2	1	7	19.3579	1	0	1	0.005944	0.000119	0.187597
3	3	2	2	6	53.8741	0	0	1	0.039317	0.000662	0.857099
3	3	2	3	5	38.8685	0	0	2	0.097331	0.000709	1.372621

Appendix VII: Four-way Classification of Welsh Data (cont'd)

AFE	YFE	EXP	TFE	N	PY	Observed deaths			Expected deaths		
						Lung cancer	Nasal cancer	All causes	Lung cancer	Nasal cancer	All causes
3	3	2	4	3	16.5713	0	0	3	0.071583	0.000548	1.345318
3	3	3	1	7	12.8011	1	0	1	0.004282	0.000089	0.134381
3	3	3	2	6	50.7423	0	1	2	0.035059	0.000643	0.872330
3	3	3	3	4	28.0280	0	0	2	0.063334	0.000500	0.994420
3	3	3	4	2	1.5369	0	0	2	0.005663	0.000040	0.096456
3	3	4	1	2	1.7480	0	0	0	0.000711	0.000016	0.022298
3	3	4	2	2	15.0377	0	1	1	0.009166	0.000196	0.261667
3	3	4	3	1	4.4412	0	1	1	0.006977	0.000071	0.124634
3	4	1	1	46	366.4772	0	0	4	0.101905	0.001798	2.904719
3	4	1	2	40	362.2961	5	0	10	0.441966	0.004523	5.630685
3	4	1	3	30	258.8806	2	1	11	0.914011	0.005062	9.714138
3	4	1	4	19	127.8625	1	0	10	0.740171	0.003881	10.684372
3	4	1	5	9	34.1688	2	0	4	0.237515	0.001198	4.636051
3	4	2	1	36	302.5701	0	0	5	0.077265	0.001356	2.269936
3	4	2	2	33	304.8248	5	0	8	0.349723	0.003645	4.460165
3	4	2	3	25	189.9575	8	0	14	0.630007	0.003504	6.363993
3	4	2	4	11	52.2952	2	1	9	0.286616	0.001443	3.718540
3	4	2	5	2	8.4961	0	0	1	0.055865	0.000307	1.154069
3	4	3	1	2	10.3977	0	0	0	0.002449	0.000042	0.073716
3	4	3	2	2	19.4099	1	0	1	0.018544	0.000213	0.249869
3	4	3	3	1	10.0000	0	0	0	0.030400	0.000187	0.317061
3	4	3	4	1	3.5437	1	0	1	0.017331	0.000080	0.201905
4	1	1	2	1	3.2507	0	0	0	0.002090	0.000055	0.114900
4	1	1	3	1	10.0000	0	0	0	0.007862	0.000259	0.605049
4	1	1	4	1	8.7240	0	0	1	0.011710	0.000415	1.194058
4	1	2	2	2	8.3676	0	0	0	0.005357	0.000148	0.330412
4	1	2	3	2	20.0000	0	0	0	0.016183	0.000601	1.377671
4	1	2	4	2	8.5656	0	0	1	0.011862	0.000408	1.194423
4	1	3	2	1	3.1534	0	0	0	0.002028	0.000053	0.110443
4	1	3	3	1	6.5699	0	0	1	0.004622	0.000145	0.345160
4	2	1	2	5	31.7454	0	0	2	0.021618	0.000516	0.969634
4	2	1	3	3	2.1759	0	1	3	0.002073	0.000041	0.093540
4	2	2	1	1	0.7452	0	0	0	0.000466	0.000012	0.020219
4	2	2	2	5	45.2374	0	0	0	0.032784	0.000771	1.555950
4	2	2	3	5	20.6312	1	2	4	0.026131	0.000625	1.461149
4	2	2	4	1	4.4465	0	0	1	0.009194	0.000219	0.722761
4	2	3	1	6	2.4304	0	0	0	0.001428	0.000036	0.054792
4	2	3	2	9	78.5702	0	0	2	0.054769	0.001506	3.105979
4	2	3	3	7	33.3228	1	2	6	0.039947	0.001046	2.580065
4	2	3	4	1	2.8110	0	0	1	0.005305	0.000137	0.459733
4	2	4	2	3	9.2477	1	2	3	0.005915	0.000147	0.273481
4	3	1	1	10	17.8136	0	0	1	0.010409	0.000271	0.510801
4	3	1	2	9	73.3073	0	0	3	0.055422	0.001389	2.872154
4	3	1	3	6	58.3683	0	0	3	0.106349	0.001865	4.775894
4	3	1	4	3	3.5110	0	0	2	0.010589	0.000155	0.375698
4	3	2	1	6	14.6930	0	0	0	0.008516	0.000217	0.342941

Appendix VII: Four-way Classification of Welsh Data (cont'd)

AFE	YFE	EXP	TFE	N	PY	Observed deaths			Expected deaths		
						Lung cancer	Nasal cancer	All causes	Lung cancer	Nasal cancer	All causes
4	3	2	2	6	40.0914	0	2	5	0.034519	0.000665	1.238614
4	3	2	3	1	10.0000	0	0	0	0.018833	0.000281	0.658282
4	3	2	4	1	0.8709	0	0	1	0.001974	0.000041	0.093471
4	3	3	1	2	2.0330	0	0	0	0.001256	0.000032	0.052300
4	3	3	2	2	10.8544	1	0	1	0.008336	0.000186	0.381166
4	3	3	3	1	0.5123	0	1	1	0.000497	0.000010	0.021945
4	4	1	1	20	151.1498	0	0	3	0.081162	0.001719	2.551850
4	4	1	2	18	164.2301	0	2	4	0.265982	0.003007	5.759737
4	4	1	3	14	79.6339	2	0	10	0.260450	0.002350	5.923701
4	4	1	4	3	7.5938	1	0	3	0.033121	0.000282	0.955459
4	4	2	1	22	178.7898	1	1	3	0.102235	0.002249	3.350846
4	4	2	2	19	131.8055	2	0	10	0.199449	0.002261	4.225490
4	4	2	3	9	61.9921	1	0	6	0.207972	0.001873	4.734968
4	4	2	4	3	9.6090	0	0	2	0.042912	0.000345	1.267546
4	4	3	1	5	24.7805	0	0	1	0.013485	0.000329	0.596625
4	4	3	2	4	23.0416	0	1	3	0.026366	0.000417	0.796841
4	4	3	3	1	0.2190	0	0	1	0.000542	0.000004	0.009514

