6. THE REFERENCE POPULATIONS

6.1 Introduction

An ideal basis for a comparison would be a group of individuals who are identical to the Rönnskär population in all respects, except for the industrial environment. However, the choice of a comparison group is usually restricted to a population for which reference data are available.

As a first broad background for our comparisons, we will use statistics covering the entire country. This can provide important indicators since official statistics permit far-reaching subdivisions of information. The second step will be to make comparisons with local populations in the geographical neighbourhood, such as the county of Västerbotten or the municipality of Skellefteå, accounting for approximately 30% of the county population. However, should we find no differences between the Rönnskär population and another geographically well-defined population, this does not necessarily mean that the industrial environment is non-hazardous. Due to 'the healthy worker effect', an industrial cohort should be expected to have a lower mortality than a population containing, inter alia, individuals who are unemployed due to ill health.

6.2 The entire country

In Fig. 6.1 the mortality development in Sweden is described by means of death rates (full lines), ie number of annual deaths per 1 000 persons in the respective age groups. The pattern is clear: for each age group, there has been a decrease up to the mid 1950s, after which the mortality has been relatively unchanged. The 'crude death rate' (dotted line), ie the number of deaths per 1 000 persons in the total population, shows another pattern: after decreasing up to 1955, there has been a gradual increase so that the value of 1976–80 is about the same as that for 1926–30. This trend is of course due to a changing population structure, shifting towards higher age groups where the mortality rates are higher. This unweighted measure of mortality is thus influenced not only by the change in the separate death rates, but also by the age distribution of the whole population.

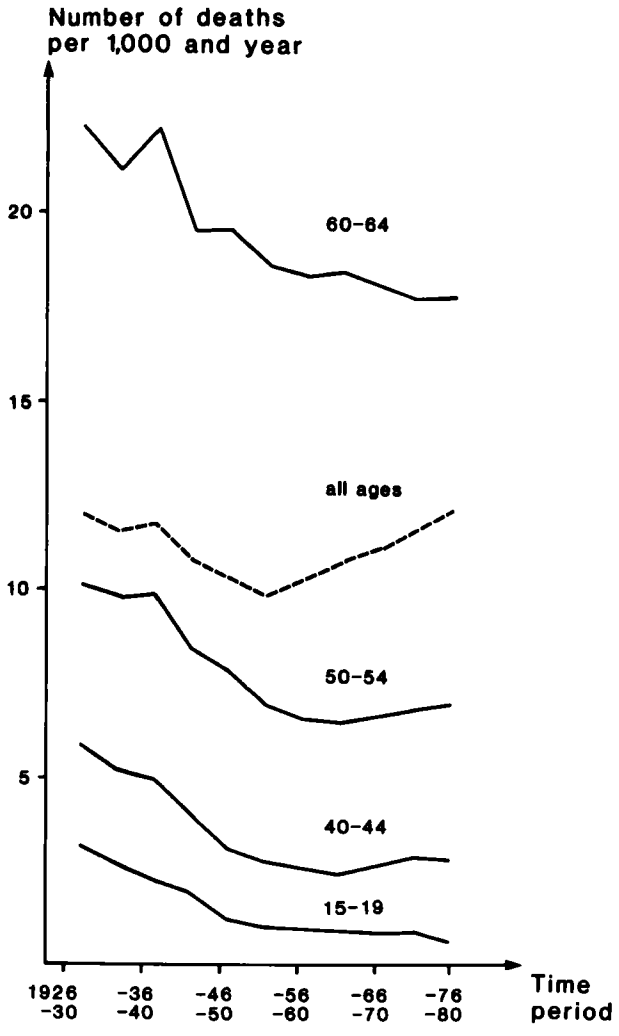

Fig. 6.1. The development among Swedish men of the crude (– – –) and the age-specific (——) mortality rates from 1926 to 1980.

Table 6.1

Age-specific mortality rates per 1 000 and year

Age (years)	1926–1930	1976–1980	Stand. pop. 1951–1955
15–19	3.14	0.76	8.1%
20–24	4.39	1.08	8.3%
25–29	4.35	1.20	8.4%
30–34	4.40	1.35	10.4%
35–39	4.77	1.87	10.1%
40–44	5.85	2.84	10.3%
45–49	7.70	4.37	9.5%
50–54	10.12	6.99	8.4%
55–59	14.58	11.04	7.3%
60–64	22.21	17.79	6.0%
65–69	34.00	29.03	5.0%
70–74	54.09	47.97	3.8%
75–79	89.24	78.24	2.5%
80–	184.37	158.65	1.9%

If we want to make comparisons between, for example the mortality during 1926–30 and the mortality during 1976–80 by means of some summary measure, the death rates of various age groups must be weighted so that the same set of weights is used for the two different time periods. In epidemiology, this is called direct standardization.

