Chapter 9
Changes in Mortality at Older Ages: The Case of Spain (1975–2006)

Rosa Gómez Redondo, Juan Manuel García González and Aina Faus Bertomeu

Abstract Recent decades have witnessed the rise of a new and growing demographic group: the old people. This remarkable historical phenomenon is the direct result of an increase in survival rates, with more and more men and women celebrating their 85th birthday every year. As death rates fall and people live longer, the frequency distribution of age at death has shifted towards the more advanced groups, affecting a greater proportion of the population as a whole while the maximum lifespan has continued to rise. It should be emphasized that the number of octogenarians in wealthy countries grew over the course of the twentieth century, paralleled by a rise in the age of death among the very old. In the case of Spain, this trend did not happen until the 1970's. This paper analyses the impact of mortality and the evolution of the main causes of death among Spanish old people. Special attention is paid to variations in gender-specific trends over the last three decades, looking for the most relevant causes of death. Our work focuses on three different age groups: 65–79; 80–89 and 90 older, to distinguish the diversity of trends among older people. This research has also profited from the increase in the availability of official data on both mortality and the living population at advanced ages in recent years.

Keywords Mortality · Causes of death · Elderly and oldest-old · Differences by sex · Differences by gender · Spain

9.1 Introduction[1]

In Spain, two basic longevity indicators, the modal and the median age at death, reached a value of 80 years for men and over 85 years for women in 2004 (Gómez Redondo et al. 2007). This represents a milestone in the evolution of the Spanish population because it is an indication that Spanish men and women will both soon

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R. Gómez Redondo (✉) · J. M. García González · A. Faus Bertomeu
Universidad Nacional de Educación a Distancia—UNED, Departamento de Servicios Sociales y Fundamentos Histórico-Jurídicos. C/ Obispo Trejo, 2. 28040 Madrid, Spain
e-mail: rgomez@poli.uned.es

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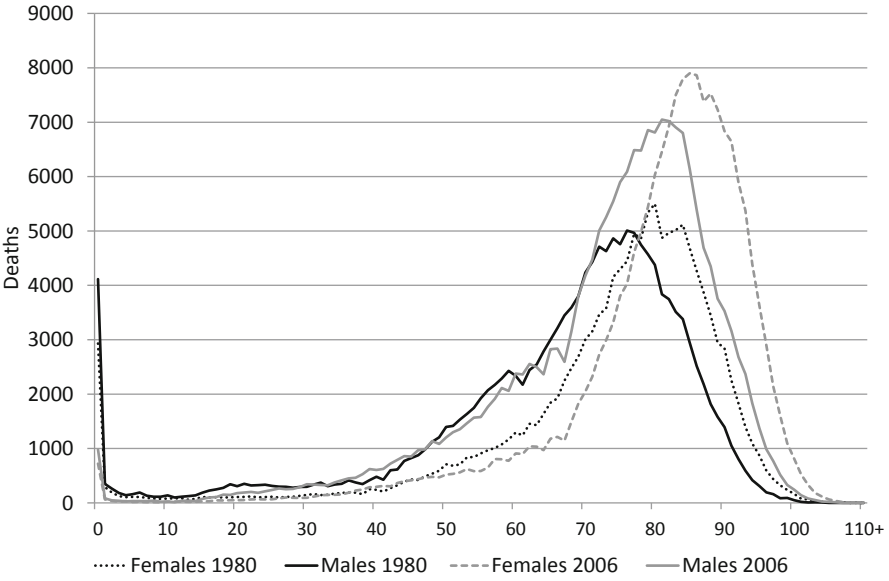

Fig. 9.1 Compression and shift of deaths. Men and women in 1980 and 2006. (Source: Own elaboration with data from the HMD and the INE)

attain a life expectancy of 85 years, a "mythical" age considered by many authors to be the maximum achievable life expectancy (Fries 1980, 1989; Olshansky et al. 1990, 2001; Coale and Guo 1991; Hayflick 2000). Another interesting aspect of recent Spanish longevity is that there is a quarter of a century gap between women's and men's indicators: women's modal and median ages at death in 1980 were only reached by men 25 years later, around 2006 (Figs. 9.1 and 9.2).

The structure of Spanish mortality has profoundly changed over the twentieth century: the mortality rate has fallen sharply, and during the second half of the twentieth century Spain joined the select group of countries with the highest level of human survival ever attained (Fig. 9.2). The whole Spanish population has undergone significant improvements throughout this period: life expectancy at birth exceeded 80 years for the first time in 2004, when it reached a value of 80.28 years for the general population (76.84 for men and 83.51 for women; Human Mortality Database). Since then, Spanish life expectancy has continued to rise steadily, reaching 80.94 years in 2006. Women, in particular, have experienced a rapid gain, with a life expectancy of 84.07 years in 2006, compared to 77.58 years among men, a difference of nearly 7.5 years.

A key moment in this process of change and advancement in Spanish mortality took place in the early 1970s. At that time, the increase in life expectancy was given a significant boost by the adult and elderly age groups, whose mortality continued to decline, especially among the female population, and has done so until today (Gómez Redondo 1995; Gómez Redondo and Boe 2005; Canudas et al. 2008). The resultant dynamics brought about a growing compression and a shift in mortality (Wilmoth 1997; Wilmoth and Horiuchi 1999; Robine 2001; Meslé and Vallin 2003), which in the last instance may be said to have led to an "aging" of the age of death, raising every longevity indicator, and bringing about a rectangularization of the survival curve.

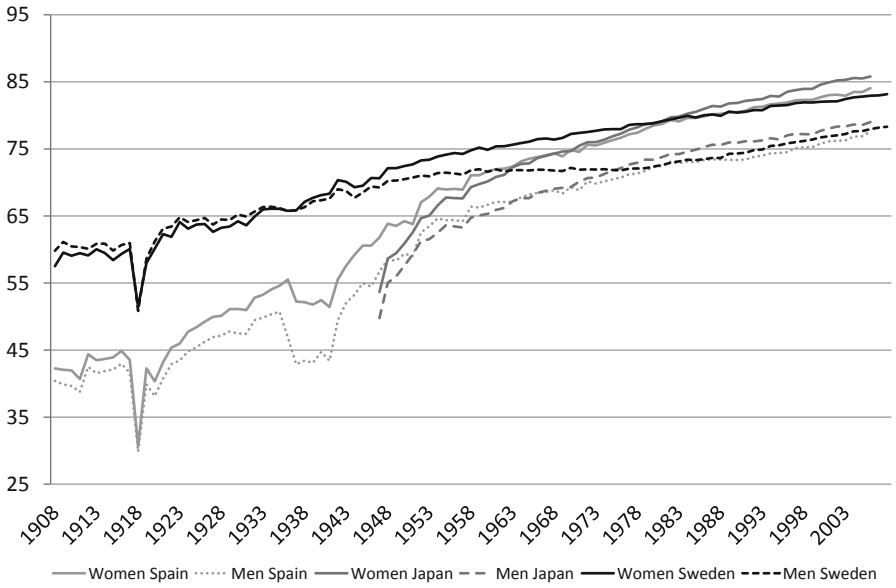

Fig. 9.2 Life expectancy at birth, 1908 to 2008, Men and women, Spain, Japan and Sweden. (Source: Own elaboration with data from the HMD)

The overall aim of this article is to analyze the evolution of mortality by cause of death between 1975 and 2006 among Spaniards over the age of 65. We distinguish three large age groups: those aged 65–79, to whom we will refer as the "young old"; those aged 80–89, referred as "old people"; and those aged 90 and older, referred as the "elderly". The analysis is carried out by gender.

First, we will focus on those sets of causes that weigh more heavily on the mortality of Spanish old people. Second, we will analyze those causes of death that show some signs and/or evidence of changing trends which might be relevant for the future convergence of men's and women's mortality (López 1983; Vallin 2006). Nevertheless, this division is difficult to maintain in practice, as the chapter also has a transverse axis, that is, a comparative analysis of the evolution of mortality by cause between men and women during the last three decades.

We have to take into account that at the end of the twentieth century the gender difference in life expectancy for children and young people began to change, but this change cannot be extrapolated to the older old population during the period under study. The difference between the life expectancy at birth for men and women has decreased during the last few years, as well as for young adults, but in the population older than 65 years we only see a small slowing down of the divergent trend, something which was already happening during the past century. During the first decade of the twenty first century, and always within the framework of the attained stabilization, it is possible to detect small decrements in the gender difference in younger old people. Nevertheless, it is not possible at the moment to claim that it a convergent trend is emerging. This is the reason why we pay special attention to the differences between men and women for certain causes of death which, in our study, show signs of change.