APPENDIX VIII

CONTINUOUS DATA (ORIGINAL RECORDS) FOR 679 WELSH NICKEL REFINERY WORKERS

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
3	0	5.0	1889.019	17.481	45.227	92.981
4	162	5.0	1885.978	23.186	48.268	63.271
6	163	10.0	1881.255	25.245	52.992	54.164
8	527	9.0	1886.340	24.721	47.907	69.679
9	150	0.	1879.500	29.958	54.746	76.844
10	163	2.0	1889.915	21.288	44.331	62.541
15	334	0.	1890.500	23.284	43.746	62.000
16	160	0.5	1874.332	50.357	59.915	65.583
17	420	0.	1909.500	15.462	34.746	50.514
18	12	0.	1892.500	24.139	51.746	57.593
19	160	10.0	1881.726	33.452	52.520	58.490
21	14	0.	1877.800	30.203	56.446	65.570
22	177	2.5	1879.500	28.669	54.746	67.481
23	162	0.	1900.500	22.648	33.746	52.703
26	999	0.	1887.474	28.197	46.772	77.056
27	420	0.	1893.849	28.962	40.397	68.521
28	420	0.	1905.849	14.052	28.397	61.529
29	434	0.	1873.500	36.744	60.746	63.008
30	420	1.0	1899.400	15.400	34.846	66.581
32	153	0.	1905.500	14.401	28.746	53.768
33	151	1.5	1883.500	27.796	50.746	61.810
34	154	4.0	1886.500	20.927	47.746	53.256
35	420	0.5	1886.395	23.523	47.852	82.827
37	162	0.	1889.093	34.490	45.153	63.043
40	162	1.0	1894.638	28.751	39.608	74.542
41	331	2.5	1886.967	27.819	47.279	65.109
42	420	0.	1899.499	24.194	34.748	83.049
44	998	0.	1889.500	34.959	44.746	56.478
47	160	1.0	1893.312	18.395	45.934	47.114
48	592	4.0	1884.500	26.834	49.746	63.634
49	162	2.5	1890.970	20.227	43.277	62.789
50	420	3.5	1896.500	26.360	37.746	54.969
51	151	1.0	1883.500	22.697	50.746	70.000
52	420	0.5	1894.748	20.752	39.499	86.688
53	160	1.0	1900.710	22.892	33.536	72.761
54	160	11.0	1889.397	25.288	44.849	77.808
55	0	0.	1900.986	22.726	33.260	81.014
56	502	2.0	1904.500	18.292	29.746	51.585
57	27	0.5	1882.500	34.560	51.746	58.434
58	241	0.	1872.500	45.640	61.746	66.768

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
59	420	0.	1901.225	22.164	33.022	81.019
60	422	5.0	1889.500	21.626	44.746	60.571
61	420	0.	1879.500	35.884	54.746	76.201
62	592	6.5	1879.500	34.152	54.746	73.432
63	160	14.0	1878.030	30.410	56.216	58.065
64	334	6.0	1888.500	18.807	45.746	64.812
65	502	6.0	1883.500	28.295	50.746	64.481
68	162	5.0	1897.849	16.651	36.397	79.830
70	162	0.	1901.274	21.570	32.973	54.748
71	163	0.5	1895.989	17.647	38.257	61.493
73	163	8.5	1887.293	25.188	46.953	78.715
75	0	0.	1905.408	16.880	28.838	76.592
76	332	7.5	1879.500	33.421	54.746	72.056
77	420	0.	1890.500	32.352	43.746	74.273
78	153	0.5	1894.915	28.099	39.331	72.389
79	334	1.0	1902.863	21.539	31.383	71.088
80	2	2.0	1889.500	33.311	44.746	64.138
82	527	3.0	1876.500	32.235	57.746	60.979
83	332	2.0	1880.500	30.777	53.746	76.022
84	0	0.	1895.479	27.542	38.767	86.521
85	151	6.5	1881.411	33.392	52.835	86.381
86	163	21.0	1885.500	22.267	48.746	59.612
87	163	4.0	1882.500	20.785	51.746	58.489
88	502	0.	1904.068	14.222	30.178	71.449
89	502	3.0	1875.500	43.432	58.746	68.505
90	491	0.	1900.953	19.596	33.293	76.882
91	154	3.5	1886.500	23.881	47.746	54.505
92	163	5.5	1895.175	24.156	39.071	52.477
93	443	0.	1888.303	20.451	45.943	81.089
94	420	5.5	1881.500	25.519	52.746	75.109
95	410	0.	1874.500	35.758	59.746	65.872
96	420	0.	1890.022	32.797	44.224	89.945
97	0	0.	1902.500	21.790	31.746	79.500
98	162	3.5	1894.159	28.808	40.088	61.822
99	420	0.	1883.500	31.768	50.746	62.393
100	331	5.0	1874.500	31.659	59.746	60.549
101	420	0.	1904.527	14.032	44.719	75.590
103	491	0.	1901.734	21.934	32.512	56.332
104	420	17.5	1883.500	26.021	50.746	73.555
106	160	11.0	1880.312	28.443	53.935	58.072
107	420	0.	1897.655	25.406	36.592	79.847
108	153	2.5	1880.500	35.653	53.746	65.445
109	592	5.5	1899.500	20.667	34.746	45.260
110	0	0.	1909.247	14.030	25.000	72.753
111	0	1.0	1905.222	17.425	29.025	76.778

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
112	491	0.	1897.452	25.573	36.794	78.578
113	998	7.5	1880.500	27.100	53.746	61.111
115	331	5.5	1888.500	25.152	45.746	66.656
116	162	1.5	1901.192	22.367	33.055	55.090
117	502	1.0	1891.652	24.364	42.594	66.337
118	493	7.0	1887.500	26.149	46.746	57.785
119	501	11.5	1881.500	26.336	52.746	58.284
120	502	7.0	1873.500	47.131	60.746	69.434
121	163	14.0	1882.011	27.556	52.235	68.578
122	162	0.	1893.238	30.301	41.008	82.805
124	331	0.	1871.500	36.000	62.746	84.724
126	162	18.0	1883.500	24.710	50.746	57.279
127	792	1.0	1900.500	22.319	33.746	62.000
128	163	0.	1886.500	20.925	47.746	53.637
129	450	2.0	1897.126	25.830	37.120	74.701
131	163	18.0	1881.959	26.675	52.288	67.197
132	332	0.	1900.929	22.088	33.318	69.745
135	491	0.	1892.109	31.208	42.137	84.893
137	465	0.	1905.386	19.081	28.860	74.279
138	181	3.5	1882.500	24.000	51.746	71.873
140	443	0.	1887.500	36.262	46.746	71.237
141	163	0.5	1891.500	18.503	42.746	62.253
142	160	7.5	1883.915	26.712	50.331	57.449
143	420	3.0	1887.500	32.951	46.746	77.303
144	160	1.5	1884.505	28.596	49.741	67.229
145	177	10.5	1882.729	27.038	51.518	91.827
147	420	4.0	1878.500	30.000	55.746	87.911
148	420	0.	1902.500	21.204	31.746	65.658
149	163	2.0	1889.997	33.307	44.249	69.036
150	160	9.5	1871.932	38.690	62.315	64.732
151	160	10.5	1875.364	32.830	58.882	77.745
152	420	4.5	1874.500	40.262	59.746	83.073
154	463	2.5	1900.150	22.655	44.096	70.000
155	434	0.	1880.500	32.719	53.746	58.237
156	196	12.5	1887.500	27.160	46.746	58.837
157	332	0.5	1905.751	16.331	28.496	74.752
158	163	5.5	1885.500	22.500	48.746	54.582
159	502	3.5	1886.500	23.747	47.746	55.612
161	162	2.5	1891.573	31.277	42.674	60.553
162	157	0.	1897.500	26.089	36.746	46.918
164	163	3.0	1896.500	24.413	37.746	52.610
165	502	2.0	1891.500	31.437	42.746	50.782
166	451	2.5	1901.063	21.641	33.183	67.511
170	420	0.	1893.619	29.433	40.627	78.741
172	163	3.0	1888.626	26.874	45.621	58.522

