CHAPTER 2

THE MAPPING OF CANCER

Cancer is a group of diseases which possess a common feature – the uncontrolled growth of the cells that make up the part of the body affected (Cairns, 1977). The cancers described in this atlas are defined by the 9th Revision of the International Classification of Diseases (WHO, 1977), hereafter referred to as ICD-9 (Table 2.1). The ICD-9 code numbers for the cancers arising in the various sites (organs) are used in the text, tables and maps.

Table 2.1: Cancer sites and codes in ICD-8, ICD-9 and ICD-10

Cancer Sites	ICD8 code	ICD9 code	ICD10 code
Oral cavity and pharynx (Oral)	140-149	140-149	C00-C14
Oesophagus	150	150	C15
Stomach	151	151	C16
Small intestine	152	152	C17
Colon, rectum and anus (Large bowel)	153-154	153-154, 159.0	C18-C21, C26.0
Liver (primary)	155, 197.8	155	C22
Gallbladder and bile ducts	156	156	C23-C24
Pancreas	157	157	C25
Larynx	161	161	C32
Trachea, bronchus and lung	162	162	C33-C34
Pleura (mesothelioma)	163	163	C38.1-C38.4, C45
Melanoma of the skin	172	172	C43
Non melanoma skin cancer	173	173	C44, C46
Breast (female)	174	174	C50
Cervix uteri	180	180	C53
Corpus uteri	182	182	C54-C55
All uterus	180-182	179-182	C53-C55, C58
Ovary	183	183	C56, C57.0-C57.4, C57.8
Prostate	185	185	C61
Testis	186	186	C62
Bladder	188	188	C67
Kidney (urinary tract)	189	189	C64-C66, C68
Brain and central nervous system	191-192	191-192	C70-C72
Thyroid	193	193	C73
Hodgkin's disease	201	201	C81
Non-Hodgkin's lymphoma	200, 202	200, 202	C82-C85, C96
Multiple myeloma	203	203	C90
Leukaemia	204-207	204-208	C91-C95 less C91.4 & C94.4/5
Other and ill-defined	195-199	195-199	C76-C80
All forms of cancer	140-207	140-208	C00-C97

Mortality

Mortality is the number of deaths from cases of cancer occurring in a given population in a particular time period, usually expressed as a rate per 100,000 population per annum.

Choice of area size

There are constraints on the choice of areal unit that are outside the control of the cancer mapper. The intention was to choose the smallest administrative unit for which population information was available by sex and age group, subject to it being sufficiently large that it could be expected to provide reliable cancer mortality rates over a period short enough for time trends to be unimportant.

The areas mapped in this atlas conform to at least level II of the European Commission (EC) statistical services, with finer subdivision where population numbers are great enough. Only 47 of the 1,278 areas have less than 100,000 person years of risk, the smallest value (around 30,000 person years) occurring in Hiiuma Island to the west of the mainland of Estonia.

Use of age-standardised rates

The crude rate gives the burden of cancer in terms of the number of deaths from cancer per hundred thousand population in each area or country. However, rates of malignant disease are generally higher in older people and so comparison of the crude rates between areas can be misleading if the age structures of the populations in areas differ. Taking median age as a simple indicator of differences in age-structure between regions, for males the overall median age was 35.0 years with a range across the small areas of 25.8 to 43.5; for females, the overall median was 38.2 years with range of 27.2 to 48.8. The maps of the median ages for males and females illustrate the wide variation which exists within Europe (Maps 2.1 and 2.2).

To overcome this problem, age-standardisation is undertaken. There are two widely used methods of standardisation – direct and indirect, each with its own advantages and disadvantages. The resultant statistic – an age-standardised mortality rate per 100,000 population per annum – is taken to represent the risk of dying from cancer in a particular area. In this atlas all rates, unless otherwise stated, are average annual rates per 100,000 population, directly age-standardised to the world standard population (SICE, 1964) as used, after adaptation, in successive volumes of Cancer Incidence in Five Continents (Doll et al., 1966). The methodology of age-standardisation has been explained in detail elsewhere (Boyle & Parkin, 1991). For brevity they are presented in the text as figures only, e.g. "mortality from stomach cancer in females in Belgium was 3.5" rather than "the average annual age-standardised mortality from stomach cancer in females in Belgium was 3.5 per 100,000".