Since this general process cannot be understood outside the framework of the health transition and epidemiological theory (Vallin and Meslé 2004), our goal here is to continue our analysis of the changes in the Spanish epidemiological pattern over a period of only thirty years (Omran 1971), keeping close track of society's response to these important transformations (Frenk et al. 1991).

Old age has clearly come to be the indisputable locus of mortality in recent decades. This is true to such an extent that mortality trends among the elderly determine the mortality trends of the Spanish population as a whole. Since the older population suffers increasingly from chronic and degenerative diseases, these are, at present, the most prevalent causes of death among the elderly (Meslé 2006a) and, consequently, among the Spanish population at large.

9.2 Sources and Methodology

The data on deaths by cause that were used in this analysis refer to the *de facto* population and derive from the micro data published by the *Instituto Nacional de Estadística* (INE, Spanish Statistics Institute) for the period 1975–2001, while the data for the period 2002–2006 were extracted from the INE website via INEBase (http://www.ine.es). Population data for the whole period 1975–2006 were taken from the Human Mortality Database (HMD). To define the denominator, we have used the population's exposure to risk of death, which is more appropriate than the population size since the former includes a correction that reflects the timing of deaths during the interval.

Given that this study covers a broad time period (longer than 30 years) and that the age structure of the population changed over this time, it was deemed appropriate to calculate age-standardized death rates by cause of death. The advantage of this approach is that these rates eliminate the effect of the age structure on mortality among the elderly—who have experienced an "aging of the aged" process since 1975– and thus allows us to discern the evolution of mortality trends in this specific population. The standard population we have used is the total (men plus women) Spanish population exposed to risk of death in 1991 as taken from the HMD, since that year falls in the middle of the period under study and also coincides with a census year. The age-standardized death rate by cause (TE_c) is obtained by adding up the product of the specific death rate for each age x and cause c and the standard population at each age x, and dividing this sum by the total standard population (men plus women):

$$\mathrm{TE}_c = \sum m_{x,c} P_x^{st} / P^{st}$$

where m corresponds to the age-specific death rates by cause c in age group x, p_x^{st} corresponds to the standard population in age group x, and P^{st} to the total standard population. These age-standardized rates by cause of death have been calculated for each sex and for three age groups: 65–79, 80–89, and 90 +. They are expressed per 100,000 inhabitants.

Population and number of deaths by single age have been used. We have data from 65 until 100 + years old, but we suspect that population and deaths belonging to the

group 90 + years may be exaggerated. This last open age group includes all people over 90 years old for both the standard population and deaths by cause, neither of which have an open-ended age group. Thus, the potential effect of changing age population structure during the analyzed period is somehow reduced.

The analysis is carried out by using cross-sectional data. It should be noted that the division of the 65 + population into three large age groups provides an analytical advantage, since it allows us to observe significant differences between the mortality trends and their strength in these three groups, given each one's distinctive health pattern. In addition, we are able to see a cohort effect on the impact of mortality. Generations born in 1910 (that reached the age of 65 in 1975) share the scene with those generations born at the end of the nineteenth century, who have emerged as today's supercentenarians. It is possible to standardize the population, but not the life stories, life conditions and health experienced by the members of these generations before they reached old age. Both the stories and the conditions will be reflected in the intensity of mortality, and this intensity will always be related to the social and technological context in which people lived. Furthermore, as is well known, there has been a substantial change in the mortality structure of Spanish women during this period. This transformation may have a certain impact on the evolution of differential mortality trends by sex.

In Spain, the information about causes of death is taken from the *Estadística de Defunciones según la Causa de Muerte*[2] (Statistics of Deaths by Cause). This database used to be part of the *Estadísticas del Movimiento Natural de la Población* (Vital Statistics), but in 1987 the INE decided to make the former a separate entity owing to the health nature of the information compiled in it.

The International Classification of Diseases and Causes of Death (ICD) has undergone three revisions during the period 1975–2006: the 8th Revision (1975–1979), the 9th Revision (1980–1998), and the 10th Revision (1999–2006). While the 8th and 9th Revisions presented only minor changes, the 10th Revision introduced substantial modifications. It allowed greater specificity, since it incorporated an alphanumerical system that doubled the number of existing codes. ICD10 also introduced several modifications in one of the coding rules for determining the basic cause of death, and provided more information for the codification of neoplasms (Audicana et al. 1998; Segura and Martínez 1998; Cirera 2006).

Research on death by cause involves several methodological difficulties that can be summarized into two essential problems:

1. the complexity of managing and standardizing the successive revisions of the ICD (Segura and Martínez 1998), while the required reconstruction of long time series of deaths by causes[3] (Vallin and Meslé 1988) is still in progress; and

[2] The available data on causes of death only refer to the basic cause of death, which is the one reported by the corresponding INE statistics. According to the World Health Organization (WHO), the basic or fundamental cause of death is "(a) the disease or lesion that initiated the change of pathological events leading directly to death, or (b) the circumstances surrounding the accident or violence produced by the fatal lesion" (WHO 1997).

[3] An ongoing project using methodology by Vallin and Meslé (1988).

2. errors on certification of cause of death may seriously compromise the quality of the analysis, although the quality of the data has notably improved over the course of the period under study.

The European Shortlist for Causes of Death (Eurostat 1998; Eurostat 2004) is the standard list used in this work, since it establishes a correspondence between the three ICD revisions made in the period 1975–2006 for 65 causes of death[4] (see Annex). These 65 causes of death include the most relevant causes within the current patterns of mortality and the mortality trends and projections of the European Union. In the absence of a reconstruction of time series of mortality by cause, this common list eliminates the discrepancies between the different ICD revisions. In this study, six large sets of causes are considered: diseases of the circulatory system, diseases of the respiratory system, malignant neoplasms, diseases of the nervous system and the sense organs, mental and behavioral disorders, and external causes of injury and poisoning. However, we will focus more specifically on those causes within these six large sets that have the greatest impact on mortality among the elderly: cerebrovascular diseases; ischemic heart diseases; malignant stomach, colon, larynx and trachea/bronchus/lung, breast, prostate and bladder neoplasms; diabetes mellitus; influenza; pneumonia; chronic lower respiratory diseases; suicide and intentional self-harm.

9.3 The Five Pillars of The Evolution of Mortality in Old Age

This analysis will consider the impact of the most important causes of death on the older population, depending on whether the men and women who make up the population are at the beginning or the end of this phase of their life cycle. Our comments are based on the figures representing annual series for each age group by causes of death.

The results obtained are basically related to five groups of causes that in our opinion are the pillars of the recent evolution of mortality. The importance of the decline in mortality from circulatory and respiratory diseases, which we will study closely later on, is matched by only one other set of causes in this period: that of the ill-defined diseases (see methodology). Nevertheless, and contrary to common understanding, the most important causes of death in Spain, and those whose decline has contributed most to the increase in life expectancy, are well defined. Death from diseases of the circulatory system accounted in 1975–79 for 58.6 % of the total deaths among women aged 90 + (53.0 for men aged 90 +), while the proportion was 44.6 % (36.9 for men) in 2005–2006. If we now add deaths from malignant tumors, we find that these two causes of death represented more than two-thirds of all deaths (71.6 % for women aged 90 + and 68.2 for men the same age) in 1975–79, while their weight lessened by the end of the period (58.1 % for women aged 90 + and 57.3 for men in the same age group). Finally, if we include deaths caused by diseases of the respiratory system we obtain 78.9 % for women aged 90 + (75.0 for men aged also 90 +) in 1975–79 and 64.9 % for women the same age (70.1 for men) in 2005–06.

[4] This shortlist was conceived as a useful and necessary tool for the carrying out of international comparisons of mortality data, both on a regional scale and in retrospective studies and projections.

Therefore, these three large sets of causes alone largely explain the epidemiological profile of the elderly population in Spain, and the changes it has undergone. On the other hand, we have also considered two additional causes because of their rapid increase over the course of recent years, especially taking into account their potential and important health, economic and social consequences in aged societies. We refer to mental illnesses and pathologies of the nervous system.