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
173	0	3.0	1895.929	26.921	38.318	86.071
175	332	0.	1887.500	26.000	46.746	76.295
176	198	4.5	1882.775	33.309	51.471	68.433
177	420	0.	1902.414	10.784	31.833	67.849
180	163	3.0	1892.500	21.311	41.746	48.117
181	526	2.0	1881.500	24.758	52.746	62.601
186	163	1.5	1897.929	25.652	36.318	61.096
187	999	0.	1906.500	18.098	27.746	34.500
190	163	5.0	1888.473	25.027	45.774	57.988
191	181	4.0	1886.500	35.092	47.746	69.814
194	446	1.0	1894.041	28.885	40.205	71.715
195	334	0.	1892.500	30.338	41.746	70.000
196	491	3.5	1892.563	27.937	41.684	81.832
197	356	2.5	1902.500	20.473	31.746	53.940
199	163	0.	1880.361	24.126	53.886	68.126
200	0	7.5	1885.866	20.548	48.381	96.134
202	541	0.5	1898.500	24.358	35.746	42.101
203	163	1.0	1886.649	36.471	47.597	71.880
204	502	6.5	1876.500	30.914	57.746	66.251
206	162	0.	1892.500	30.579	41.746	64.519
207	162	4.0	1895.690	18.074	38.556	60.312
208	163	1.5	1887.027	26.473	47.219	67.211
210	163	0.	1890.507	30.029	43.740	55.011
211	163	5.0	1886.500	31.922	47.746	50.030
212	163	1.5	1895.500	18.000	38.746	49.623
213	162	0.	1910.129	14.202	24.118	63.049
214	420	1.5	1886.655	29.142	47.592	78.559
215	434	0.	1885.500	25.111	48.746	54.366
216	420	0.	1881.500	23.464	52.746	66.669
218	491	10.0	1883.500	30.503	50.746	78.779
219	151	0.5	1884.391	38.730	49.856	83.182
221	163	11.0	1888.918	21.827	45.328	68.027
222	160	3.5	1876.085	37.737	58.162	70.910
223	162	0.	1889.500	33.867	44.746	63.758
224	434	0.	1903.500	13.774	30.746	37.645
225	177	0.	1883.849	25.608	50.397	83.770
226	260	0.	1883.500	21.000	50.746	67.999
227	0	0.	1904.344	12.585	29.902	77.656
228	502	0.	1906.912	15.671	27.334	71.660
229	420	0.	1901.500	23.363	32.746	62.735
230	0	0.	1903.500	13.063	30.746	78.500
231	162	3.0	1896.500	21.330	37.746	59.587
234	420	2.0	1882.500	27.651	51.746	71.456
236	161	0.	1892.500	21.889	41.746	68.281
237	163	5.0	1895.500	27.322	38.746	52.421

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
239	420	0.	1878.500	26.068	55.746	80.832
240	0	1.0	1902.500	20.533	31.746	79.500
243	998	2.0	1887.500	26.160	46.746	51.505
245	422	1.5	1886.500	23.930	47.746	73.587
246	163	0.	1894.500	20.788	39.746	55.642
248	420	1.0	1895.622	28.435	38.625	69.540
250	163	10.0	1885.500	24.842	48.746	59.897
251	153	3.5	1877.500	34.773	56.746	72.971
252	420	1.0	1888.500	17.579	45.746	58.453
255	0	0.	1899.162	23.943	35.085	82.838
256	223	2.0	1880.500	39.956	53.746	68.235
257	490	0.	1899.500	23.369	34.746	62.990
259	154	2.5	1885.500	37.426	48.746	76.489
261	0	0.	1901.384	21.929	32.863	80.616
265	999	0.	1902.500	13.495	31.746	55.892
266	331	0.	1887.500	34.514	46.746	61.060
267	2	3.0	1881.500	38.934	52.746	65.930
268	420	1.0	1894.500	20.790	39.746	88.412
270	163	2.0	1895.800	27.088	38.446	53.430
271	160	9.0	1884.519	30.549	49.727	64.990
272	420	5.5	1882.500	38.415	51.746	68.634
273	154	0.	1909.500	14.691	24.746	55.930
274	491	2.0	1883.438	36.977	50.808	75.066
275	331	0.	1880.500	44.112	53.746	54.155
276	153	1.0	1900.352	22.670	33.894	69.464
277	163	0.	1903.500	21.402	30.746	65.000
279	163	1.0	1880.500	27.653	53.746	63.308
281	420	0.	1893.285	26.939	40.962	76.531
282	162	6.0	1891.500	22.505	42.746	54.053
283	500	0.	1894.715	29.000	39.531	57.561
284	431	6.5	1880.500	26.451	53.746	56.377
285	420	0.	1899.063	15.721	35.183	68.334
286	421	5.0	1886.500	23.684	47.746	63.832
287	331	6.0	1878.500	28.000	55.746	84.064
289	162	0.	1884.951	35.771	49.296	76.942
291	502	8.0	1874.500	28.341	59.746	66.085
292	422	3.5	1871.500	37.137	62.746	86.223
293	610	8.5	1882.500	28.122	51.746	56.930
294	160	5.5	1885.299	35.270	48.948	62.096
295	196	0.	1889.019	35.448	45.227	74.937
297	420	5.0	1886.500	27.133	47.746	70.823
298	160	12.0	1885.822	25.230	48.425	54.700
299	160	0.	1898.500	23.432	35.746	68.653
300	163	5.0	1900.104	20.295	34.143	46.751
301	525	8.0	1889.500	22.582	44.746	51.322

