7. MORTALITY IN RÖNNSKÄR AND IN THE GENERAL AND LOCAL POPULATIONS

7.1 Introduction

Some kind of standardization must be applied when comparing the mortality of the Rönnskär population with that of the whole country, since the Rönnskär population has quite a specific age distribution. The first weighting procedure, already presented, is to utilize the age distribution of the whole country as a standard population. This has been done when weighting the age-specific death rates of the Rönnskär workers, as displayed in Fig. 7.1. It shows that the overall mortality in Rönnskär decreased between 1926 and 1950, as it did in the country as a whole (cf Fig. 6.2). The death rates for the Rönnskär workers for the last two decades have, however, increased—contrary to the trend elsewhere in the country. This upward trend appears to be connected with cancer, which might reflect the hazardous environment in combination with long latency times. For lung cancer, an even more dramatic trend is displayed in Fig. 7.2. The lung cancer mortality rate of the Rönnskär workers has increased more rapidly than in the reference populations. This illustrates, among other things, the importance of updating the actual cohort in order to follow future developments.

The other weighing approach is to utilize, for example, the death rates of the whole country, in the calculation of how many deaths could be expected in the Rönnskär population if its mortality pattern had been the same as the general population. By forming the ratio between the actually observed and the expected number of deaths (calculated by applying death rates for the whole country to the age distribution of the Rönnskär population), we get the so-called Standardized Mortality Ratio (SMR). As with the SRR values, the SMR values are usually expressed as percentages, which means that if SMR = 100, there is no difference in mortality between the population under study and the reference population.

7.2 Total mortality

By means of SMR calculations it is possible to make comparisons where age distribution and calendar time are both taken into consideration. Table 7.1 is concerned with the age class 60–64 years. Column (3) gives the distribution of the person-years with regard to calendar time and column (4) the number of deaths. Columns (5) and (6) enable a direct comparison between the death rates in Rönnskär and the whole country. A summary value can then be calculated [column (7)], where the expected number of deaths in Rönnskär is shown for each calendar period, assuming the same death rates as for the whole country. This gives 130.69 as the expected number of deaths. Since the observed number of deaths was 166, the SMR = (166/130.69) · 100 = 127.

The mortality in each age group can then be analysed as in Table 7.1 and the results for the whole Rönnskär population are presented in Table 7.2, which, in column (6), also contains confidence limits (95%) for the SMR value based on normal approximation of the Poisson distribution. Compared to the country as a whole the excess mortality for the whole Rönnskär population is 11%, but there is considerable variability between different age groups. The significantly lower mortality in the younger age groups seems to reflect the 'healthy worker effect', ie the consequence of the fact that the workers who were employed during the thirties and forties were not only young but also healthier than the general population.

Naturally, the results in Table 7.2 are heavily dependent upon which death rates have been used when calculating the expected number of deaths. If, for example, only reference data from 1951–76 had been utilized, the higher mortality during the thirties and forties would not have been taken into account. The resultant SMR values, given in Table 7.2, would then have been 93, 112, 116, 129 and 114, with an SMR = 116 for the total Rönnskär population. Of course, this is an underestimation of the healthy

