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Compression or expansion of morbidity? Trends in healthy-life expectancy in the elderly Austrian population between 1978 and 1998

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Abstract

The aim of our study is to test the theories of compression or expansion of morbidity on the basis of data on the elderly population of Austria. Our data come from four microcensus surveys for the years 1978, 1983, 1991, and 1998. We use self-perceived health ratings to calculate healthy-life expectancy for the elderly population aged 60–89. Because our data are based on four cross-sectional surveys, we devote the first part of the paper to the consequences of possible sampling and non-sampling errors in our analysis of time trends. We come to the conclusion that, although the absolute number of years lived in good health may be overestimated, the time trend in healthy-life expectancy over the 20 years most probably is unbiased. The second part of the paper describes trends in healthy-life expectancy for the Austrian population. Our results suggest that both healthy-life expectancy and the ratio of healthy years to life expectancy increased between 1978 and 1998. Thus, in Austria ill health seems to be more and more compressed into the later years of life. Contrary to Fries's hypothesis, however, life expectancy does not seem to be approaching a maximum average life span in Austria, as mortality rates at older ages have been continuously decreasing over the last 20 years.

Keywords: Health expectancy; Mortality; Morbidity; Health status; Austria

Introduction

As in most economically advanced countries, life expectancy in Austria has increased steadily over the last several decades. Compared with the early 1970s, life expectancy at birth has been extended by 8.1 years for men and 7.5 years for women. It reached 74.6 years for men and 80.9 years for women in 1998. Because of the already low levels of mortality for children and younger adults these gains in life expectancy are primarily the result of reductions in the mortality of the elderly. Between 1980 and 1998 the standardized mortality rate was reduced by 30% for men and 33% for women aged 60 years or older. There is no evidence that this trend will stop or be reversed in the future. Together with the ageing of populations in absolute and relative terms this is considered to be one of the major challenges facing social welfare systems.

The ultimate magnitude of the social and economic burdens of extended survival and population aging will to a great extent be determined by the future development of morbidity. Two different models describing the past and possible future developments of mortality and morbidity have been proposed. An "expansion of morbidity" theory (Gruenberg, 1977; Olshansky, Rudberg, Carnes, Cassel & Brady, 1991) assumes that the increase in life expectancy is caused by a reduction in the fatality rate of chronic diseases rather than by a decline in the incidence of these diseases. The increase in longevity should therefore go hand in hand with an increasing number of years spent in poor health. In

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contrast, Fries (1989) proposed a theory predicting a "compression of morbidity". According to Fries the onset of chronic diseases will be postponed, but the average maximum life span will not exceed 85 years. Morbidity will then be compressed into a shorter period of time at the end of life. But one can also imagine a situation in which the ratio of unhealthy years to life expectancy decreases and life expectancy in poor health increases. This scenario is called "the relative compression of morbidity". The opposite scenario, "the relative expansion of morbidity", implies a decrease in the health ratio (ratio of healthy years to life expectancy) combined with an increase in the number of healthy years (Robine & Mathers, 1993).

An appropriate method for analyzing trends in morbidity and mortality at the population level simultaneously is the calculation of health expectancies. These calculations have been performed for several countries covering different time periods and using various health measures (Crimmins, Saito & Ingegneri, 1989, 1997; Bebbington, 1991; van Ginneken, Dissevelt, van de Water & van Sonsbeek, 1991; van de Water, Boshuizen & Perenboom, 1996; Valkonen, Sihvonen & Lahelma, 1997; for an overview see Robine, Mathers & Brouard, 1996).

In general, the question of whether researchers find an expansion or compression of morbidity over the years depends partly on the definition of health they apply. When using self-reported disability, the increase in life expectancy is more likely to lead to an expansion of morbidity (for a review see Robine et al., 1996; Crimmins et al., 1997). However, a recent study by Manton, Corder and Stallard (1997) found a decrease in the age-standardized prevalence rate of disability for the US population aged 65 and above. Studies that analyze self-rated health usually tend to find a compression of morbidity, particularly among middle-aged men (van de Water et al., 1996; Waidmann, Bound & Schoenbaum, 1995).