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
302	593	0.	1900.508	15.232	33.738	75.421
303	422	7.5	1879.500	31.796	54.746	67.653
305	334	3.0	1899.871	16.629	34.375	73.907
306	999	0.	1897.500	25.322	36.746	37.300
307	422	0.	1877.500	27.352	56.746	85.215
309	331	3.5	1900.891	14.531	33.356	68.539
310	422	12.0	1878.500	27.601	55.746	76.434
313	0	0.5	1896.563	19.196	37.684	85.437
315	420	0.	1879.500	24.185	54.746	79.621
316	491	0.	1889.225	33.797	45.022	91.915
318	541	0.5	1899.500	17.000	34.746	43.747
319	160	0.	1900.738	22.123	33.509	66.320
321	0	0.	1897.433	25.584	36.814	84.567
322	592	0.	1900.500	22.675	33.746	55.059
324	332	0.	1885.249	37.586	48.997	83.869
325	434	0.	1910.500	14.074	23.746	43.034
326	502	3.0	1879.500	43.311	54.746	64.781
327	465	1.5	1903.962	13.655	30.285	73.057
328	331	1.5	1884.500	20.796	49.746	66.445
329	163	6.0	1888.500	23.790	45.746	51.344
330	160	0.	1881.578	28.899	52.668	70.079
332	420	0.	1884.328	38.560	49.919	69.310
334	162	6.0	1892.500	28.399	46.746	71.943
335	440	6.0	1884.500	26.678	54.746	78.467
336	420	12.0	1876.500	28.000	62.746	83.809
337	420	0.	1885.500	36.815	48.746	67.993
338	0	0.	1894.929	29.402	49.318	87.071
339	331	5.0	1882.500	28.459	51.746	72.448
340	502	0.	1894.285	28.726	39.962	66.568
341	154	0.	1888.500	31.686	45.746	51.481
344	420	1.0	1908.891	14.559	25.356	68.290
345	162	2.0	1900.828	22.027	33.419	54.350
346	163	4.5	1894.203	28.792	40.044	58.202
348	0	2.0	1901.329	21.792	32.918	80.671
349	332	0.	1899.249	23.967	34.997	75.414
351	331	6.0	1873.500	49.314	65.746	73.226
353	204	0.	1901.500	23.169	32.746	48.763
354	420	0.	1877.115	31.344	57.131	97.778
357	420	0.	1896.801	22.699	37.446	75.601
360	450	0.	1883.907	30.052	50.340	86.241
361	443	0.	1887.584	31.630	46.663	81.838
362	331	0.5	1889.181	21.433	45.066	88.258
363	160	10.0	1883.422	26.597	50.825	57.789
364	345	3.0	1886.500	21.697	47.746	60.664
365	420	0.	1900.202	22.669	34.044	60.415

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
368	420	2.0	1888.563	22.937	50.684	81.286
369	420	0.	1904.328	19.387	29.919	70.376
370	420	1.0	1899.619	14.595	34.627	76.963
371	600	8.0	1886.500	28.588	47.746	57.765
375	592	1.0	1885.500	26.790	48.746	60.226
376	332	0.	1907.047	15.036	27.200	68.838
377	153	9.5	1881.500	27.664	52.746	80.212
378	160	3.5	1893.500	19.911	40.746	63.974
380	411	0.	1907.153	14.740	27.093	53.663
381	160	13.0	1884.596	29.459	49.651	78.087
383	204	0.	1903.096	19.926	31.151	72.575
384	431	7.0	1877.500	37.462	56.746	64.533
385	0	0.	1903.534	16.600	30.712	78.466
386	451	5.0	1901.674	15.329	32.573	78.375
388	434	4.0	1892.500	30.316	41.746	49.547
389	420	0.5	1903.000	20.304	31.246	58.855
390	420	2.5	1886.504	22.996	52.742	85.791
391	162	13.0	1881.500	28.892	52.746	60.692
392	160	15.0	1891.019	21.505	43.227	57.585
394	237	0.	1904.571	14.004	29.675	65.829
395	160	3.0	1896.164	22.855	38.083	70.806
397	332	0.	1890.500	32.560	43.746	46.410
400	162	0.	1903.370	19.425	30.877	77.067
403	502	7.0	1887.500	35.330	46.746	48.596
404	155	0.	1902.904	20.578	31.342	77.555
406	163	5.5	1892.500	21.199	41.746	66.708
407	422	3.0	1883.500	39.360	50.746	66.566
408	443	1.0	1882.500	25.505	51.746	74.481
409	163	2.0	1874.500	38.404	59.746	70.807
410	162	0.	1900.500	22.525	33.746	51.661
412	420	0.	1880.500	35.182	53.746	78.215
416	162	0.	1893.811	29.770	40.436	61.685
417	162	7.0	1875.500	38.807	58.746	69.459
419	155	0.	1902.540	20.455	31.707	70.808
420	420	3.0	1894.500	24.823	39.746	71.338
421	160	1.0	1884.500	30.000	49.746	69.782
423	502	0.	1874.500	31.700	59.746	74.522
424	332	0.	1891.751	31.041	42.496	72.796
425	163	3.0	1897.500	13.316	36.746	55.514
427	422	3.5	1888.336	26.971	45.910	67.417
428	162	0.	1896.500	26.878	37.746	45.212
429	434	1.0	1897.562	25.249	36.685	79.154
432	0	0.	1904.112	18.852	40.134	77.888
433	146	3.0	1883.458	39.469	50.789	63.762
436	420	0.	1899.378	23.512	34.868	73.351

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
437	331	0.	1875.500	34.977	58.746	70.297
439	0	2.0	1901.178	21.786	33.068	48.970
440	162	0.	1892.500	26.000	41.746	66.716
442	590	0.	1873.500	34.116	60.746	75.705
443	420	0.	1905.326	14.556	28.920	65.762
444	0	0.	1908.036	14.778	36.211	73.964
446	160	0.	1888.071	35.050	46.175	65.017
447	432	0.	1890.463	21.849	43.783	74.989
449	153	0.	1885.500	20.579	48.746	65.577
452	500	0.	1891.260	28.677	42.986	76.770
453	160	0.	1892.503	31.308	41.744	64.183
455	332	5.5	1883.500	31.497	50.746	57.577
456	331	19.0	1888.500	21.253	45.746	54.796
457	181	2.0	1895.869	27.778	38.378	67.027
458	163	1.0	1878.500	27.338	55.746	58.996
459	610	7.0	1880.188	26.220	54.058	88.038
460	204	0.	1899.500	24.809	34.746	66.760
461	332	6.0	1896.992	22.334	37.255	76.789
462	421	4.5	1895.255	25.144	38.992	56.655
463	790	0.	1895.170	19.515	39.077	73.002
465	578	0.	1900.500	22.848	33.746	45.736
466	163	0.	1878.500	27.045	55.746	62.262
469	162	0.	1896.445	26.492	37.801	64.859
470	443	0.5	1892.500	26.000	41.746	57.541
473	162	7.0	1890.249	23.904	43.997	63.690
474	332	1.0	1886.792	38.011	47.455	83.137
475	550	0.	1891.500	30.421	42.746	50.122
476	162	0.	1894.992	28.186	39.255	81.134
477	502	0.	1896.503	26.451	37.744	86.056
478	204	0.	1895.337	28.720	38.909	73.926
484	151	0.	1888.500	22.648	50.746	68.372
485	162	5.0	1897.619	25.162	36.627	78.946
486	0	2.0	1901.500	21.621	32.746	44.821
488	936	0.	1899.762	23.940	34.485	75.227
490	162	2.0	1900.500	22.311	33.746	45.127
491	162	0.	1902.592	20.279	31.655	56.238
492	500	7.0	1883.500	31.262	50.746	68.719
495	420	0.	1873.500	29.881	60.746	77.779
496	181	2.0	1894.981	27.841	39.266	56.896
497	434	3.0	1875.500	30.295	58.746	62.640
499	331	9.0	1889.500	20.771	44.746	67.003
500	332	0.	1887.500	36.749	46.746	72.932
501	162	3.0	1883.477	26.871	50.770	73.335
502	733	0.5	1892.500	20.982	41.746	63.440
504	501	0.	1877.500	36.226	56.746	67.429