9.3.1 The Role of Diseases of the Circulatory System in the Decline of Mortality in the Population Over the Age of 65

Overall mortality at age 90 + shifted from 26,221 deaths per 100,000 inhabitants in 1975–79 to 20,904 in 2005–06 for women aged 90 + (29,744 and 24,418, respectively, for men aged 90 +). For women aged 80–89, it decreased from 11,677 to 6,964 (15,034 to 10,058 for men aged 80–89). And for the 65–79 age group, women's rates fell from 2,927 to 1,353 (4,870 to 2,893 for men aged 65–79). During this period we see an improvement in the trends of only two sets of causes: diseases of the circulatory system and diseases of the respiratory system. Tumors, mental disorders and diseases of the nervous system moved in the opposite direction. At much lower levels, we also find endocrine and digestive diseases, to mention just the main ones.

Cardiovascular diseases are certainly the true motor and main component of the decrease in mortality during the last quarter of the century. By contrast, the main brake to the continuous decrease is the tumor group. Figure 9.3 shows mortality from diseases of the circulatory system. We can observe a significant fall in overall mortality from this set of causes, with a clear declining trend for both sexes. The reduction in the number of deaths due to this type of disease is in line with what we know about the cardiovascular revolution in Western societies, although it is taking place with a certain delay (Caselli et al. 1995; Meslé and Vallin 2002). The greatest differences between men and women are found in the 65–79 age group. The trends by sex are closer in the 90 + age group, where women show higher mortality.

Among the population aged 65–79, female mortality shows a higher percentage decrease than male mortality, although the decrease of the standardized death rate (SDR) is smaller, since it dropped from 1,555 deaths per 100,000 inhabitants in 1975–79 to 425 in 2005–2006 for women aged 65–79, and from 2,276 to 810 deaths for men aged 65–79. The decrease is also clear for the 80–89 age group (from 7,166 to 2,869 deaths among women and from 8,163 to 3,352 among men) and the 90 + age group (from 15,351 to 9,313 deaths in the case of women and from 15,765 to 9,000 in that of men). Nevertheless**,** the weight of this cause of death on the overall male mortality is less than on the overall female mortality at the end of this period (Meslé 2006b).

It is worth noting that, for this set of causes, both the trends and the levels are very similar for both sexes, which means that the observable differences in overall mortality by sex are due to causes other than those associated with circulatory diseases. Mortality from this group of diseases has experienced a huge decline, having been reduced by over half its value in the course of these three decades. Nonetheless, and in line with what we know from previous studies (Gómez Redondo 1995; Blanes 2007;

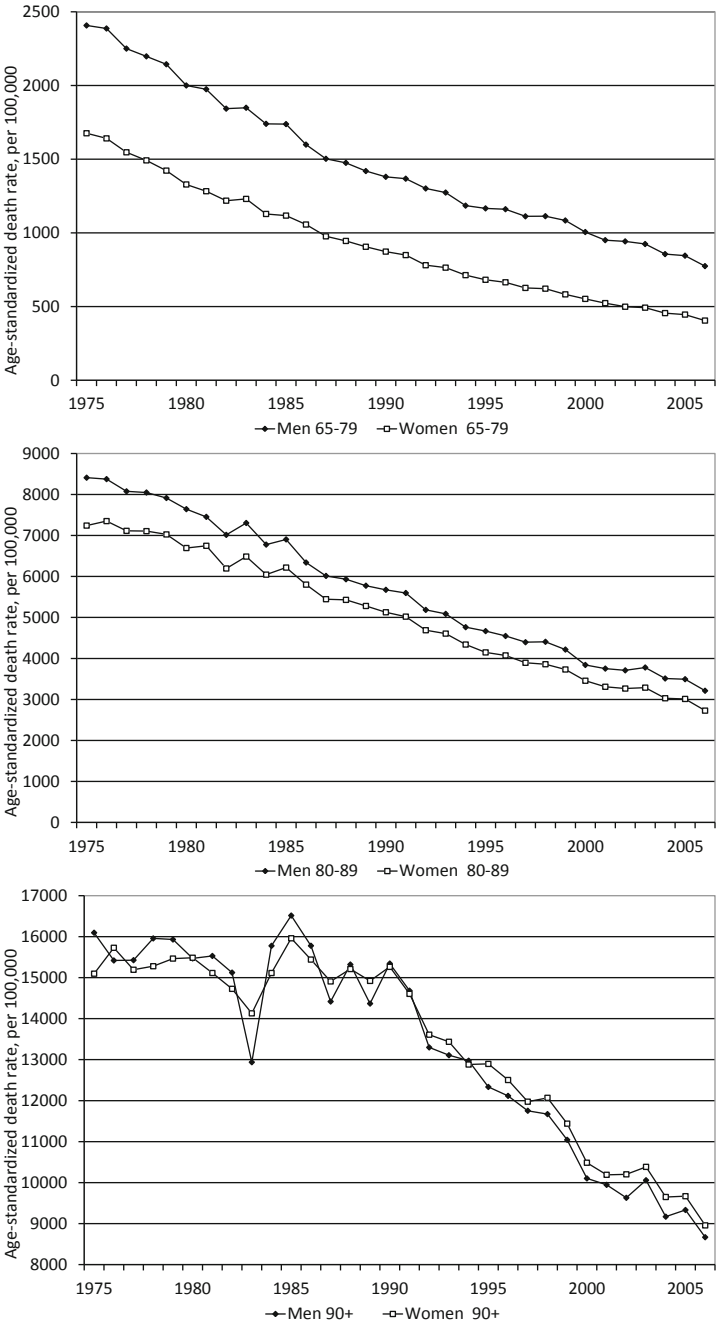

Fig. 9.3 Mortality from diseases of the circulatory system. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

Robles 2009; Gómez Redondo et al. 2010), diseases of the circulatory system still represent the main cause of death among the Spanish elderly population, because of the late arrival of the cardiovascular revolution in Spain (during the 1970s and 1980s). Indeed, mortality from this type of disease among the older population is more than double that caused by tumors, the next most important group. Mortality caused by the whole group of tumors was stable for most of this period, especially among men under 80, and it even experienced a slight decrease in the last few years. For those aged 65–79 mortality caused by the tumor group is comparable to that due to circulatory system diseases. This is the reason we discuss tumor-related mortality later on. Tumors are very heterogeneous, and each specific cause follows a particular trend affecting men and women differently. Let us only mention here that some are declining causes of death (prostate and stomach tumors) while some are increasing (bladder, colon and breast tumors). Within the 65–79 age group, the drop is from 530 deaths per 100,000 inhabitants in 1975–79 to 479 deaths in 2005–2006 for women aged 65–79, while there is a slight increase (from 1,096 to 1,115 deaths) among men aged 65–79. Therefore, diseases of the circulatory system have a greater impact on women than on men—and greater as well on the 90 + age group than on the 65–79 one.

Within this large set of causes, we can disaggregate two main causes of death, namely ischemic and cerebrovascular diseases (Figs. 9.4 and 9.5), both of them enormously important. Clearly the most salient result of this analysis is the great fall in mortality from cerebrovascular diseases throughout the period in question, regardless of the age group considered. A clearly declining linear trend can be observed for both sexes, to a point where mortality from ischemic diseases, which had distinctly lower levels in earlier years, now exceeds mortality associated with cerebrovascular diseases, at least among octogenarian men and women and among men aged 65–79. On the other hand, the reduction of mortality caused by ischemic diseases is not so marked among those older than 80 years, but is clearly observable among the younger-old since the early 1990s (Fig. 9.5). With regard to differences by sex, the incidence of death from cerebrovascular diseases is almost identical in men and women belonging to the 80–89 and 90 + age groups throughout this period, but higher among men than among women in the 65–79 age group. At the same time, in the case of ischemic diseases, a marked male over-mortality can be observed among this younger-old population, but showing a slow tendency to decline both in men and in women, a fact that might indicate an incipient tendency towards convergence.