The aim of our study is to provide further evidence to help us to determine which of the competing theories of the development of morbidity is more consistent with time trends in health expectancy, using the Austrian elderly population as an example. As a measure of health we use self-perceived health ratings. Combining these health ratings with information on life expectancy we calculate healthy-life expectancy for the Austrian population aged 60 years and older for the years 1978, 1983, 1991, and 1998.

Over the years the concept of self-rated health has become widely accepted as a sensible measure of health status. Greiner, Snowdon & Greiner (1996) provide an excellent overview of a large number of studies that deal with the relationship between health-related factors and the concept of self-rated health. These studies came to the conclusion that self-perceived health ratings are associated with physical function, current illness, and disability. They are also influenced by a large number of other factors relevant to health. Among them are health behaviors such as smoking, current use of medical resources (e.g. number of days spent in hospital), external resources (e.g. social supports), internal resources (e.g. religiosity), and psychological factors. Longitudinal studies indicate that self-perceived health is a sensible predictor of mortality (for a review see Idler & Benyamini, 1997).

Methods and data

Methods

We base our calculation of healthy-life expectancy on the method introduced by Sullivan (1971). When using this method, expected years in good or ill health are calculated by applying the age- and sex-specific cross-sectional prevalence rates of self-perceived health to the person-years lived in different age categories derived from period life tables. Our calculations cover the age interval 60–89. We restricted our analysis to the elderly because this is the age group where the "compression" and "expansion" mechanisms are manifested. However, we had to exclude ages 90+ because at these ages prevalence rates of good health tend to fluctuate randomly even in large sample surveys, especially for men. We therefore use partial life expectancy up to age 89 instead of total life expectancy.

Applying the Sullivan method for monitoring trends in healthy-life expectancy is attractive because it only requires cross-sectional data. From a methodological point of view the combination of the stock variable 'prevalence of ill health' with the flow variable 'mortality' may lead to odd results (Berendregt, Bonneux & van der Maas, 1994). This is especially true when sudden changes in the transition from one health status to another occur. However, Mathers and Robine (1997) have shown that the Sullivan method provides a good estimate of trends in health expectancy in the long term if changes in the prevalence of good or ill health are smooth and relatively regular.

Data

Data on mortality were drawn from period life tables for 1978, 1983, 1991, and 1998 published by the Austrian Central Statistical Office. Abridged life tables for 5-year age-groups were calculated based on Chiang (1984). Data on self-perceived health were collected by in-person microcensus surveys conducted in the four years with supplementary questions on health topics for the entire population (1978, 1983, and 1991) or for the elderly population only (1998). For microcensus surveys,

0.9% of all Austrian non-institutional households were selected as a sample, which, in absolute figures, amounts to 28,000 households. Among these there were about 9000 households of elderly people. The interviewers were trained by the statistical services of the federal provinces and the Austrian Central Statistical Office. In the survey all members of the household were asked to respond to the questions. For persons not present at the time of the interview, another household member (a close relative) was allowed to answer. The sample population was weighted so as to serve as a representative sample of the non-institutionalized Austrian population by age and sex.

In all surveys self-perceived health was assessed by the question of how the respondent described the general state of his/her health. The wording of the question was identical in all four surveys. Respondents who rated their health as "very good", "good", or "fair" are combined into one category, while the answers "poor" or "very poor" form a second category. In order to test the sensitivity of our results to this dichotomization we calculate in a second step prevalence rates of good health by combining the answers "very good" and "good" into one group. Table 1 gives the number of respondents for whom we have information about their self-perceived health status.

Data quality

Our analysis is based on four cross-sectional surveys. Observed trends in the prevalence rates of good or poor health may reflect errors and changes in the data collection process rather than changes in the health status of the population. We therefore gave special attention to possible biases and their potential impact on observed trends.