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
506	160	6.0	1889.460	21.605	44.786	67.523
507	163	5.0	1887.797	24.730	46.449	48.889
508	0	0.	1905.184	14.162	39.063	64.997
509	0	0.	1900.352	22.749	33.894	81.648
510	899	1.5	1899.126	15.482	35.120	79.099
511	146	0.	1881.500	23.782	52.746	75.049
512	163	1.5	1880.500	23.732	53.746	60.180
513	420	1.0	1886.500	29.953	47.746	61.385
514	162	6.5	1882.419	27.679	51.827	55.049
516	161	6.0	1887.723	30.510	46.523	71.734
518	160	5.5	1880.648	22.876	53.599	80.361
522	540	6.0	1885.500	21.489	48.746	63.276
523	0	1.0	1906.038	16.627	28.208	75.962
524	422	0.5	1880.500	32.651	53.746	72.851
525	420	0.	1899.312	21.600	34.934	65.439
526	525	8.0	1880.500	27.171	53.746	79.119
527	420	0.	1898.500	20.497	35.746	65.478
528	502	4.0	1896.445	26.335	37.801	75.467
529	160	1.0	1901.636	21.397	32.611	50.293
531	331	0.5	1892.432	30.398	51.815	85.946
533	434	0.	1902.041	21.008	32.205	75.636
535	422	3.0	1878.500	36.766	55.746	77.637
537	0	0.	1908.128	12.735	26.118	73.872
538	420	4.5	1895.247	16.778	39.000	59.129
540	157	2.5	1899.500	23.621	34.746	63.684
542	420	7.0	1875.500	33.232	58.746	87.919
544	420	8.5	1891.500	18.259	42.746	64.215
545	491	0.5	1900.251	20.631	33.995	71.436
546	0	0.	1909.500	14.495	24.746	72.500
547	420	1.0	1902.500	14.178	31.746	51.325
549	420	0.	1903.951	20.492	35.296	64.306
551	420	17.0	1888.260	18.760	45.987	72.757
553	420	0.	1896.609	26.566	37.637	70.495
554	163	0.	1892.500	28.279	41.746	54.210
556	0	0.	1908.555	14.823	25.692	73.445
559	422	1.0	1887.500	32.000	46.746	78.801
560	162	9.0	1881.500	30.262	52.746	61.160
561	162	16.0	1883.500	26.527	50.746	61.271
562	502	5.0	1875.500	32.555	58.746	65.049
563	163	0.	1894.148	20.844	40.099	56.978
565	163	0.	1882.500	28.842	51.746	81.382
566	160	2.5	1876.601	35.407	57.645	66.448
570	332	9.5	1890.500	15.000	43.746	72.215
572	420	5.0	1894.500	19.226	39.746	70.941
574	491	0.	1909.729	14.036	24.518	70.659

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
575	434	6.5	1871.500	35.903	62.746	72.473
577	163	9.0	1874.500	35.538	59.746	61.344
578	160	0.	1883.995	26.148	50.252	74.504
579	420	1.0	1881.500	25.193	52.746	78.820
582	502	0.	1892.623	30.232	41.624	79.557
584	163	8.0	1886.500	21.790	47.746	57.385
585	25	7.0	1878.500	27.642	55.746	63.884
586	493	0.	1902.500	21.863	31.746	40.752
587	153	6.5	1884.500	31.607	49.746	64.511
588	163	5.5	1871.500	43.829	62.746	64.683
590	610	2.0	1878.500	28.144	55.746	78.290
591	420	4.5	1884.500	25.023	49.746	67.240
592	163	8.0	1879.923	31.871	54.323	69.649
593	160	7.5	1882.438	31.885	51.808	61.821
595	160	8.0	1884.937	26.148	49.309	79.560
596	163	1.0	1892.948	31.650	41.298	69.871
597	491	7.0	1887.500	23.122	46.746	62.842
599	160	0.	1885.932	30.771	48.315	81.403
601	153	0.5	1880.500	29.818	53.746	67.155
603	162	0.	1899.318	24.479	34.929	57.622
605	420	0.	1896.303	18.804	52.943	83.568
606	181	5.5	1891.814	22.789	42.433	67.490
608	332	3.0	1900.503	22.281	33.744	72.634
609	160	3.0	1891.340	23.825	57.907	70.455
610	331	0.	1879.500	29.194	54.746	75.264
611	153	2.0	1875.500	47.292	58.746	68.888
612	422	0.	1892.500	30.495	41.746	60.755
615	420	0.	1897.879	14.079	36.367	78.203
616	420	0.5	1908.500	14.495	25.746	54.621
618	434	9.0	1882.500	30.574	51.746	53.735
620	177	0.	1903.222	16.025	31.025	63.425
621	434	0.	1871.500	44.051	62.746	83.692
622	422	4.5	1883.500	21.525	50.746	71.555
623	163	1.0	1877.500	44.434	56.746	61.922
625	420	0.5	1889.416	25.307	44.830	81.263
627	181	0.	1887.975	25.912	46.271	76.314
629	481	0.	1895.011	16.489	39.235	75.016
631	490	3.0	1886.500	29.000	47.746	66.437
632	501	0.	1889.789	23.534	44.457	74.979
633	422	0.	1894.500	26.068	39.746	69.628
635	420	9.0	1898.500	15.785	35.746	58.555
637	999	0.	1900.008	22.956	34.238	71.118
638	153	0.	1894.500	29.130	39.746	51.401
639	160	16.0	1881.912	27.781	52.334	78.145
640	163	8.5	1875.118	31.233	59.129	71.880