There is a great temptation, when a series of maps is being produced for a single country, to standardise to its own population, as this results in standardised rates which are close to the current crude mortality rates. However, for the present atlas this would have implied calculation of an EU-EEA standard population based on EU-EEA membership at the time of data collection. However, the age structure varies among the constituent countries, the EU has increased in size and is likely to expand further, and the age-structure of its constituent population changes over time. So such a solution has considerable disadvantages, principally lack of comparability of the standardised rates over time. Hence the use of the single and unchanging world standard population in this atlas; its use also permits comparison with a wide variety of data published elsewhere. Further, it is possible to compare not only the rates for one site of cancer in each of the areas mapped but also to compare them directly with those for another form of cancer. As the world standard population has a younger age structure than that of the EU-EEA, the age-standardised rates are usually lower than the corresponding crude (non-standardised) rates.

Indirect standardisation, as the name implies, also takes population age-structure into account. Here, the age-specific rates for a particular cancer for the EU-EEA as a whole are applied to the population of each area mapped and the number of cancer deaths to be expected if that region had the same mortality as the EU-EEA as a whole is computed. This number is compared with the number actually observed and the ratio of observed to expected is presented as a percentage. The

EU-EEA value is taken to be 100. The advantage of this method is that it reduces distortions associated with small numbers of cancers in small populations. However, as the populations for the area covered in this atlas generally yield a minimum of 100,000 person-years, this advantage is less important. The disadvantages of indirect standardisation are that it is not strictly valid to compare rates for individual areas for a particular cancer site; and it is not possible to compare rates for different cancer sites (as the standardised rates are all based on an overall average of 100 for every site). Also, it is difficult to follow trends over time, particularly when EU-EEA membership changes.

Illustrating differences between areas

The maps indicate the level of age-standardised mortality in the 1,278 areas mapped. Colour has been used to distinguish between districts with high, medium and low mortality rates. In the main maps for each cancer, a relative scale using seven classes for each cancer was based on the percentiles of the distribution of rates in areas weighted by the population size in each region. The following cut-off points were used: 5% of the population with the lowest rates, the next 10%, the next 20%, the middle 30%, the next 20%, the next 10%, and ending with the 5% of the population with the highest rates. The cut-off points for the seven classes differ from one cancer to another. The classes are depicted by three shades of orange-red for the higher rates, yellow for the mid-range and three shades of green for the lower rates. The scale at the top right-hand corner of each map shows the range of mortality rates for that site.

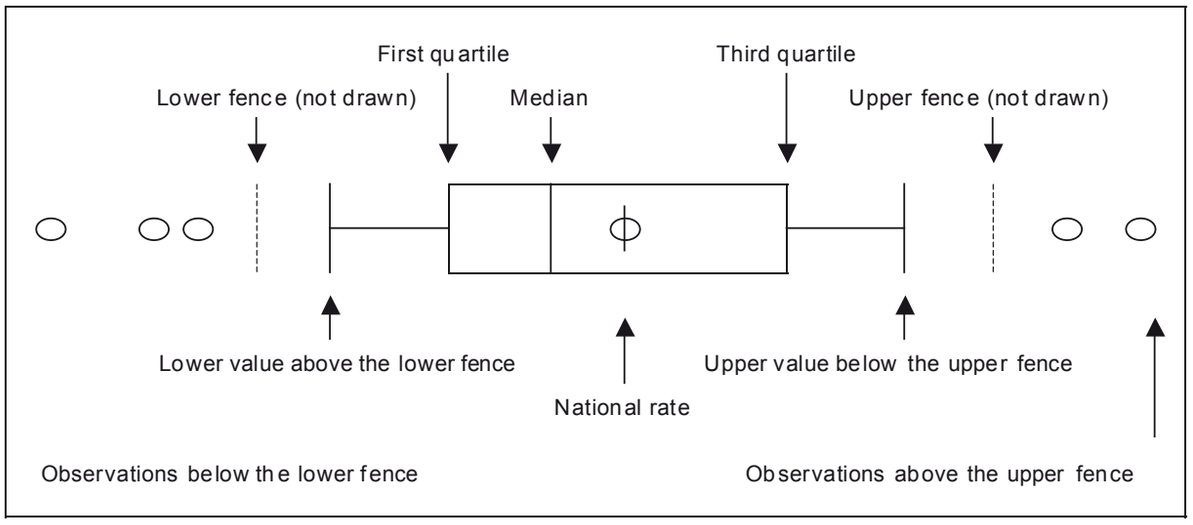
On all maps, the upper right hand figure presents box and whiskers plots for each country based on rates at the EU-EEA level II or III areas. The following statistics are represented: the national rate, median, first quartile and third quartile (Figure 2.1). Moreover, outliers are also shown that are outside the so-called fences (not drawn) which are defined as follows:

Inter-quartile range (IQR) = Third quartile – First quartile
Upper fence = Third quartile + 1.5 x IQR
Lower fence = First quartile – 1.5 x IQR

Finally, the two whiskers represent the lower value above the lower fence and the upper value below the upper fence.

It must be borne in mind that because the allocation of colour is relative to the median mortality rate for each cancer, all of the main maps contain roughly the same proportions of areas of each colour – whether the cancer has high or low average mortality, and whether the absolute range in variability is wide or narrow. The maps for the various cancers differ in appearance, principally of course because the high and low rates occur in different areas. But in addition the large, sparsely populated areas have greater visual impact than the smaller, less densely populated ones, so the proportions of high and low rates that are in these types of areas also affects the appearance of the maps.

Figure 2.1: Schematic representation of box and whiskers plots and location of fences



The smaller maps presented in the lower right of each chart also illustrate the variability in mortality rates, but using the *same* (21 point) colour scale for every cancer site. In this set of maps, those for cancers with generally low mortality rates are predominantly pale (yellow) and those for cancers with generally high rates are darker (red and brown). These maps enable rapid visual comparisons to be made between rates for males and females for the same cancer, and between different cancers. They also give an indication of the absolute range in the variability of mortality from each cancer: if the range in values is narrow, the map will be mostly one colour, but if the range is wide the map will be multi-coloured.

Patterns of cancer distribution

As will become evident in the descriptions of the cancer patterns in Chapter 6, emphasis has been placed on painting a broad canvas rather than picking out isolated areas of high mortality. However, while there is frequently a tendency to dismiss an isolated area of high mortality as being due to statistical chance, each such area should be examined critically to see whether any reasons for a high mortality are likely to exist. If a pattern for isolated areas becomes evident, then such close enquiry becomes all the more essential. For example, many years ago, the concentration of deaths from mesothelioma in towns with shipbuilding industries was eventually related to the industrial use of asbestos.

It is also instructive to look at the spatial distribution of cancer of the liver (ICD-8 155) in males in the 40 areas of the Netherlands depicted in the cancer atlas for that country (Netherlands Central Bureau of Statistics, 1980). This shows one area with a standardised mortality ratio which is significantly above the national average at the 5% probability level and a further area significantly above the national average at the 10% level. Similarly, there are two areas which were significantly lower at the 10% and 5% levels. Such a finding is exactly what one would expect from the laws of statistical probability and this phenomenon must constantly be borne in mind. In this atlas 1,278 areas are compared in each map: by chance alone around 60 areas in each map could be expected to have mortality rates significantly greater than the EU-EEA average for that cancer and a similar number to have rates significantly lower than the average at the 5% level of statistical significance.

The presence of a group of areas with higher or lower than average cancer mortality which are contiguous or close together is always of interest as this suggests the presence or absence of risk factors common to these areas. For further discussion, see Kemp et al. (1985).

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