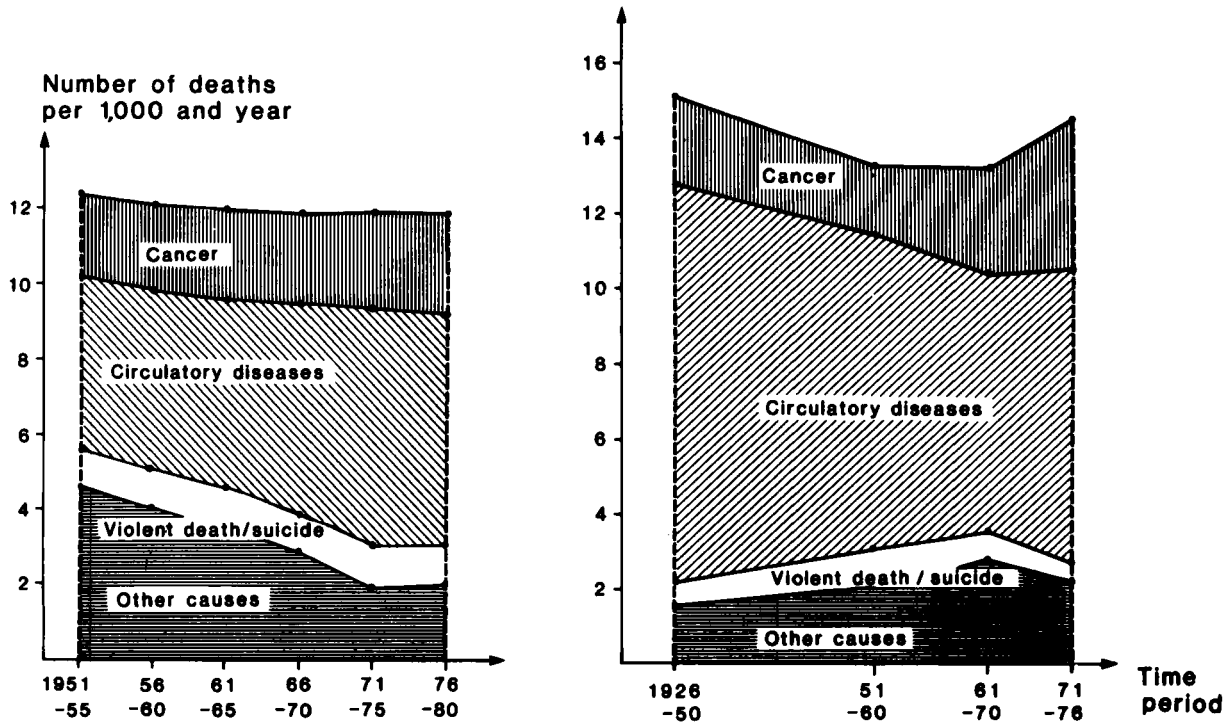

Fig. 7.1. Mortality pattern among Swedish men 1951–1980 and in the Rönnskär cohort during 1926–1976. (Ages over 15 years. Direct standardization with Swedish men 1951–1955 as standard population.)

worker effect. Nevertheless, the 1951–76 reference data has been used in all further calculations in this chapter. The reason for this is that, before 1951 official statistical publications lack detailed mortality data for each separate death cause.

All the calculations so far have been done on the basis of 5-year intervals. If, instead, the analysis in Table 7.2 is made on the basis of one-year intervals, the results are practically the same.

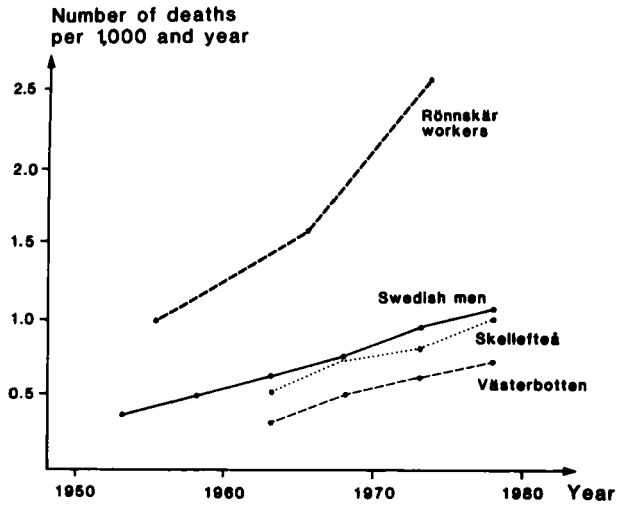

Fig. 7.2. Lung cancer mortality in the Rönnskär cohort compared with the three reference populations. (Ages over 45 years. Direct standardization with Swedish men 1951–1955 as standard population.)

7.3 The mortality pattern

Analogous with the previous analysis, SMR values have been calculated for the main separate death causes. The expected numbers of deaths have been calculated both on the basis of statistics for the whole country and for the county of Västerbotten. Since the mortality pattern in Skellefteå municipality is similar to that of Västerbotten, data concerning Skellefteå have only been used in exceptional cases.