Suppose one decided to apply the system of weights given in Table 6.1, reflecting the age distribution 1951–55 of Swedish males from 15 years of age. The weighted death rates are:

$$\bar{d}_{1926\ 30} = (0.081 \cdot 3.14 + 0.083 \cdot 4.39 + \cdots + 0.019 \cdot 184.37) = 15.99$$

$$\bar{d}_{1976-80} = (0.081 \cdot 0.76 + 0.083 \cdot 1.08 + \cdots + 0.019 \cdot 158.65) = 11.99$$

It is then natural to apply 'the Standardized Rate Ratio'

$$SRR = (\bar{d}_{1976-80}/\bar{d}_{1926-30}) \cdot 100 = 75\%$$

which here expresses the mortality for 1976–80 as 75% of that for the earlier period. An SRR value of 100% thus means that there has been no change in mortality.

From 1951 the mortality data for the whole country are available according to the various causes of death. Fig. 6.2 illustrates the main characteristics of the development during the last three decades. Within each category (of causes of death) the incidence figures for the various age groups have been weighed (standardized) together with weights for the male mean population 1951–55. Two important tendencies can be seen quite clearly: the mortality from circulatory diseases has increased and the mortality from other causes has decreased.

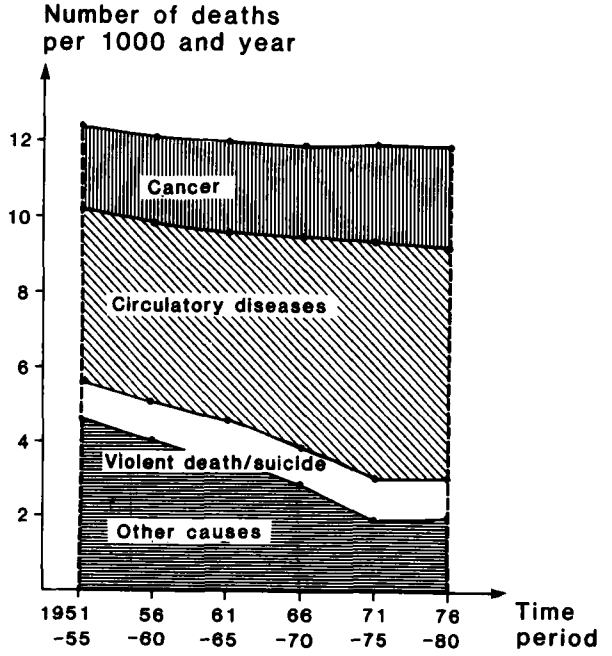

Fig. 6.2. Directly standardized mortality rates among Swedish men 1951–1980 for four main categories of death causes. (The Swedish male population 1951–1955 forms the standard).

In order to obtain a clearer picture of the trends involved in the mortality development, it is possible to calculate yearly SRR values for each of the main categories. It is also possible to obtain more detailed subdivisions with regard to death causes within the main categories. Fig. 6.3 shows the same pattern as Fig. 6.2 but, in addition, an increasing trend in violent death and cancer diseases. Among the cancer diseases, lung cancer shows a particularly dramatic increase.

It seems natural to ask whether the increase in mortality is found in specific age categories. As can be seen from

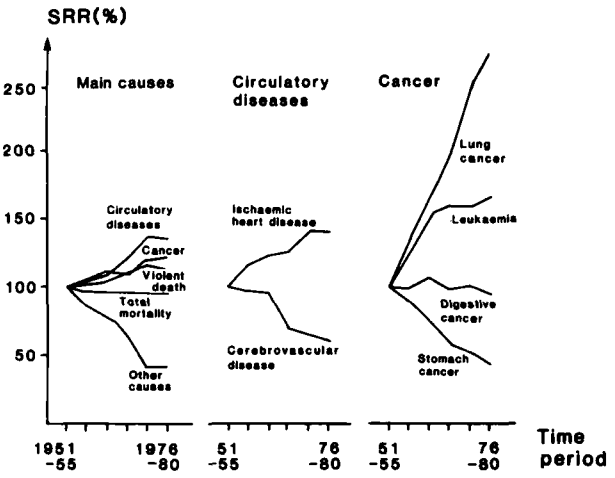

Fig. 6.3. Mortality trends among Swedish men 1951–1980 for some main causes of death, expressed as directly standardized mortality rate ratios. (The male population 1951–55 forms the standard).

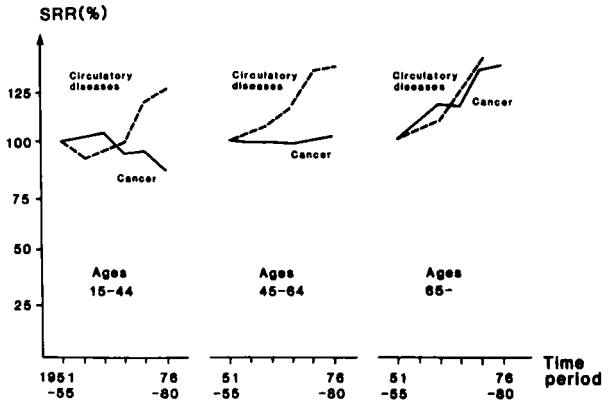

Fig. 6.4. Mortality trends in cancer and circulatory diseases among Swedish men 1951–80 for different age groups. Directly standardized mortality rate ratios. (The male population 1951–1955 forms the standard.)