Considering the magnitude of the decline in mortality from circulatory diseases, it makes sense to ask what factors are responsible for this trend. From a medical point of view, the answer is complex and would have to take into account at least three factors (Vallin and Meslé 2006). In the first place, we should mention the improvements in medical technology that have opened the door to a number of different therapeutic and surgical treatment strategies, such as the use of anti-coagulants, beta-blockers, pacemakers and bypass coronary surgery. In the second place, we should refer to the organization of emergency medical services, which play a key role in preventing many deaths by providing immediate attention. Finally, we should call attention to prevention. Since the aim of prevention is to monitor certain risk factors that can only be modified through the interaction between health policies and individual behavioral changes—the latter being very difficult to gauge—it is not easy to achieve. In this

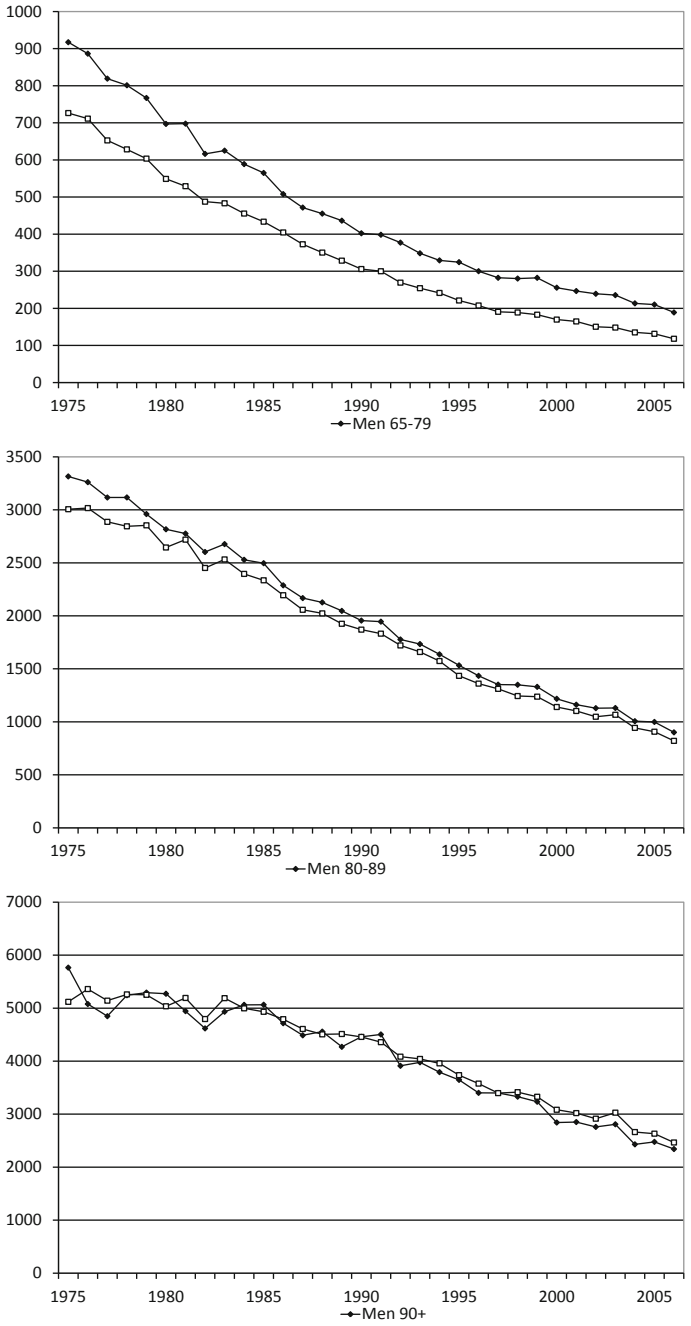

Fig. 9.4 Mortality from cerebrovascular diseases. Men and women. 60–79, 80–89 and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

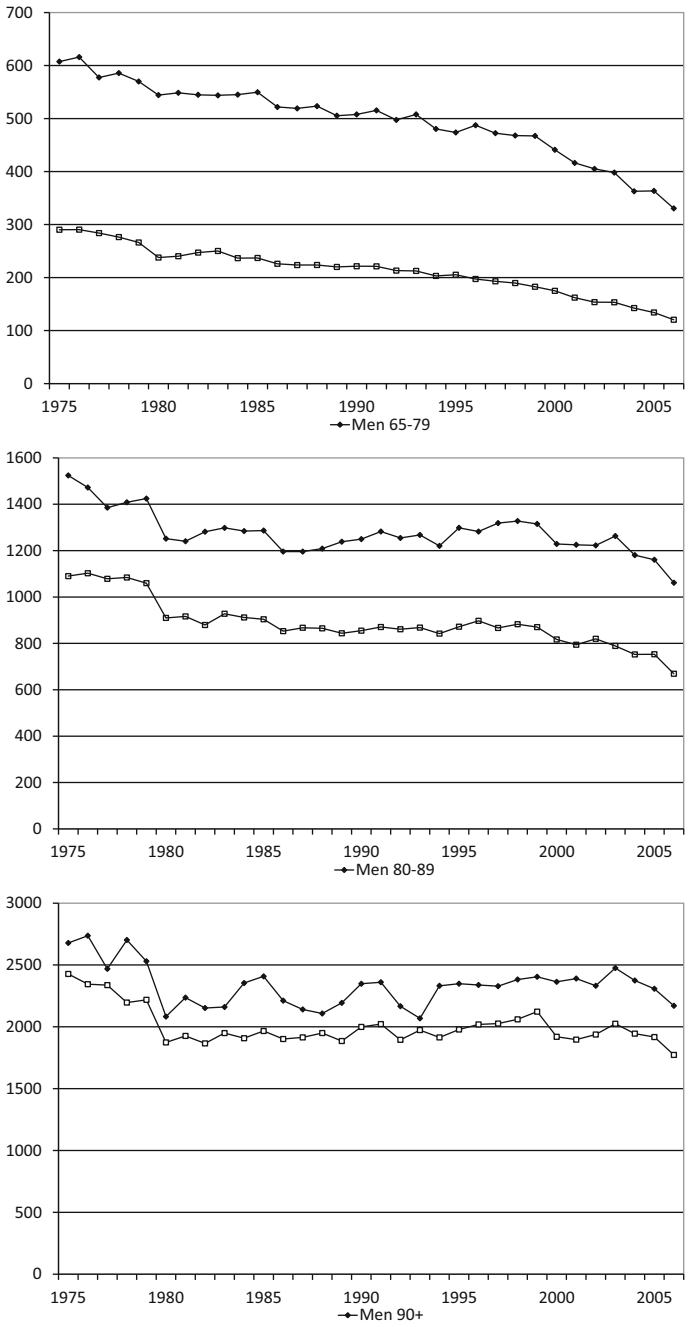

Fig. 9.5 Mortality from ischemic heart diseases. Men and women. 60–79, 80–89 and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

sense, awareness of the importance of the risk factors linked to different patterns of behavior is probably the crucial element in Spain's current healthcare transition stage.

An interesting result of this analysis is the similarity between the Spanish pattern of mortality from cerebrovascular and ischemic diseases among the elderly and that of Japan. In both cases, mortality from cerebrovascular diseases was higher during the period under study than in other Western countries, where the opposite situation was common and where cerebrovascular diseases represented the driving force behind the cardiovascular revolution. In the case of Japan and Spain, the new tendencies point to the pharmacological control of hypertension and to changes in eating habits as the main factors behind the reductions among older adults and the elderly in recent years. With regard to the reduction of mortality discussed above, it is important, on the one hand, to underline the role played by the health centers, which have proactively worked to prevent hypertension and diabetes. On the other hand, the strong political drive to reduce hypertension through information and prevention in the community sphere should also be acknowledged (Yoshinaga and Une 2005).

9.3.2 A Basic Factor in the Increment of Mortality in Old Age: Tumors

Tumors and diseases of the respiratory system represent the two other main sets of mortality causes among the elderly in Spain and in other countries in Spain's immediate vicinity. Figure 9.6 shows the progressive increment in mortality associated with the whole group of tumors—for women aged 90 +, the rate rose from 1,128 deaths per 100,000 inhabitants in 1975–79 to 1,419 in 2005–06 (2,022 to 3,116 for men aged 90 +). Differences by sex are very interesting within this set of causes, with male mortality being much higher than female mortality, indicating that the overall higher male mortality shown in Fig. 9.6 is related to the higher values of male mortality caused by these illnesses. In women, we can observe stabilization in mortality from tumors with a slight tendency towards decline within the 65–79 age group, something that is also evident in the case of men of the same age in the final years of this period. The percentages of malignant neoplasms in relation to the total number of deaths increased remarkably in these 30 years, among both women and men. The prevalence is much higher in the 65–79 age group—where malignant neoplasms represent more than one third of the total number of deaths—than in the 80–89 age group, where they only account for 20 % of deaths, or the 90 + age group, where cancer is responsible for less than 10 % of deaths. Furthermore, the prevalence of cancer is much higher in men than in women, especially within the 65–79 age group.