Figure 7.3 displays a summary of the external comparisons made by means of SMR values for men over 15 years of age. The excess mortality among Rönnskär workers is found to be due to cancer and circulatory diseases. On the whole we obtain the same pattern irrespective of whether the county or the whole country is used as a standard. The excess mortality for cancer is somewhat more pronounced than for circulatory diseases. The excess cancer mortality is dominated by the 79 cancers in the respiratory organs, 76 of which were classified as lung cancer (see also Table 2.2).

The SMR values are more influenced by the choice of reference population if a more detailed sub-division of death causes is applied. If, for example, the expected number of lung cancer cases is calculated on the basis of the whole country, we obtain 28.9 and SMR = (76/28.9) · 100 = 263. Using death rates from the county of

Table 7.1

Illustration of the method for indirect standardization (SMR) with regard to calendar time

(1) Age (years)	(2) Calendar period	(3) Number of person years	(4) Observed number of deaths	(5) Number of deaths per 1000 person-years	(6)	(7) Expected number of deaths	(8) SMR (%)
				Rönnskär	Sweden		
	1926-30	0	0	0	22.21	0	
	31-35	7	0	0	21.09	0.15	
	36-40	57	0	0	22.15	1.26	
	41-45	137	3	21.90	19.40	2.66	
	46-50	230	12	52.17	19.49	4.48	
60-64	51-55	386	11	28.50	18.53	7.15	
	56-60	650	14	21.54	18.27	11.88	
	61-65	1 278	23	18.00	18.37	23.48	
	66-70	1 872	44	23.50	18.03	33.75	
	71-75	2 173	48	22.09	17.75	38.57	
	76-	411	11	26.76	17.79	7.31	
	1926-	7 202	166	23.05	18.15	130.69	127

Table 7.2

Standardized mortality ratios (SMR) for the entire Rönnskär cohort of 3 915 workers, using Swedish men as the standard population. (Total mortality)

(1) Age (years)	(2) Number of person-years	(3) Observed number of deaths	(4) Expected number of deaths	(5) SMR	(6) 95% C.L.
15-19	1 384	1	1.8		
20-24	5 922	9	11.1		
25-29	10 874	6	20.2	74	(60;88)
30-34	13 876	27	27.4		
35-39	15 342	27	35.3		
40-44	15 467	35	46.1		
45-49	14 123	56	62.5		
50-54	12 331	103	84.8	108	(91;125)
55-59	9 972	112	110.1		
60-64	7 202	166	130.7	115	(102;129)
65-69	4 279	162	127.6		
70-74	2 025	129	98.9	128	(114;143)
75-79	732	75	58.5		
80-	287	45	46.5	114	(94;135)
Total	113 816	953	861.5	111	(104;118)

Västerbotten, the expected number of lung cancer deaths is 19.1 and consequently SMR = 398. The number of stomach cancer cases in the Rönnskär population was 48. When using the whole country as a standard SMR = 171, but with death rates from Västerbotten SMR = 110.

We notice from Fig. 7.3 that there appears to be an excess mortality from brain tumours and cancer of the nervous system. This SMR value is, however, based upon only 20 cases. The leukemia cases were also quite few (see Table 2.2).

It is also possible to analyse the mortality for special sub-cohorts by means of the same method, e.g. for employees who have at any time worked at the roasters. The excess mortality in lung cancer for this group is reflected by SMR = 441 in comparison to the whole country, and SMR = 682 when the county of Västerbotten is used as a standard.

7.4 Survival

The total excess mortality in Rönnskär, as measured by the SMR value, was 11% (Table 7.2). What does this value mean, expressed in terms of life expectancy?

In Table 5.3, columns (5), (6) and (7), the survival of the Rönnskär cohort was estimated. The same calculation