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
641	350	0.	1880.500	26.138	53.746	70.571
642	420	0.	1884.500	26.495	49.746	66.201
643	332	1.0	1874.500	33.932	59.746	73.995
645	999	1.5	1892.500	30.522	41.746	47.519
646	0	0.5	1896.131	26.891	43.115	85.869
647	420	0.	1900.295	23.899	33.951	74.513
648	420	2.0	1882.500	40.670	51.746	75.223
650	491	0.	1880.090	31.619	64.156	89.959
654	331	0.	1892.500	19.541	41.746	46.867
655	420	0.	1902.825	22.061	31.422	75.740
656	154	1.5	1879.500	45.098	54.746	63.388
658	160	1.0	1880.260	38.705	53.987	68.503
660	422	16.0	1881.373	25.290	52.874	85.726
662	491	0.	1877.773	29.904	56.474	93.493
663	521	0.	1876.500	45.108	57.746	73.111
664	454	0.	1900.232	20.546	34.014	68.645
665	420	0.	1879.500	26.774	54.746	77.434
667	422	4.5	1889.953	21.090	44.293	84.419
668	162	11.5	1888.137	21.817	46.110	65.551
669	420	0.	1882.500	27.664	51.746	57.242
674	160	12.5	1872.678	32.178	61.569	63.065
675	163	3.0	1898.500	24.322	35.746	53.831
676	163	1.0	1886.594	36.427	47.652	57.897
677	150	3.5	1889.353	27.365	44.893	69.490
679	490	3.0	1891.500	31.295	42.746	58.352
681	2	1.0	1894.500	28.333	39.746	46.508
682	154	0.5	1899.500	23.810	34.746	66.344
684	434	11.5	1886.500	27.341	47.746	58.637
685	151	0.5	1901.225	21.630	33.022	77.745
687	160	4.0	1885.170	28.907	49.077	78.433
688	541	0.	1885.500	20.777	48.746	56.522
689	443	0.	1893.500	25.116	40.746	64.232
690	420	0.	1906.500	17.221	27.746	55.122
694	0	0.	1900.500	15.000	33.746	46.347
696	191	0.	1877.500	46.105	56.746	73.648
697	162	0.	1906.145	14.120	28.101	63.373
698	422	8.0	1878.500	36.089	55.746	69.727
700	420	0.	1889.500	24.881	54.746	75.079
701	502	1.0	1898.956	25.235	35.290	82.186
702	522	10.0	1879.500	31.544	54.746	59.544
704	163	2.0	1894.500	28.358	49.746	69.423
705	420	3.0	1899.526	21.122	34.720	65.899
706	160	6.0	1874.441	38.636	59.805	74.937
707	163	0.	1881.337	42.225	52.909	76.005
710	0	0.5	1899.899	22.923	34.348	82.101

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
711	163	8.0	1880.563	34.122	53.684	69.711
712	422	0.	1870.500	44.840	63.746	85.653
713	810	2.0	1894.500	28.675	39.746	46.949
715	162	11.0	1891.049	22.562	43.197	54.658
716	491	0.	1894.699	25.430	39.548	84.334
717	160	11.5	1875.847	32.192	58.400	59.101
719	160	8.0	1880.738	34.465	53.509	56.030
721	334	6.5	1887.531	20.469	46.715	85.403
722	420	2.0	1896.355	26.516	37.891	74.017
723	502	0.	1889.500	33.640	49.746	77.021
724	163	1.0	1896.500	27.691	37.746	65.478
727	331	0.	1868.500	46.881	65.746	75.448
729	160	2.0	1892.500	29.804	41.746	70.333
730	163	0.	1888.475	27.314	45.771	79.341
731	163	4.5	1896.904	15.582	37.342	53.460
735	443	0.	1897.918	24.942	36.329	64.811
738	163	0.5	1894.668	28.167	39.578	64.027
742	527	3.0	1882.500	20.752	51.746	57.360
743	151	0.	1896.355	26.502	37.891	80.016
744	163	0.	1903.500	20.749	30.746	54.544
747	163	0.	1895.500	27.319	38.746	46.470
750	162	1.0	1886.500	32.708	47.746	49.256
751	420	3.0	1874.500	39.000	59.746	73.015
752	443	0.	1880.500	42.423	58.746	82.563
753	331	6.5	1875.500	36.300	58.746	69.533
754	163	2.5	1891.400	31.436	42.846	55.756
755	162	2.5	1891.500	30.522	42.746	53.445
756	998	3.5	1877.500	33.000	56.746	65.486
759	153	1.0	1901.500	21.823	32.746	62.533
760	0	0.	1893.500	29.284	40.746	88.500
763	450	0.	1877.704	32.773	61.542	72.512
764	163	3.0	1885.433	23.067	48.814	63.523
765	443	1.5	1891.452	32.192	42.794	69.753
766	420	0.	1900.333	23.811	33.913	66.456
768	160	13.0	1881.663	25.837	52.583	59.548
769	163	2.0	1886.500	27.114	47.746	51.141
772	420	0.	1895.500	27.369	38.746	55.275
773	0	0.	1891.500	32.100	42.746	44.626
774	163	1.0	1886.500	23.785	47.746	48.692
775	162	3.0	1892.008	28.721	42.238	61.066
776	160	0.	1876.500	36.022	57.746	66.881
777	451	0.	1897.638	21.540	46.608	79.132
778	163	5.5	1897.500	22.650	36.746	42.051
780	160	0.	1886.805	36.737	47.441	56.795
781	160	6.0	1875.789	39.414	58.457	69.926