The rise of mortality by cancer is in line with the current epidemiological transition in which we currently find ourselves. Its incidence can be seen to rise as aging progresses. Aging raises the probability of death, since cells display greater somatic mutations and chromosomal abnormalities—many of which may cause cancer—leading to the increase of tumors among the longer-lived populations of today. In addition to these biological factors which are linked to the greater longevity of the

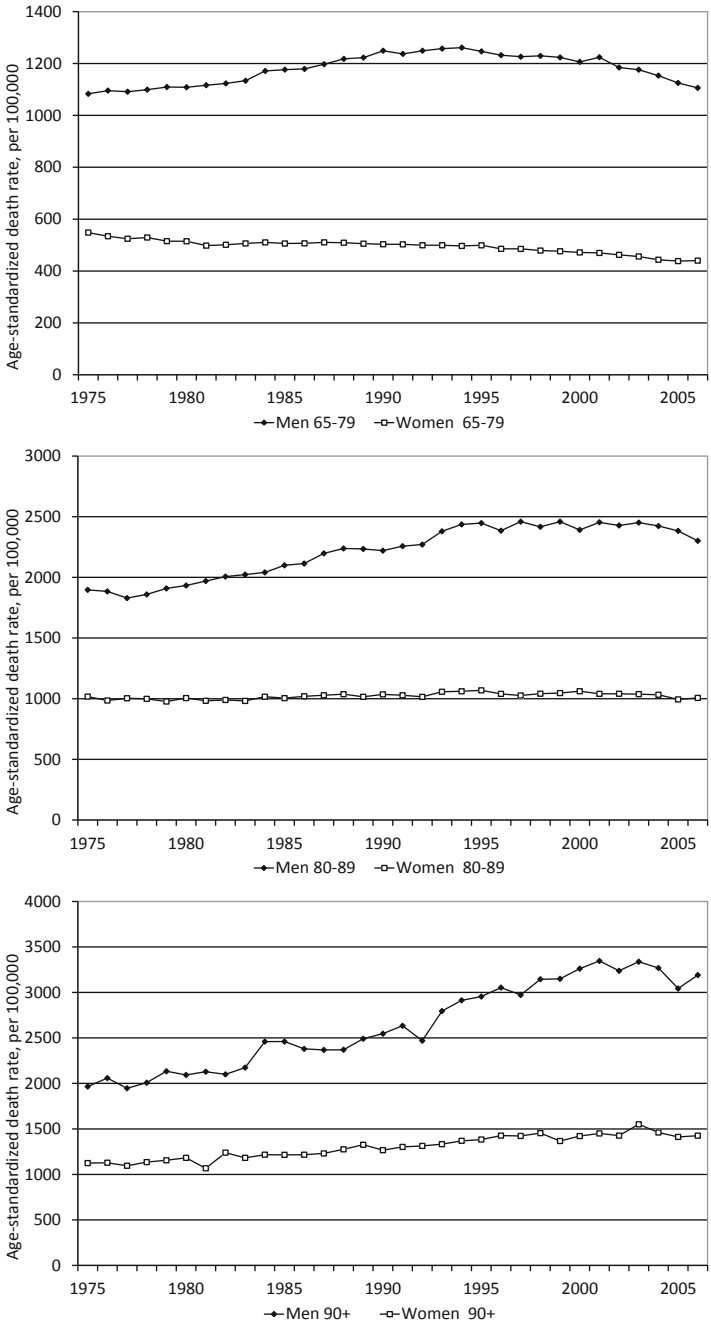

Fig. 9.6 Mortality from malignant neoplasms. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

human species, the rising incidence of cancer is also due to the growing prevalence of certain habits that interfere with health—such as smoking and alcohol consumption—and are associated with changes in diet and lifestyle, and to the exposure to carcinogenic agents (Waldron 1983). In this sense, one goal of the growing research in this field should be to differentiate—depending on the type of cancer to which we are referring—between, on the one hand, behavioral and societal factors and, on the other, the advent of genomic and proteomic technology (at a cellular and molecular level). These types of factors will both shape the future panorama concerning the prevention of these diseases.

It is essential to describe the distribution by age and sex of malignant neoplasms, although the evolution of mortality from certain tumors has followed different, and even disparate, trends Although our main objective is not to analyze each one cause making up this wide group, but rather to concentrate on those exhibiting higher divergence by sex, it is necessary to highlight here some other causes which have shown a relevant development. Deaths from stomach cancer dropped over the course of this period, as happened also in other countries (Klenk et al. 2007), while malignant colon neoplasms notably increased from 1975–79 to 2006, both by sex and age. Both sexes share the same pattern, although this kind of tumor has a lower prevalence among women than among men. Studies carried out in other countries reveal a similar mortality pattern for cancer, both as concerns the decrease in mortality caused by stomach cancer and in relation to the rise in mortality associated with colon neoplasms.

This tumor is a special case, since it seems to be more prevalent in the Spanish population than in other countries. Mortality caused by colon tumors has had a very peculiar evolution, since at the beginning of the period the rates were very similar for men and for women, but male mortality attributable to this cause "took off" starting in the 1980s and rates more than tripled over the course of the three decades analyzed. Mortality from this cause also increased among women, coming to exceed breast cancer by the beginning of the 1990s[5].

9.3.3 An Element of Circumstantial Irregularity in the Decreasing Trend of Mortality: Respiratory System Diseases

Diseases of the respiratory system have been the other traditional group of diseases causing higher mortality in Spain. Figure 9.7 shows the fairly irregular decline of mortality from respiratory diseases. This irregular decline in the incidence of death from respiratory diseases leads to a net result in 2006 that reverses the 1975–79 situation, with tumors coming to represent the second leading cause of death among the elderly, displacing respiratory diseases to a third position. This erratic trend is similar in men and in women, and for all age groups.

[5] Mortality due to pancreas, rectum, anus, bladder and lymphatic cancers also increased, although their respective levels are much lower than those discussed above.

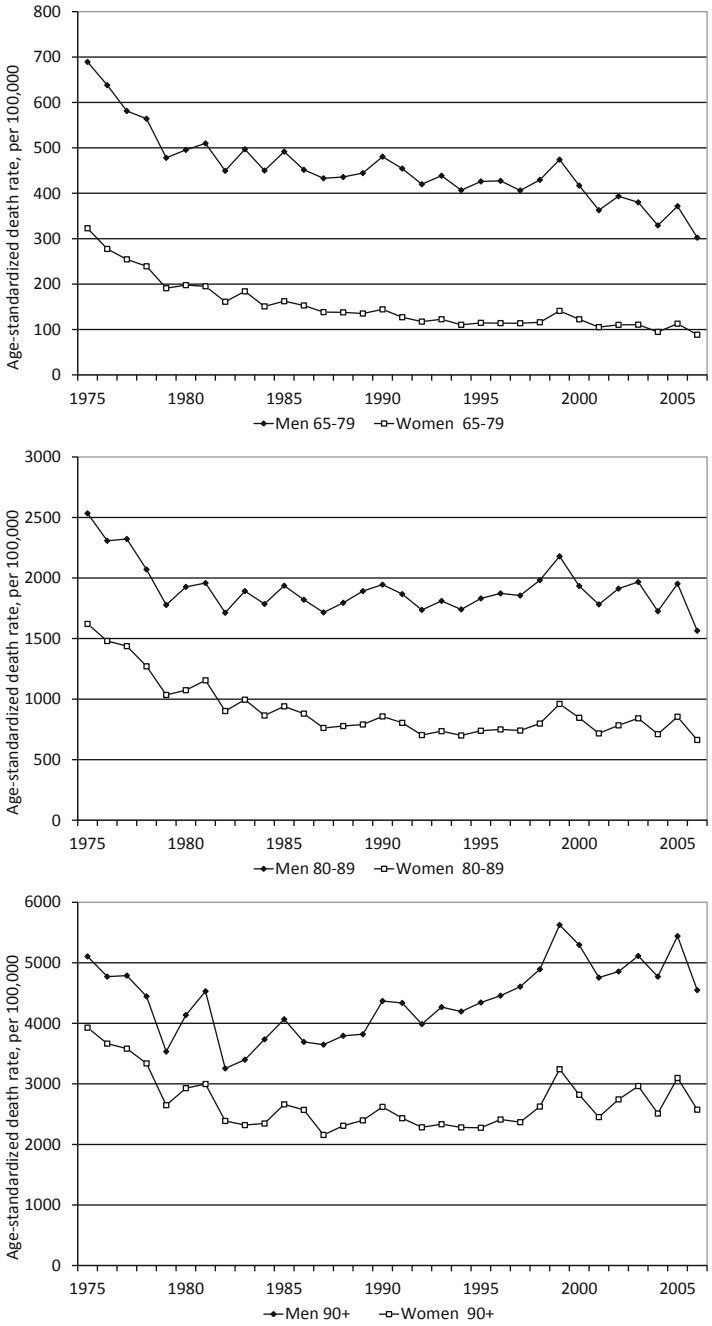

Fig. 9.7 Mortality from diseases of the respiratory system. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