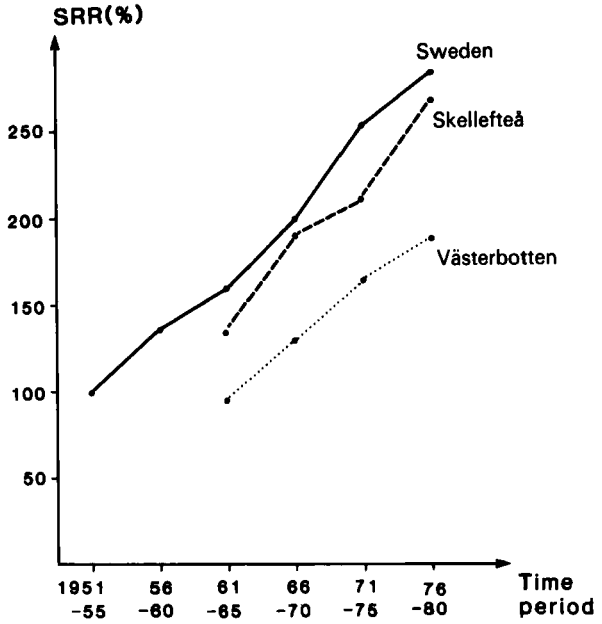

Fig. 6.5. The development of lung cancer mortality among men in Sweden, the county of Västerbotten and the Skellefteå municipality 1951–1980. (Directly standardized mortality rate ratios, SRR, using the Swedish male population 1951–1955 as standard.)

Fig. 6.4, the mortality increase from circulatory diseases is evident in all age groups. The increase in cancer mortality is, however, concentrated to ages over 65 years. This might be connected with latency: The results of environmental hazards and, for example smoking occur some decades after the first exposure.

6.3 Local populations

The mortality in Västerbotten, with about 236 400 inhabitants, during the time period 1951–80 was 1.6% higher than the national level and the corresponding figure for Skellefteå municipality was as high as 5.4%. Especially, demonstrated in Figs. 6.2 and 6.3, mortality from ciculatory diseases had increased considerably during the study

Table 6.2

The mortality pattern 1951–80 among men in the county of Västerbotten and in Skellefteå municipality compared with the total Swedish male population. Directly standardized mortality rate ratios. (— indicates too few cases)

Cause of death	Standardized mortality rate ratio (SRR)		
	Sweden	Västerbotten	Skellefteå
All causes	100	102	105
Cancer	100	93	96
Circulatory diseases	100	111	113
Violent death/suicide	100	90	79
Other causes	100	100	111
Cancer			
Digestive organs	100	102	101
Respiratory system	100	66	92
Genito-urinary organs	100	111	—
Brain and nervous system	100	68	—
Lung	100	66	91
Stomach	100	136	132
Blood, bone marrow and lymphatic system	100	101	122
Circulatory diseases			
Ischaemic heart disease	100	105	107
Cerebrovascular disease	100	123	137
Respiratory diseases	100	98	98
Diseases in digestive organs	100	75	86
Genito-urinary diseases	100	122	—

period. As is obvious from Table 6.2, this local excess mortality is mainly due to cerebrovascular diseases. The total cancer mortality in Västerbotten is appreciably lower than the national level. On the other hand, there is a certain excess mortality from stomach cancer in the local populations. The data available from Skellefte municipality do not permit very detailed divisions into cause-of-death sub categories.

Since the data concerning the Rönnskär cohort describes a mortality pattern during several decades, it is of interest whether there have been any obvious changes in the mortality of the reference populations during the same time. Such a change is evident in the case of lung cancer mortality which, according to Fig. 6.5, has increased considerably in all three populations. For Skellefteå municipality, where the Rönnskär smelter is situated, the mortality rate is almost as great as that for the whole country.

During 1961–76 there were 170 male lung cancer deaths in Skellefteå, with its about 70 000 inhabitants, compared to 62 in the Rönnskär cohort. When compared to the country as a whole, it is not improbable that the high lung cancer mortality rate in Skellefteå is due to the higher lung cancer death rate among the Rönnskär workers. If this is the case, it would illustrate how the mortality pattern of a small local population can be influenced by a single potentially hazardous industry.

A time-trend with regard to specific death causes can be interpreted in various ways. Doubtlessly the diagnostic accuracy, for example, could have a great influence, but this is impossible to measure on the basis of official statistics alone. The autopsy rate, however, is an interesting indicator. Since 1951, a notation has been made on the Swedish death certificates, whether an autopsy was performed or not. The autopsy rate for the whole country during the fifties up to the end of the sixties increased from approximately 20% to about 40%. It has also been shown (Rosén et al, 1983) that in each of the main disease categories the autopsy rate was higher in the local populations considered here than in the country as a whole.