6

Outlook: The Impact of Reducing Cold-Related Mortality

6.1 Introduction

While the previous two chapters dealt with factors which influence the extent of seasonal mortality fluctuations, this small chapter wants to answer the question: If we are able to eliminate or at least diminish the seasonal fluctuations in mortality, what is the public health benefit? We answer this question by investigating how much life expectancy would increase if people did not have to face the adverse environmental conditions during winter, but were actually exposed to summer conditions for their whole life. Thus, we compare "real" mortality conditions and the corresponding remaining life expectancy with "summer" mortality conditions.

6.2 Data, Methods, and Results

Our aim is to calculate a seasonal life-table. To obtain it, we extend the standard construction of the life-table. Two data sets are usually required — the number of people alive in a certain age and the number of people who have died at that age. Our approach is similar, but we use more information for a given calendar year.

- The number of people alive in a certain month at a certain (integer) age.
- The number of people who died during a certain month at a certain (integer) age.

  These data are provided in two data-sources.

- Monthly death counts by age were obtained from the Multiple Cause of Death Public Use Files as described in Chapter 4. The year 1998, the last year which was analyzed in the chapter on US death counts, was chosen for the current analysis.

- Monthly population counts for the year 1998 by sex were obtained from the US Bureau of the Census [373].

One additional item of information is needed, usually denoted as $a(x)$ in life-table notation: the mean number of person-years (or in our application: person-months) lived in the interval by those dying in the interval. We assumed that people die on average in the middle of each month, thus assigning the value 0.5 to all ages. In our analysis, we restricted ourselves to a range from 50 to 100 years of age.

Using this information we were able to calculate all life-table functions. To ascertain that our approach worked, we compared remaining life expectancy at age 50 from our calculations with life-table calculations from the Human Life Table Database (HLD) [167]. The HLD calculations resulted in values of e_{50} of 31.63 years for women and 27.29 years for men. We considered our approach satisfactory, as these "official" results correspond closely to our estimations for age 50 in April for women (our result: 31.629 years) and for age 50 between June and July for men (June: 27.339, July: 27.269).

We estimated "summer" mortality by fitting a straight line to the natural logarithm of the yearly minimum probabilities of dying (q_x-values). This approach is shown in Figure 6.1. The solid lines represent the observed, real, age-specific probabilities of dying on a log-scale in light gray for women and in dark gray for men. The dotted lines show our fitted values from linear regression. The legend in the lower right corner of the figure shows that this linear approach fitted our data remarkably well. We obtained adjusted values for r^2 of 0.997 for women and 0.999 for men.

Table 6.1 shows the results from the comparison of real mortality with summer mortality. For that purpose we calculated remaining life expectancy in both ways for every five years starting from age 50 until age 95 for women as well as for men. We can see that remaining life expectancy at age 50 could be increased by 0.83 years for women and by 1.08 years for men if summer mortality conditions prevailed for the rest of their lives rather than the observed mortality conditions. The absolute gain in years decreases at more advanced ages. The proportional benefit, however, increases. At age 90, remaining life expectancy of women as well as of men could be increased by 13% (women: 12.95%; men: 13.43%).

6.3 Discussion

Our analysis has shown that the differences between the observable remaining life expectancy at age 50 is increased by 0.83 years for women and 1.08 years for men. It should be pointed out that these gains at a particular age do not apply only to the "rescued" people, but to *all* women and *all* men. Although such an increase in life expectancy seems to be only moderate, an economic