We distinguished two major sources of bias: sampling and non-sampling errors; the latter may result primarily from non-response and from people dropping out of the survey. In the following three subsections we discuss any such errors present in our surveys and their possible impact on trends in the prevalence rates of good and poor health.

Sampling error

One source of error in our sampling design is the exclusion of the institutionalized population. We expect this error to affect the results for women more than for men, because elderly women have a higher risk of living in institutions. Between 1971 and 1998 the proportion of people living in institutions decreased between ages 60 and 79, while it remained stable for ages 80–84 and increased slightly among those aged 85+ (men 1971: 8%, 1998: 11%; women 1971: 15%, 1998: 20%). Thus, in the four microcensus surveys, the exclusion of the population living in institutions may result in an estimate of health status that is too positive. However, since the proportion of the institutionalized population increases only slightly over time and only in the highest age group, we can assume that limiting ourselves to private households does not introduce a bias into the time trend in healthy-life expectancy.

Table 1
Number of respondents by sex, age, and health status for the years 1978, 1983, 1991, and 1998

Age	1978		1983		1991		1998	
	In good health[a]	In poor health	In good health	In poor health	In good health	In poor health	In good health	In poor health
Males								
60–64	1011	122	1073	123	1071	98	1083	67
65–69	1118	225	654	78	853	97	1044	98
70–74	884	263	766	140	485	97	780	101
75–79	537	221	461	136	378	108	487	86
80–84	188	114	219	95	231	83	224	44
85–89	63	44	62	37	94	45	123	43
Females								
60–64	1238	192	1655	136	1217	115	1186	67
65–69	1707	371	1002	138	1314	161	1252	110
70–74	1362	457	1254	255	847	161	1263	152
75–79	892	480	875	294	716	190	936	163
80–84	353	309	470	220	467	197	464	158
85–89	163	129	168	91	191	122	264	134

[a] The category "in good health" consists of the ratings "very good", "good", and "fair".

This statement holds true under the assumption that the frailty distribution of those living in institutions did not change over time (and to our knowledge it did not).

Non-response and missing answers

Our main potential non-sampling error is non-response to the health question. The proportion of missing answers is similar for males and females and increases with age (Table 2). This increase with age may introduce a bias into the estimate of healthy-life expectancy. It has been reported that older panel dropouts as well as non-respondents may suffer from poorer physical health and tend to be socially less integrated (Rodgers & Herzog, 1992) than younger respondents. However, the same age-pattern was observed in all four survey years, and we therefore concluded that the age-pattern of missing answers did not introduce a bias into the time trend.

We cannot rule out the possibility that the change in the proportion of missing answers with time causes some bias. In fact, between 1978 and 1991 the proportion of missing answers increased in all age groups (Table 2) while in 1998 the figures closely resemble the values for the year 1983.

Table 2
Percentage of proxy answers and non-response by sex and age for the years 1978, 1983, 1991, and 1998

	Age					
	60–64	65–69	70–74	75–79	80–84	85–89
Proxy answers						
Males						
1978	23	19	18	23	24	43
1983	19	15	17	13	29	24
1991	24	19	19	16	23	32
1998	30	27	26	28	25	28
Females						
1978	16	16	16	16	29	35
1983	13	12	11	14	22	34
1991	14	13	12	14	24	32
1998	22	19	20	19	22	37
Non-response/missing						
Males						
1978	6	8	8	10	11	7
1983	9	12	12	17	15	22
1991	15	15	17	16	21	19
1998	10	10	12	12	17	11
Females						
1978	8	7	9	8	11	10
1983	12	13	12	13	12	13
1991	15	16	18	16	19	25
1998	11	10	11	13	13	17

Proxy answers

In all four surveys proxy answers are frequent. In 1978, 19% of the answers to the question on health status were proxy answers, in 1998, 24%. The proxy is usually a close relative, such as a spouse or a child of the respondent. Rodgers and Herzog (1992) report that in follow-ups, those with proxy respondents were more likely to have died than those who had answered by themselves. This means that excluding proxy answers would bias the data in favour of healthy individuals, especially among the elderly. We found that the proportion and the age pattern of proxy answers changed only slightly over the years 1978–1991, but it increased in the 1998 survey for ages 60–79 (Table 2). The increase in the last survey may reflect the fact that in recent years elderly people are more likely to live together with their children (Hörl & Kytir, 1999). Thus, the increase in proxy answers may be independent of health status.