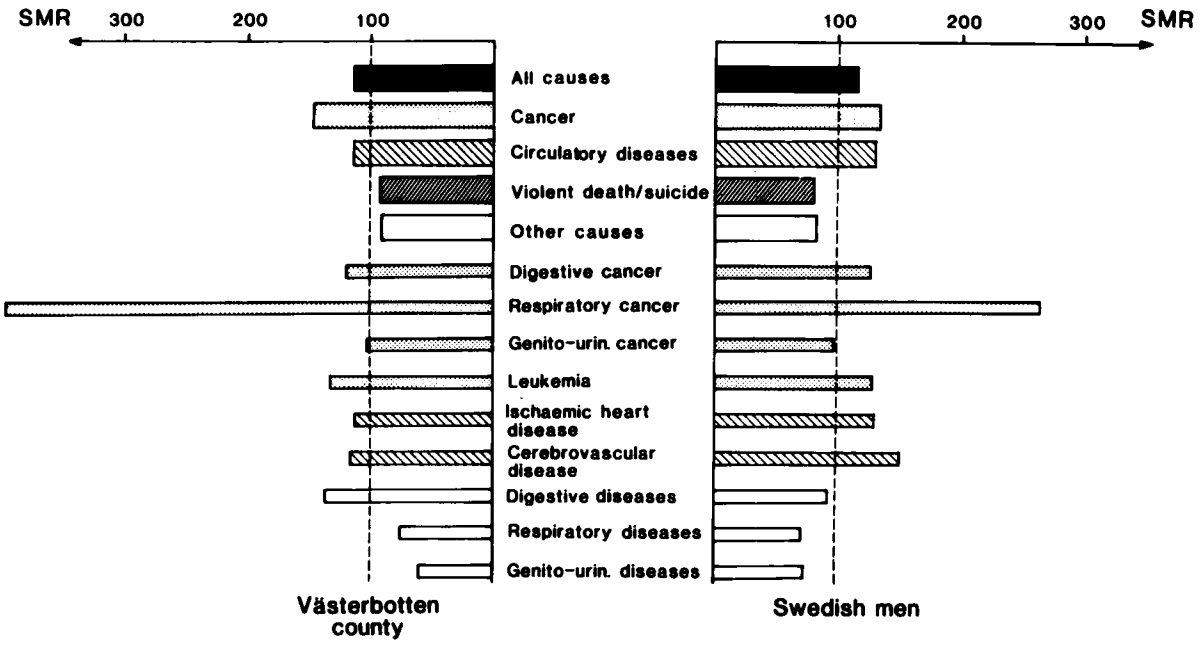

Fig. 7.3. Mortality pattern among Rönnskär workers in relation to men in the county of Västerbotten and in the whole country.