Fluctuations, which respond to epidemic patterns associated with influenza or other related illnesses such as pneumonia or broncho-pneumonia, characterize the evolution of the prevalence of respiratory diseases. These illnesses have a high incidence among the elderly, who are very vulnerable to them (Horiuchi 2006). Focusing on this elderly group, it should be noted that a recent increase in mortality rates from respiratory diseases in both sexes has recently followed the previous decline. In addition, a certain number of causes in this set show a very marked seasonal pattern during both the winter and summer months, punctuated by episodes such as the heat wave of 2003. The evolution of two main causes of death in this set (pneumonias and chronic diseases of the lower respiratory system), evidences a very high male over-mortality. This is especially true of chronic lower respiratory diseases, which are closely associated with both prolonged tobacco consumption and with exposure to toxic substances linked to certain occupations.

9.3.4 A Brake on the Extension of Life Without Disability: Mental Disorders and Nervous System Diseases

Mortality by sex from mental disorders and diseases of the nervous system shows the greatest proportionate increase during the period under study. The great interest of these two causes stems from their impact on disability conditions among the elderly population, from the creation of dependency and also from the fact that they are the only two causes of death that present female over-mortality at older ages.

The introduction of the ICD-10 in 1999 gave rise to a diagnostic shift away from mental disorders and behaviors and towards diseases of the nervous system (Ruiz et al. 2002). In fact, dementias of the Alzheimer type, which were previously included in the group of organic senile and pre-senile psychoses, “left” the category of mental disorders and, together with Alzheimer, joined the category of nervous system diseases, causing a decline in the former and a progressive rise in the latter over the course of recent years. In this analysis, we consider both causes as a source for the potential growth of poor health and dependency at the end of the life cycle among the elderly. This is the reason why we describe these sets of causes as pillars in the recent evolution of mortality. At the same time, we believe that these causes show evidence of future changes in Spanish mortality, with a very possible convergence of mortality among older men and women. Due to their specific relevance, we postpone the analysis of these two sets of causes to the next section of this work.

9.4 Specific Signs of Changes Towards Convergence

In this section we shall analyze some causes of death that show indications of changing trends that might become important factors in the future evolution of differential mortality in Spain, something we already outlined above.

9.4.1 The Impact of Changing Habits: Tobacco Consumption

Malignant larynx and trachea/bronchus/lung neoplasms We find a significant increase in mortality caused by cancer of the larynx and trachea/bronchus/lung [6], the type of tumor that has contributed most heavily to the overall mortality from this type of disease (Fig. 9.8). Malignant larynx and trachea/bronchus/lung neoplasms have a much higher incidence among men (basically associated with tobacco consumption) than among women at these ages (Peto and López 1994). The prevalence of this type of cancer increased during the period studied, although this tendency shifted during the 1970s and only recently experienced a slight reduction. The magnitude of this increase is so great that the incidence of this kind of tumor has come to exceed that of prostate cancer, by far the most prevalent kind of cancer among men, as we will see later.

In the near future, we could expect a trend towards convergence of male and female mortality caused by tumors associated with tobacco consumption. Larynx and lung tumors are two significant examples. Figure 9.8 shows that there is an emerging trend among men to reduce their mortality from this cause—a trend that is well known to be linked to the prevention of unhealthy habits (tobacco). This has been especially evident within the 65–79 age group during the last years under study. We might already be experiencing a slight decrease a result of the expansion of preventive behaviors and the giving up of this habit.

On the other hand, there is not yet any convergence in the levels of male and female mortality associated with these types of cancer (Peto and Lopez 1994; Pampel 2002a, b), despite the currently high tobacco consumption habit of Spanish women, which, however, did not exist in the past among those cohorts making up the older population today. Women's adoption of certain masculine habits that had been traditionally absent among women in the past occurred in Spain with a certain delay as compared to other countries and, thus, no indications of its possible effects and consequences are yet noticeable, at least among the cohorts included in the age groups under study.

9.4.2 Changing Trends Associated with Social and Health Prevention

Diabetes

Diabetes is another cause for which prevention through medical care, pharmacological treatments, periodic controls, a healthy diet and habits are important. Diabetes is a traditional cause of female over-mortality; however, its evolution benefited women

[6] In the Eurostat classification larynx neoplasm is always linked to trachea/bronchus/lung neoplasms.

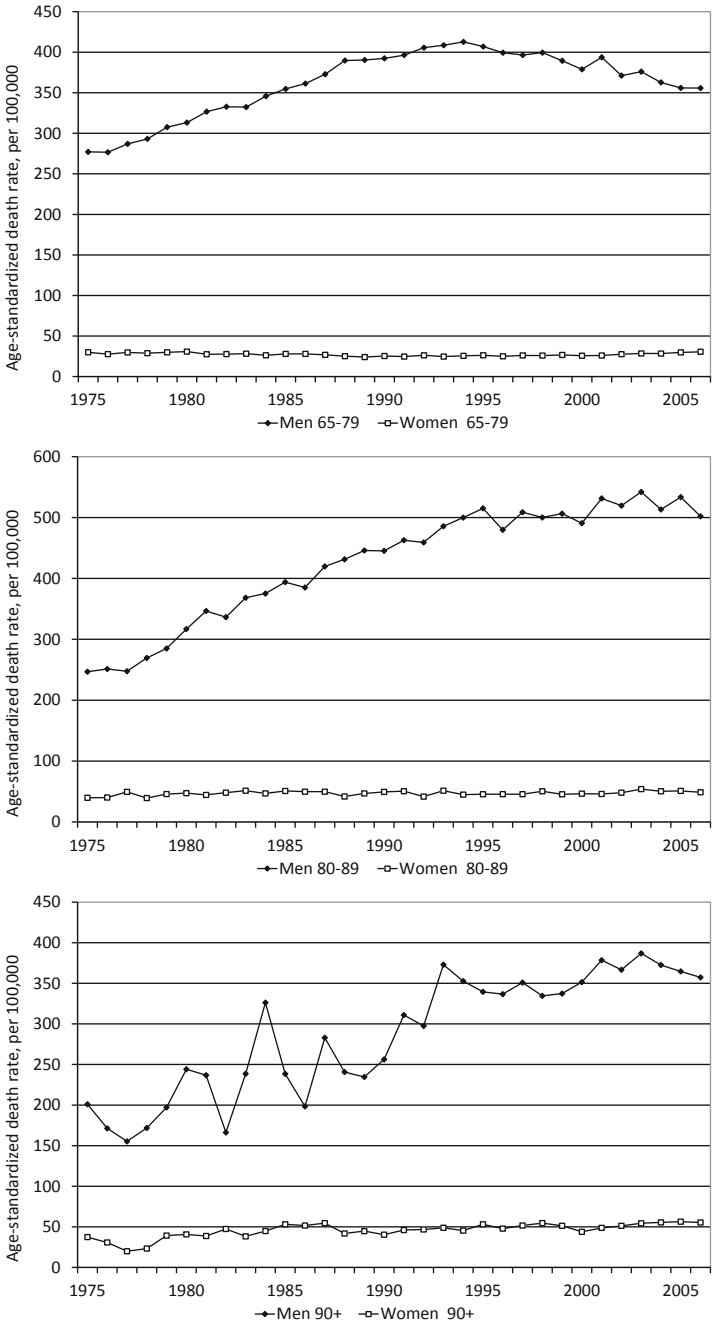

Fig. 9.8 Mortality from malignant larynx and trachea/bronchus/lung neoplasms Men and women 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

aged 65–79 during the 1980s, leading to a lower level of female mortality as compared to men from the middle of the 1990's (Fig. 9.9). This is evident among younger old women, but not in the other two age groups. As we know from health surveys, women are more willing to contact family doctors and carry out periodic controls and prescriptions than men are. Since the 1980's, diet care, medication and diabetes control are widespread among the older Spanish population.