Results

Health status

The results of the four health surveys indicate that the health status of both sexes improved among the elderly Austrian population (60–89). With the exception of the highest age group (85–89) improvements are statistically significant for the comparison of the years 1978–1983 and 1991–1998. Between 1983 and 1991 age-specific prevalence rates of good health remained basically unchanged for both sexes: the differences between the 2 years are statistically insignificant (Table 3).

Table 3
Prevalence rates of good health by sex for the years 1978, 1983, 1991, and 1998, based on the health ratings "very good", "good", and "fair"

	Prevalence rates of good health							
	Males				Females			
Age	1978	1983	1991	1998	1978	1983	1991	1998
60–64	89.2	89.7	91.6	94.2*[a]	86.6	92.4**	91.4	94.7**
65–69	83.3	89.3**	89.7	91.4	82.1	87.9**	89.1	91.9*
70–74	77.1	84.6**	83.4	88.5*	74.9	83.1**	84.0	89.2**
75–79	70.8	77.3*	77.8	85.4*	65.1	74.9**	79.0	85.1**
80–84	62.4	69.7	73.5	83.6*	53.5	68.1**	70.4	74.6
85–89	59.4	62.2	67.7	74.3	55.8	64.9	61.1	66.4

[a] *Significantly different from the previous time period at the 5% level; **significantly different from the previous time period at the 1% level.

Women generally rate their health worse than men. The extent of the difference is sensitive to the chosen categorization of good health (Table 4). Sex differences are more pronounced on the basis of the self-ratings "very good" and "good". Sex-specific differences diminish over the years, independently of the chosen categorization.

Healthy-life expectancy and health ratio

Not only life expectancy but also healthy-life expectancy increased significantly over the study period. In the year 1978, a 60 year-old women could expect to live another 14.5 years in good health (healthy-life expectancy up to age 90), a man of the same age 12.6 years; by the year 1998 healthy-life expectancy had increased to 19.2 years for females and 16.6 years for males (Table 5). More importantly, not only the number of years of good health but also the health ratio increased (Table 8). In 1978, a 60 year-old woman could expect to live 75% of her remaining lifetime (until age 90) in good health, by the year 1998 87%. Among males of the same age the proportion of healthy years increased from 80% (1978) to 89% (1998).

This implies that over the study period the elderly Austrian population not only live longer but also that the absolute number of years lived in poor health decreased (Table 7): for males from 3.1 years in 1978 to 2 years in 1998 and for females from 4.8 (1978) to 2.8 years (1998). The positive trend in healthy-life expectancy and in the health ratio is present in all age groups

Table 4
Prevalence rates of good health by sex for the years 1978, 1983, 1991, and 1998, based on the health ratings "very good" and "good"

	Prevalence rates of good health							
	Males				Females			
Age	1978	1983	1991	1998	1978	1983	1991	1998
60–64	45.6	50.6*[a]	54.4	66.4**	38.6	47.7**	49.7	64.5**
65–69	42.0	45.9	51.7*	60.9**	29.3	38.8**	44.7**	59.2**
70–74	33.0	40.0**	41.7	54.6**	26.0	32.5**	37.0*	50.8**
75–79	26.6	30.5	38.4*	45.6*	18.2	24.8**	28.7	44.2**
80–84	24.1	25.4	27.0	42.1**	14.6	16.1	27.0**	32.9
85–89	16.6	14.2	26.3*	36.4	10.9	17.6	19.0	24.1

[a] *Significantly different from the previous time period at the 5% level; **significantly different from the previous time period at the 1% level.