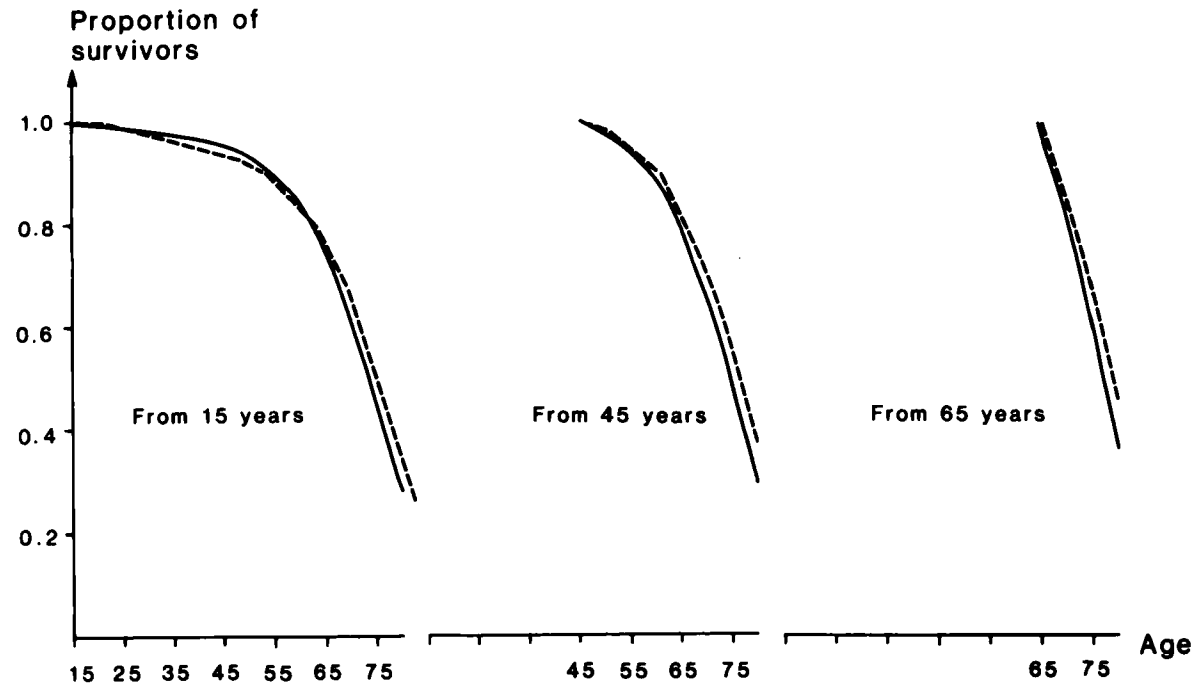

Fig. 7.4. Survival among Rönnskär workers and Swedish males estimated on the basis of observed death rates 1926–1980 and taking into account the distribution with regard to age and calendar time in the Rönnskär cohort. —— Rönnskär; - - - Swedish men.

could be made utilizing death rates for the whole country, but using weightings from the person-year distribution for the Rönnskär cohort, both with regards to age and calendar time. The results are displayed in Fig. 7.4. The first graph shows that the survival curves intersect. During the first age decades the survival among Rönnskär workers is higher than among males in the whole country. This is probably due to 'the healthy worker effect'. The survival curves are obviously lower after 45 years of age for the Rönnskär cohort than for the country as a whole.

The difference between a Rönnskär worker and males in the country as a whole, expressed in terms of life expec-

Table 7.3

Expected and probable remaining life time among Rönnskär workers and Swedish men. The national figures have been weighted, based on the distribution of age and calendar time in the Rönnskär cohort

Population		Expected remaining life-time from			Probable remaining life-time from		
		15-	45-	65-	15-	45-	65-
Rönnskär		56.8	28.6	12.7	58.7	29.4	12.1
Sweden		57.5	30.1	14.0	60.5	31.4	13.9
Swedish men	1926-30	52.8	28.0	13.1	57.3	29.6	13.0
	31-35	53.8	28.3	13.2	58.0	29.8	13.0
	36-40	54.1	28.1	13.0	58.0	29.6	12.8
	41-45	55.7	29.3	13.7	59.5	30.8	13.6
	46-50	56.8	29.3	13.5	59.9	30.8	13.5
	51-55	57.8	29.9	13.8	60.6	31.3	13.8
	56-60	58.2	30.1	13.9	60.8	31.4	13.8
	61-65	58.3	30.1	13.9	60.8	31.4	13.8
	66-70	58.3	30.2	14.0	60.8	31.4	13.8
	71-75	58.3	30.2	14.0	60.8	31.4	13.8
	76-80	58.3	30.2	14.1	60.8	31.4	13.9

tancy or probable remaining life time, is of the magnitude of one to two years—despite 'the healthy worker effect'. The impact of this can also be seen in a historical perspective. It becomes evident from Table 7.3 that the survival of the Rönnskär cohort corresponds approximately to the survival of the whole country's population during the thirties and the beginning of the forties.

The above survival calculations are based upon the entire Rönnskär cohort. If it were possible to demonstrate further differences between various exposure categories within the cohort, it would then mean that certain groups have lost even more years on average.

It should be pointed out that life tables for the entire Swedish population are usually based upon death rates observed during a short time period, say a year, for all ages. They therefore reflect a fictitious survival pattern, since no real cohort of individuals all born in the same year has experienced this pattern over all ages. Thus, the presented analysis in fact answers the hypothetical question: If a male, x years old, is exposed to the death rates of a Rönnskär worker—how long can he be expected to survive?

7.5 Conclusions thus far

By means of standardized comparisons, the mortality pattern for the Rönnskär cohort has been compared with that of males in the whole country, in the county of Västerbotten and in Skellefteå municipality. Both direct standardization and indirect standardization have been applied.

The Rönnskär workers have an excess mortality, taking all death causes together, both in comparison with the whole country and with the county of Västerbotten. Large deviations from the reference populations are found concerning cancer diseases, especially lung cancer. During the period under study, the lung cancer risk has increased continuously. The roaster workers show a dramatic excess mortality from lung cancer in comparison with males in the country as a whole.

The higher mortality rates of the Rönnskär workers imply a shorter life expectancy. In terms of life expectancy, the difference between the total Rönnskär cohort and males in the whole country is of the magnitude of one to two years.