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
782	792	1.0	1899.781	23.093	39.466	66.307
783	151	0.	1880.500	35.568	53.746	74.799
786	163	3.0	1891.932	26.970	42.315	68.700
787	163	0.	1892.500	32.074	41.746	56.670
788	0	0.	1901.890	22.722	32.356	80.110
789	332	2.0	1878.500	29.902	55.746	62.383
790	160	3.0	1884.626	29.456	49.621	59.341
792	0	0.	1908.500	13.549	25.746	73.500
794	205	0.5	1890.500	29.943	43.746	61.026
795	331	1.0	1885.500	37.390	48.746	67.547
796	334	1.0	1888.500	24.631	45.746	55.305
797	420	1.5	1870.500	37.729	63.746	78.432
798	420	5.0	1900.872	14.852	33.375	60.096
800	420	0.	1898.500	24.284	35.746	58.172
801	502	7.5	1884.500	25.834	49.746	58.432
802	332	0.	1876.500	27.267	57.746	86.094
803	540	1.0	1883.500	26.703	50.746	78.675
805	162	4.0	1880.500	30.275	53.746	58.393
806	163	0.	1891.819	22.504	42.427	55.290
808	431	10.0	1876.500	29.560	57.746	62.223
810	591	0.	1890.500	24.664	43.746	52.673
811	160	6.0	1882.411	27.386	51.835	63.367
812	0	0.5	1899.584	20.859	44.663	82.416
815	331	0.	1894.500	22.358	39.746	53.174
816	2	0.	1896.527	26.303	37.719	67.317
817	422	13.0	1877.500	32.930	56.746	70.492
818	160	4.0	1889.589	20.060	44.657	71.521
819	434	0.	1872.500	52.191	61.746	67.773
820	0	0.	1900.358	23.261	33.889	81.642
821	422	3.0	1893.104	29.751	41.142	55.800
822	332	14.5	1874.500	28.453	59.746	61.136
825	521	0.	1889.592	24.908	49.655	86.744
827	160	12.0	1874.978	36.726	59.268	64.510
828	0	0.	1908.667	14.380	25.580	73.333
829	156	3.0	1880.500	27.825	53.746	60.440
831	465	3.5	1890.173	32.622	44.074	71.016
832	163	8.5	1878.500	27.000	55.746	63.744
833	160	1.0	1876.609	38.999	57.637	62.443
834	163	0.5	1894.500	28.297	39.746	65.508
835	163	0.5	1897.321	21.819	36.926	54.868
836	998	6.5	1879.500	32.847	54.746	68.004
837	332	0.	1902.500	13.462	31.746	51.262
839	160	6.5	1889.000	25.666	45.246	62.334
840	334	0.	1874.545	48.362	69.701	93.613
841	422	3.0	1878.500	24.700	60.746	66.607

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
842	420	0.	1905.742	17.079	28.504	68.206
843	592	12.0	1881.500	28.000	52.746	79.563
845	163	9.0	1888.500	19.330	45.746	46.596
846	481	2.0	1895.926	27.699	38.320	77.066
847	610	0.5	1892.765	30.961	41.481	69.632
849	260	0.	1883.500	39.223	50.746	73.238
851	163	5.0	1897.500	25.371	36.746	50.108
852	350	0.	1892.156	32.093	42.091	73.392
853	181	6.0	1886.164	29.137	48.082	69.449
856	162	0.	1901.641	21.477	32.605	59.945
857	444	1.0	1890.175	28.860	44.071	69.214
858	502	0.	1902.945	20.159	46.301	63.367
859	2	5.0	1882.500	20.790	51.746	52.251
860	420	0.	1897.500	25.604	36.746	59.845
861	502	0.	1898.310	24.715	35.937	67.860
862	162	1.0	1894.586	28.277	39.660	58.102
863	332	0.	1898.767	24.104	35.479	73.547
864	420	0.	1895.531	27.589	38.715	80.444
866	332	0.	1870.500	34.309	68.746	84.533
868	177	0.	1900.609	14.418	33.637	63.292
871	420	1.0	1885.500	28.347	48.746	67.156
874	610	0.	1880.500	36.599	53.746	76.096
875	160	5.0	1873.967	40.737	60.279	76.501
876	541	0.	1906.500	15.429	27.746	43.292
879	163	2.0	1876.033	46.830	58.214	70.877
880	162	0.	1899.258	23.847	34.989	80.723
881	163	1.0	1889.036	34.134	45.211	63.257
883	304	0.	1894.085	28.767	40.161	66.440
884	0	0.	1904.380	18.456	29.867	77.620
885	0	0.	1899.500	24.042	34.746	82.500
886	163	0.5	1896.500	28.098	37.746	62.103
887	420	0.5	1874.500	40.495	59.746	84.941
888	331	2.0	1890.500	22.670	43.746	67.363
890	451	0.	1901.573	21.455	32.674	81.153
891	434	1.0	1901.500	22.270	32.746	42.484
892	163	6.0	1886.500	22.790	47.746	65.664
893	502	0.	1897.005	26.499	37.241	75.880
896	177	0.5	1891.500	22.821	42.746	71.547
898	420	8.5	1884.500	23.694	49.746	74.264
899	420	0.	1883.500	39.336	50.746	76.626
900	480	0.5	1890.800	21.000	43.446	79.219
901	421	0.	1902.500	21.719	31.746	52.853
903	451	0.	1903.203	14.005	41.044	77.297
904	420	8.5	1885.500	21.944	48.746	76.056
906	502	0.	1869.500	47.952	64.746	65.982

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
907	177	6.0	1887.500	18.640	46.746	73.117
908	420	0.	1889.710	33.074	44.537	69.997
909	177	2.0	1902.792	20.230	31.455	75.973
913	151	1.0	1904.142	14.148	30.104	62.814
914	331	2.0	1896.500	21.656	37.746	59.347
917	420	0.	1879.500	25.000	54.746	64.836
919	491	0.	1892.156	21.344	42.091	82.159
920	420	0.	1894.466	23.899	39.781	72.649
921	393	4.0	1879.500	25.774	54.746	56.817
923	334	0.	1893.230	27.368	46.016	81.770
924	420	0.	1896.101	27.288	38.145	85.570
925	502	2.0	1887.500	36.067	46.746	57.492
928	0	0.	1897.748	17.752	36.499	84.252
929	332	0.	1874.500	48.311	59.746	60.788
931	332	0.	1869.500	46.680	64.746	70.292
932	420	0.	1893.734	29.123	40.512	68.926
933	420	0.	1882.540	27.937	51.707	85.354
934	420	0.	1897.500	23.090	36.746	55.804
936	0	0.	1895.904	28.003	38.342	66.433
939	420	0.	1884.817	25.961	49.430	69.619
940	590	6.5	1879.500	35.103	54.746	61.418
941	0	3.5	1897.500	25.305	36.746	38.355
942	160	0.	1884.208	22.453	50.039	51.461
943	162	6.0	1883.500	30.000	50.746	59.125
944	502	0.5	1901.500	20.223	32.746	57.505
945	331	4.5	1863.500	49.555	70.746	83.289
946	999	0.	1894.500	28.273	39.746	46.096
947	0	0.	1896.940	26.230	37.307	69.030
949	162	0.	1902.500	13.245	31.746	50.126
950	0	0.	1902.500	22.342	31.746	33.735
952	153	0.	1887.063	35.806	47.183	70.510
953	177	2.0	1884.500	38.311	49.746	63.336
954	434	0.	1902.500	20.495	41.746	48.738
956	163	0.	1898.500	24.125	35.746	44.388
957	163	0.	1876.552	32.301	57.695	73.314
958	422	0.	1892.686	25.495	41.561	75.218
959	162	0.	1893.060	30.529	41.186	70.836
960	420	0.	1890.721	32.189	43.526	73.932
961	420	0.	1873.500	37.892	60.746	66.478
962	450	0.	1890.337	33.477	43.909	77.093
963	331	3.5	1886.500	28.462	47.746	51.695
964	502	3.0	1892.500	30.675	41.746	73.640
965	332	0.	1900.658	15.699	33.588	63.839
966	163	10.5	1883.904	23.712	50.342	64.495
967	162	0.	1886.005	36.885	48.241	67.515