Table 5
Healthy-life expectancy up to age 90 by sex for the years 1978, 1983, 1991, and 1998, based on the health ratings "very good", "good", and "fair"

	Healthy-life expectancy							
	Males				Females			
Age	1978	1983	1991	1998	1978	1983	1991	1998
60	12.6	13.7**[a]	14.9**	16.3**	14.5	16.4**	17.5**	19.0**
65	9.3	10.5**	11.5**	12.8**	10.8	12.5**	13.6**	14.9**
70	6.7	7.6**	8.5**	9.7**	7.6	9.0**	9.9**	11.0**
75	4.5	5.1**	5.8**	6.7**	4.9	6.0**	6.7**	7.5**
80	2.8	3.2*	3.7**	4.4**	2.8	3.6**	3.9*	4.3**
85	1.3	1.4	1.6	1.8*	1.3	1.5*	1.5	1.7**

[a] *Significantly different from the previous time period at the 5% level; **significantly different from the previous time period at the 1% level.

Table 6
Healthy-life expectancy up to age 90 by sex for the years 1978, 1983, 1991, and 1998, based on the health ratings "very good" and "good"

	Healthy-life expectancy							
	Males				Females			
Age	1978	1983	1991	1998	1978	1983	1991	1998
60	5.8	6.7**[a]	7.9**	10.4**	5.2	6.7**	8.0**	11.2**
65	4.1	4.8**	5.8**	7.7**	3.5	4.7**	5.8**	8.3**
70	2.7	3.2**	4.0**	5.5**	2.3	3.0**	3.9**	5.7**
75	1.7	1.9	2.6**	3.6**	1.3	1.7**	2.4**	3.6**
80	1.0	1.1	1.4	2.2**	0.7	0.9	1.4**	1.8
85	0.4	0.3	0.6	0.9	0.2	0.4	0.5	0.6

[a] *Significantly different from the previous time period at the 5% level; **significantly different from the previous time period at the 1% level.

Table 7
Unhealthy-life expectancy up to age 90 by sex for the years 1978, 1983, 1991, and 1998, based on the health ratings "very good", "good", and "fair"

	Unhealthy-life expectancy							
	Males				Females			
Age	1978	1983	1991	1998	1978	1983	1991	1998
60	3.1	2.5**[a]	2.6	2.0**	4.8	3.4**	3.5	2.8**
65	2.9	2.2**	2.5	1.9**	4.4	3.2**	3.2	2.7**
70	2.6	2.1**	2.3	1.7**	3.9	2.8**	2.9	2.4**
75	2.2	1.9*	1.9	1.4**	3.2	2.4**	2.4	2.1*
80	1.7	1.5	1.4	1.0	2.4	1.7**	1.8	1.7
85	0.9	0.9	0.7	0.6	1.0	0.8	0.9	0.8

[a] *Significantly different from the previous time period at the 5% level; **significantly different from the previous time period at the 1% level.

Table 8
Health ratio for the ages 60 to 90 by sex for the years 1978, 1983, 1991, and 1998, based on the health ratings "very good", "good", and "fair"

	Health ratio							
	Males				Females			
Age	1978	1983	1991	1998	1978	1983	1991	1998
60	80	85**[a]	85	89**	75	83**	83	87**
65	76	82**	82	87**	71	80**	81	85**
70	72	79**	79	85**	66	76**	77	82**
75	67	73**	75	83**	60	71**	73	78**
80	62	68	72	81*	54	67**	68	72
85	59	62	68	74	56	65	61	66

[a] *Significantly different from the previous time period at the 5% level; **significantly different from the previous time period at the 1% level.

above age 60. In 1978 an 80 year-old women could expect to live approximately half of her remaining lifetime in good health, by 1998 almost three-quarters (Table 8). We find a similar positive trend for both sexes when the calculations are based on the health ratings "very good" and "good".

Sex-specific differences in healthy-life expectancy depend strongly on the form of categorization chosen for the self-ratings of health. If the wider concept of good health is applied, then the healthy-life expectancy of females exceeds that of males in all years and in almost all age groups. If the restricted concept is applied, then female healthy-life expectancy is lower than that of males in the 1970s and 1980s, while it equals or exceeds male healthy-life expectancy in the 1990s (Table 6).