Malignant Prostate and Breast Neoplasms

There are two sex-specific causes of death, breast and prostate cancer that, although they have quite different etiology and treatment, are both very sensitive to early detection. Thus, prevention plays an important role in reducing mortality from these causes. Improvements in the diagnosis and specific therapies to treat these two types of tumors have had different effects on each age group, although the evolution of the overall impact is similar in older male and female populations.

Breast cancer is one of the diseases with a very high impact on women's health. For this reason, the European Union Expert Committee recommended launching programs for the early diagnosis of gynecologic cancers as the best option, considering the impossibility to act on most of the risk factors (age, family genetics, premature menarche and delayed menopause, late pregnancy and absence of offspring, etc.). Current medical knowledge, as applied in these programs and in high quality therapies, guarantees a significant decrease of mortality. These programs were adopted regularly in Spain in 1993 (González et al. 2007).

In the case of breast tumors, there has been a clear decrease from the middle of the 1990's within the younger old women group, turning around the increasing trend from previous decades. On the other hand, mortality among women aged 80 and older does not show such a trend, although in the last years there is evidence within the 80–89 age group that points to stabilization (Fig. 9.10). These results reflect the fact that the early diagnosis programs were first implemented in women aged 50 to 65 years. Later on, they were extended to women aged 40–50, but up to the present no general protocol for periodic gynecologic controls has been implemented in older Spanish women, especially in those over 80 years. Even with this limitation, survival from this tumor in Spain is high, and it keeps improving (Alcaraz 2002).

In the case of prostate cancer, both its easy detection (although the generalization of the diagnostic test is still under way) and the availability of outpatient treatment have also led to a mortality decrease since the 1990s, particularly among men aged 65–79 (Fig. 9.11)

Diseases of the Respiratory System

Better living conditions at home and in residential areas, as well as the availability of medical treatments for diseases of the respiratory system (a major cause of death) have allowed a reduction in mortality from this cause among the older population. Prevention and pharmacological therapies have also played an important role here: this is first seen in the decrease of deaths due to pneumonia (Fig. 9.12), followed later

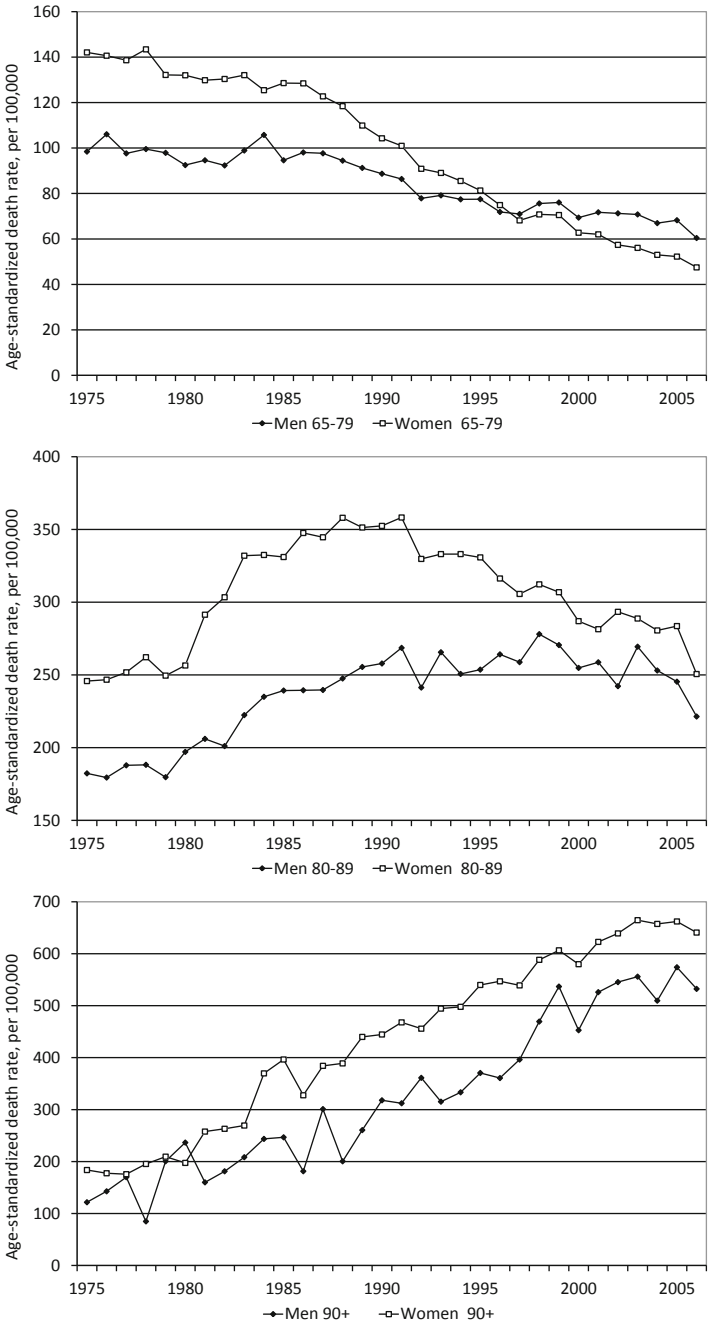

Fig. 9.9 Mortality from diabetes. Men and women 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

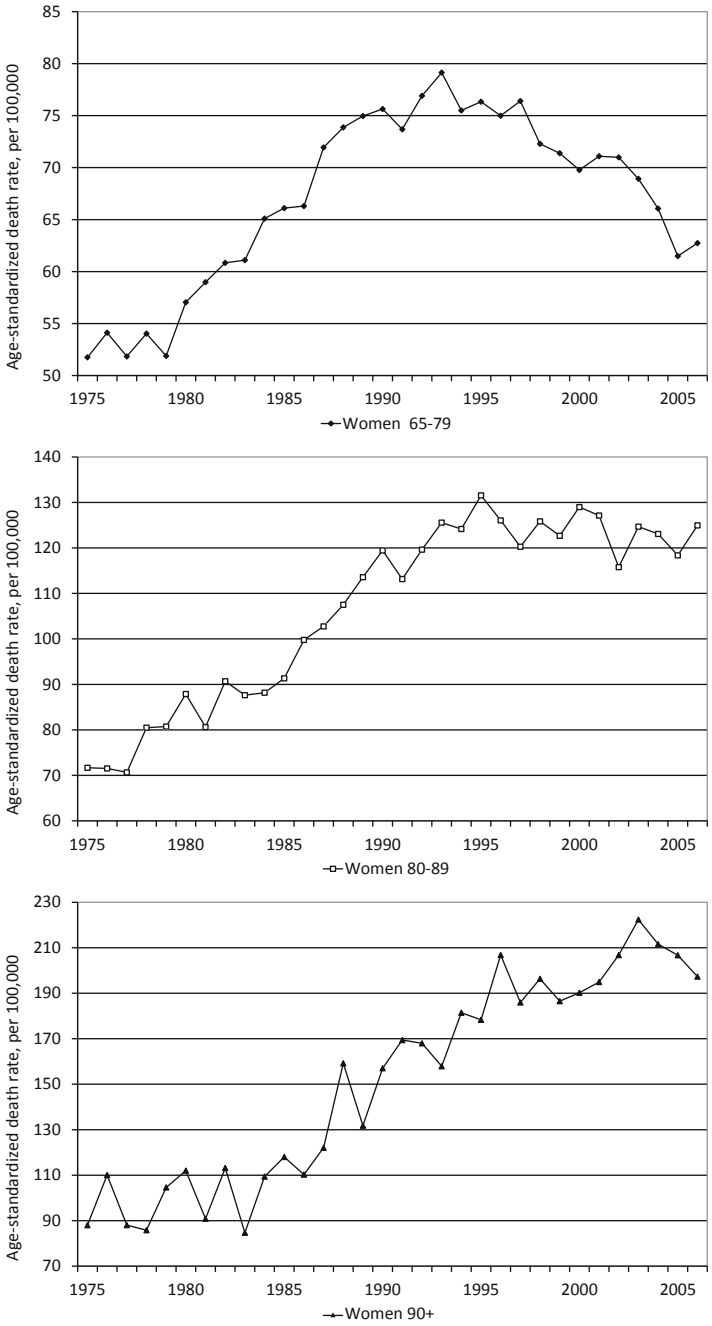

Fig. 9.10 Mortality from malignant breast neoplasms. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