Appendix VIII: Original Records from Welsh Study (cont'd)

ID	ICD code	Exposure level	Date of birth	Age at first employment	Age at start of follow-up	Age at death or withdrawal
968	420	0.5	1878.500	44.969	55.746	87.234
969	160	14.0	1881.500	28.799	52.746	57.686
971	154	0.	1894.500	28.358	39.746	57.803
972	162	0.	1903.589	14.753	35.657	57.329
973	162	0.	1894.562	20.400	39.685	79.353
0	490	0.	1880.500	22.938	53.746	55.174
0	177	3.5	1868.500	46.766	65.746	68.749
0	430	0.	1903.500	19.284	30.746	67.138
0	0	0.	1895.500	27.675	38.746	39.722

APPENDIX IX

ENGLAND AND WALES: AGE- AND YEAR-SPECIFIC DEATH RATES FROM NASAL SINUS AND LUNG CANCER AND FROM ALL CAUSES

Calendar period	Age group (years)	Death rate (per 1 000 000 per year)		
		Lung cancer	Nasal cancer	All causes
1936 - 1940	10 - 14	1	0	1270
	15 - 19	2	0	2203
	20 - 24	6	0	3122
	25 - 29	14	0	3038
	30 - 34	30	1	3219
	35 - 39	68	1	4234
	40 - 44	149	3	5803
	45 - 49	274	5	8605
	50 - 54	431	10	13514
	55 - 59	586	15	20101
	60 - 64	646	16	30695
	65 - 69	636	19	45814
	70 - 74	533	27	73444
	75 - 79	464	48	120915
	80 - 84	324	47	183712
1941 - 1945	10 - 14	1	0	1195
	15 - 19	2	0	2223
	20 - 24	6	0	3703
	25 - 29	16	0	3191
	30 - 34	34	1	3123
	35 - 39	81	1	3631
	40 - 44	191	3	5035
	45 - 49	384	5	7664
	50 - 54	597	10	11860
	55 - 59	883	15	18522
	60 - 64	1021	16	28227
	65 - 69	970	19	42833
	70 - 74	748	27	64278
	75 - 79	631	48	104395
	80 - 84	385	47	161959

Appendix IX (cont'd)

Calendar period	Age group (years)	Death rate (per 1 000 000 per year)		
		Lung cancer	Nasal cancer	All causes
1946 - 1950	10 - 14	1	0	691
	15 - 19	3	0	1197
	20 - 24	8	0	1597
	25 - 29	18	0	1805
	30 - 34	36	1	2027
	35 - 39	94	1	2588
	40 - 44	236	3	3882
	45 - 49	544	5	6703
	50 - 54	954	10	10719
	55 - 59	1350	15	17423
	60 - 64	1717	16	28020
	65 - 69	1763	19	41767
	70 - 74	1400	27	64563
	75 - 79	1085	48	101751
	80 - 84	765	47	157771
1951 - 1955	10 - 14	0	0	480
	15 - 19	2	0	860
	20 - 24	7	0	1237
	25 - 29	13	0	1266
	30 - 34	35	1	1510
	35 - 39	98	1	2107
	40 - 44	248	3	3249
	45 - 49	579	5	5710
	50 - 54	1224	10	10456
	55 - 59	2003	15	17428
	60 - 64	2555	16	28435
	65 - 69	2926	19	44500
	70 - 74	2624	27	68059
	75 - 79	2069	48	108090
	80 - 84	1416	47	166158
1956 - 1960	10 - 14	0	0	403
	15 - 19	2	0	877
	20 - 24	4	0	1120
	25 - 29	12	0	1062
	30 - 34	35	1	1264
	35 - 39	93	1	1895
	40 - 44	251	3	3049
	45 - 49	590	3	5260
	50 - 54	1248	6	9550
	55 - 59	2317	12	17270
	60 - 64	3315	17	27884
	65 - 69	3926	24	43487
	70 - 74	3878	28	67418
	75 - 79	3332	43	103261
	80 - 84	2258	50	161489

Appendix IX (cont'd)

Calendar period	Age group (years)	Death rate (per 1 000 000 per year)		
		Lung cancer	Nasal cancer	All causes
1961 - 1965	10 - 14	0	0	407
	15 - 19	2	0	951
	20 - 24	5	0	1103
	25 - 29	11	0	1008
	30 - 34	34	0	1218
	35 - 39	90	1	1855
	40 - 44	223	3	3048
	45 - 49	563	4	5333
	50 - 54	1221	8	9327
	55 - 59	2284	9	16533
	60 - 64	3663	14	28089
	65 - 69	4844	18	44194
	70 - 74	4977	26	67547
	75 - 79	4513	41	102346
	80 - 84	3417	42	157935
1966 - 1970	10 - 14	0	0	389
	15 - 19	2	0	961
	20 - 24	4	0	975
	25 - 29	10	0	929
	30 - 34	25	0	1121
	35 - 39	76	1	1693
	40 - 44	216	2	3030
	45 - 49	531	5	5307
	50 - 54	1160	7	9255
	55 - 59	2201	11	15878
	60 - 64	3695	16	26829
	65 - 69	5273	23	43953
	70 - 74	6210	29	67717
	75 - 79	5914	36	100781
	80 - 84	4563	31	143567
1971 - 1975	10 - 14	0	0	346
	15 - 19	1	0	876
	20 - 24	4	0	987
	25 - 29	10	1	887
	30 - 34	24	1	1073
	35 - 39	58	1	1583
	40 - 44	177	4	2851
	45 - 49	503	4	5293
	50 - 54	1070	8	9096
	55 - 59	2077	11	15292
	60 - 64	3546	16	25132
	65 - 69	5174	26	41432
	70 - 74	6820	29	66018
	75 - 79	7273	33	99794
	80 - 84	6089	38	147939

Appendix IX (cont'd)

Calendar period	Age group (years)	Death rate (per 1 000 000 per year)		
		Lung cancer	Nasal cancer	All causes
1976 - 1980	10 - 14	0	0	293
	15 - 19	1	0	869
	20 - 24	2	0	932
	25 - 29	7	1	883
	30 - 34	17	1	994
	35 - 39	56	1	1511
	40 - 44	139	2	2535
	45 - 49	403	3	4717
	50 - 54	1003	9	8699
	55 - 59	1896	9	14449
	60 - 64	3342	15	24144
	65 - 69	4985	17	38731
	70 - 74	6718	20	62218
	75 - 79	8068	38	97305
	80 - 84	7744	33	145137