Discussion and conclusion

We have attempted to find further empirical evidence concerning the question of whether an increase in life expectancy results in a prolonged period of ill health or in an increase in the number of years that are lived in good health. The onset of sustained decline in old-age mortality in Austria is estimated for the years 1972 (females) and 1976 (males). However, it was not until the years 1983/1984 that the annual decline in mortality at higher ages had reached between 1 and 2%. The decline then accelerated at the beginning of the 1990s (Kannisto, 1994). Thus, the time span of our analysis from 1978 to 1998 covers significant improvements in the life expectancy of the elderly population.

Our data on self-perceived health are based on four large sample surveys. Because we use cross-sectional surveys, we devoted the first part of this paper to the consequences of possible sampling and non-sampling errors in our analysis of time trends. We came to the conclusion that the absolute number of years lived in good health may be overestimated. However, it is most likely that the time trend in healthy-life expectancy over the 20 years is unbiased by the exclusion of the institutionalized population and the increase in the proportion of proxy-answers. This conclusion arises from the fact that, during the study period, the proportion of the institutionalized population did not increase. Furthermore, the increase in the proportion of proxy answers in 1998 as compared to the three previous study years probably results from a change in household composition rather than from a change in health status. However, we cannot fully rule out the possibility that the increase in non-response affects our result. Between 1978 and 1991 non-response increased, while in 1998 it fell back to the level of 1983. If we assume that those who do not respond to the survey are less healthy than those who remain in it, then the improvements in healthy-life expectancy between 1978 and 1991 are overestimated. But this also implies that the improvements between 1991 and 1998 were even greater than we found in our data.

The second part of the paper describes trends in healthy-life expectancy for the Austrian population. We come to the conclusion that the elderly in Austria not only live longer, but also that their health status has improved over time. At all ages above 60 life expectancy in good health has been increasing while at the same time life expectancy in ill health has been decreasing. This result is independent of the form of categorization chosen for the five-scale ratings of health. Thus, our data do not indicate an expansion of morbidity in the elderly population at all. On the contrary, our results show strong evidence in support of the theory that an absolute compression of morbidity into the last years of life has taken place. This trend is particularly strong in the two periods 1978–1983 and 1991–1998. Contrary to Fries's hypothesis, however, the absolute compression of morbidity occurred in a period of sustained decline in old-age mortality.

Only during the period 1983–1991 did improvements in self-perceived health seem to stagnate, which is consistent with results from a study by van de Water et al. (1996) for the elderly Dutch population.

One could argue that changes in the perception of health are one explanation for the dramatic compression of morbidity. Longitudinal studies have shown that to some extent the perception of health is not only culturally dependent but also time dependent (Deeg, 1999). Though our data span a time period of 20 years, in this study we compare the results for intermediate time periods. Health surveys were performed a maximum of eight years apart from each other. Over this shorter time period it is much less likely that

substantial changes in the perception of health have occurred.

Although the result of absolute compression of morbidity is independent of the categorization chosen for good and ill health, we found that the male/female comparison is sensitive to it. Whether the healthy-life expectancy of women is higher than that of men depends on how the category "fair" is assigned. This result leads us to question the validity of international comparisons based on the absolute numbers of years in good or ill health rather than on the time trend in healthy-life expectancy. Absolute differences between countries may be caused not only by different categorizations but also by different social and cultural perceptions of good, fair, or ill health. However, we may assume that the differences in perception are persistent over time and should have much less effect on the comparison of time trends.

The positive trends in healthy-life expectancy and the health ratio over the past 20 years support the view that elderly people in the 21st century may not only live longer but also live longer in good health. For society as a whole, the possible reductions in bad health may compensate the effects of population aging on health care needs and costs at least to some extent. It therefore remains an important task to observe trends in health expectancy in low mortality populations.

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