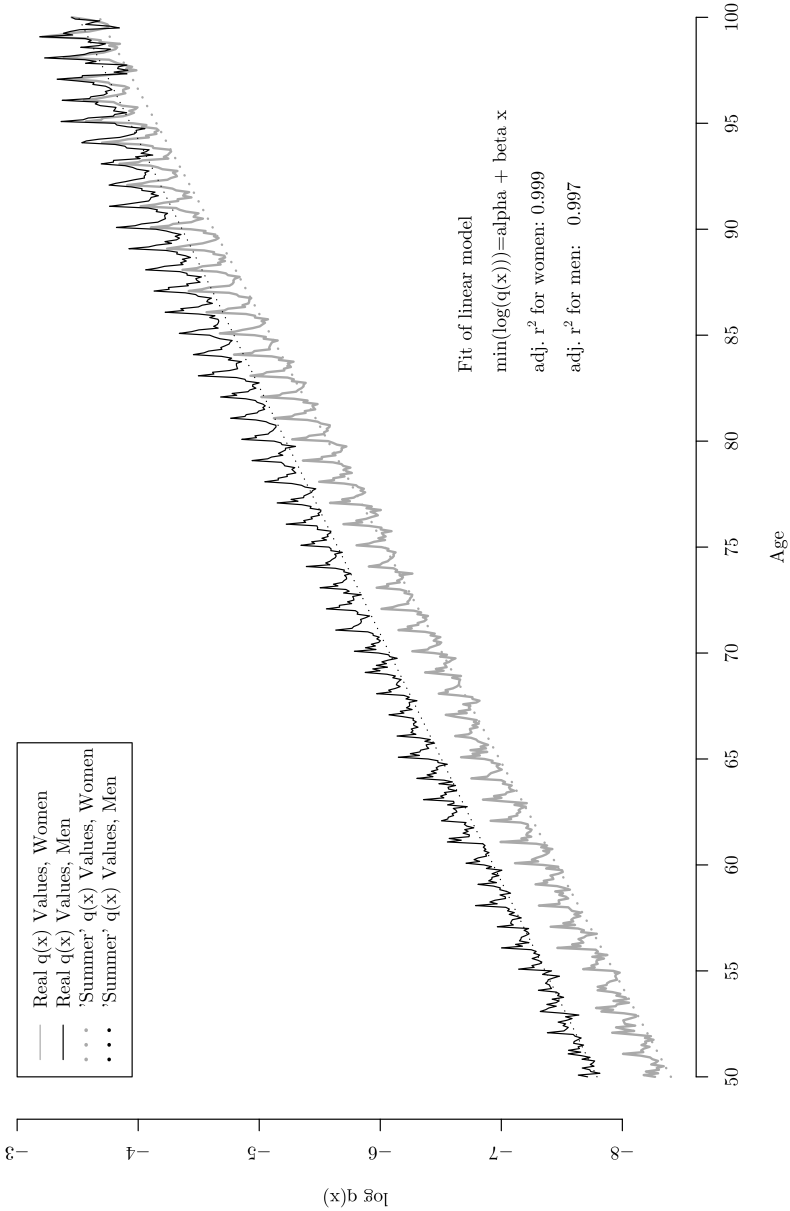

Fig. 6.1. Real and "Summer" Probabilities of Dying and Fit of the Linear Model

Table 6.1. Gains in Life Expectancy from Reducing Annual Cold-Related Mortality

	Women				Men			
Age x	e_x^{real}	e_x^{Summer}	Gains in e_x	$\frac{Gain}{e_x^{real}}\%$	e_x^{real}	e_x^{Summer}	Gains in e_x	$\frac{Gain}{e_x^{real}}\%$
50.00	31.85	32.68	0.83	2.59	27.70	28.77	1.08	3.90
55.00	27.42	28.20	0.78	2.86	23.51	24.59	1.08	4.60
60.00	23.19	23.91	0.72	3.13	19.59	20.66	1.07	5.45
65.00	19.22	19.87	0.65	3.38	16.01	17.02	1.01	6.33
70.00	15.52	16.13	0.61	3.90	12.77	13.72	0.95	7.46
75.00	12.16	12.75	0.59	4.82	9.93	10.80	0.87	8.76
80.00	9.12	9.78	0.66	7.22	7.44	8.28	0.84	11.31
85.00	6.53	7.22	0.69	10.53	5.42	6.16	0.74	13.66
90.00	4.47	5.05	0.58	12.95	3.87	4.39	0.52	13.43
95.00	2.73	3.06	0.33	12.00	2.54	2.77	0.23	8.98

perspective could emphasize the relevance of this additional life year won. Recent studies conducted at the University of Chicago and at Yale estimated the impact of health and life expectancy improvements on national wealth [261, 274]. Murphy and Topel estimate "that improvements in life expectancy alone added approximately $ 2.8 trillion *per year* (in constant 1992 dollars) to national wealth between 1970 and 1990" [261, p. 2–3]. During those two decades remaining life expectancy at age 50 rose a bit more than five years for women as well as for men. The potential gain from reducing cold-related mortality is, in comparison, relatively small (0.8 years for women and about 1 year for men). Nevertheless, national wealth could benefit from such a reduction in considerable sums as well.

It should be stressed, however, that these gains outlined in Table 6.1 present a *theoretical maximum* for several reasons. For example:

- Period life-tables do not describe the mortality experience of a real cohort but of a synthetic cohort. This applies even more to the case of a seasonal lifetable. The results are only correct if the current rates would prevail.[1]
- If a life has been saved in winter, it does not imply that the "rescued" person has the same probabilities of dying for her/his remaining life as the rest of the cohort. Typically, people who would have died without the saving are frailer and, thus, more susceptible to death than their peers [385, 387]. "More generally, individuals of the same age may differ from differ from each other in their 'frailty' or relative risk of death" [377, p. 154].

[1] Life expectancy at current *rates* is different from life expectancy at current *conditions* as shown by Vaupel [380].