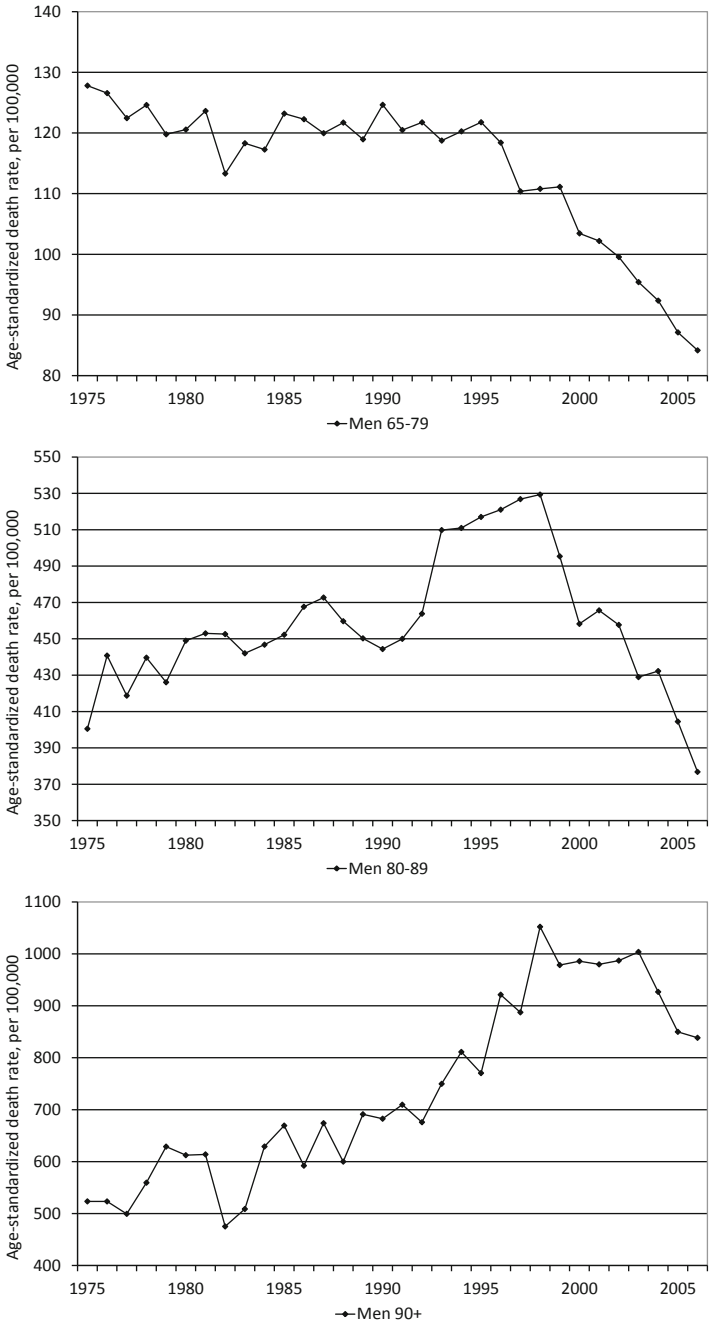

Fig. 9.11 Mortality from malignant prostate neoplasms. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

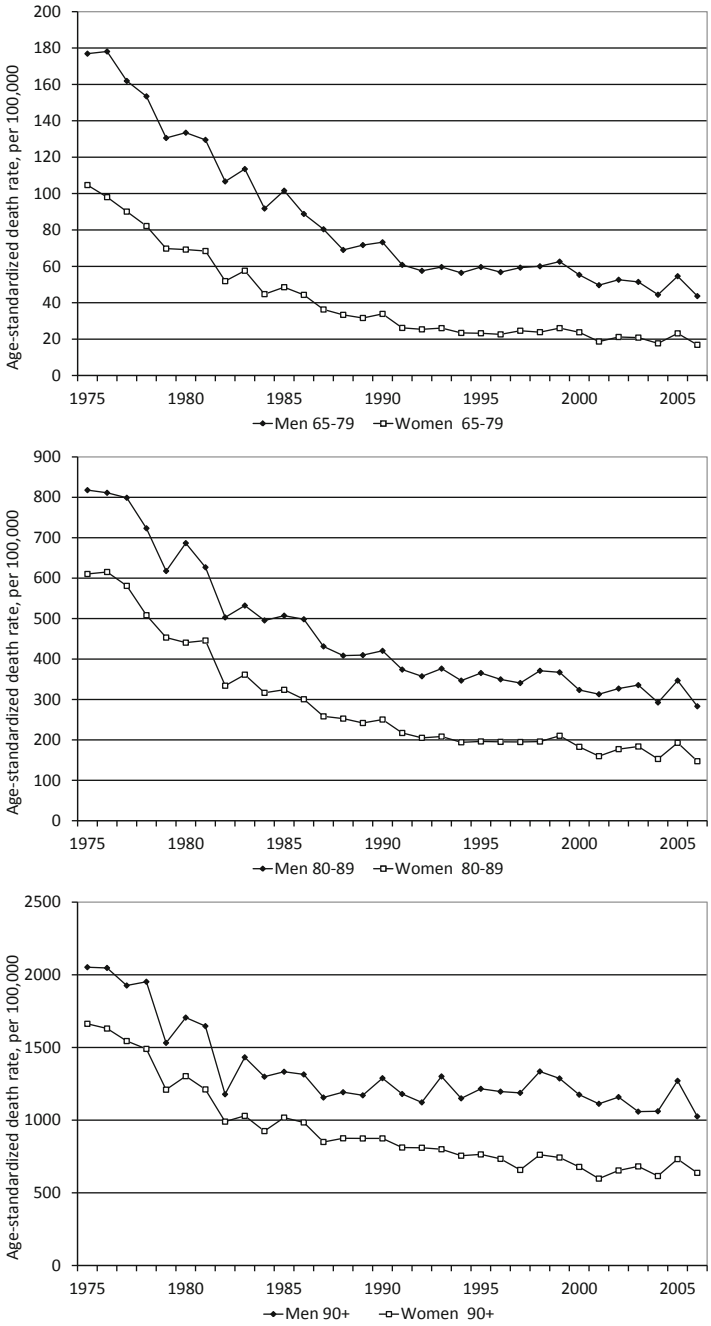

Fig. 9.12 Mortality from pneumonia. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

by the prevention of influenza (Fig. 9.13). Vaccination campaigns for the second age group, together with appropriate medicines, have had a great effect on the survival of the most fragile population.

Differences between men and women are evident in chronic lower respiratory diseases, but the mortality trend for these illnesses during this period shows an overall stabilization (Fig. 9.14). Men's over-mortality, partially caused by tobacco consumption, might explain the relative stagnation of mortality due to this cause observed in every age group during the last years.

9.4.3 The Impact of Differential Behavior in External Causes of Death

In 2006, deaths caused by external causes amounted to 4 % of the total number of deaths (14,830), and to more than 2 % of the deaths among those over 65 years (4,577). Since 1975, mortality from these causes has not experienced any clear and substantial improvement. Due to the heterogeneity of the different causes included in this set (car accidents, suicide, self-harm, homicides, accidental poisoning and falls), there are important divergences between their mortality rates by age and sex (Fig. 9.15).

Despite the fact that improvement in prevention[7] as well as in the quality of the physical and social environment are of special relevance in the evolution of mortality from most of these causes, deaths due to them have not experienced a clear decrease during this period. An example of this are deaths by accidental falls (Rubenstein 2006), a major source of disability and death among the elderly. On the other hand, within the global set of external causes of death, sex-related differences in mortality are evident in any age group, and we have only detected a slight decrease of mortality due to these causes among the younger old.

9.4.4 The Impact of Demographic Structure: Age and Sex

Mental disorders and nervous diseases Mental disorders and nervous diseases are the only ones showing an important increase during this period, especially at more advanced ages and during the past few years. The increasing trend of mental disorders throughout almost the entire period is also evident in the case of nervous diseases, although at a smaller rate, especially during the last years. This is of major importance due to the consequences it has for the quality of life of the older people and of ageing societies as a whole.

[7] These factors have improved in Spain during the last years through the proper design and implementation of architectural barriers, both at home and outside, as well as by increasing home support services for older people. In addition, health assistance in general, including surgical interventions for the elderly, has also been improved.

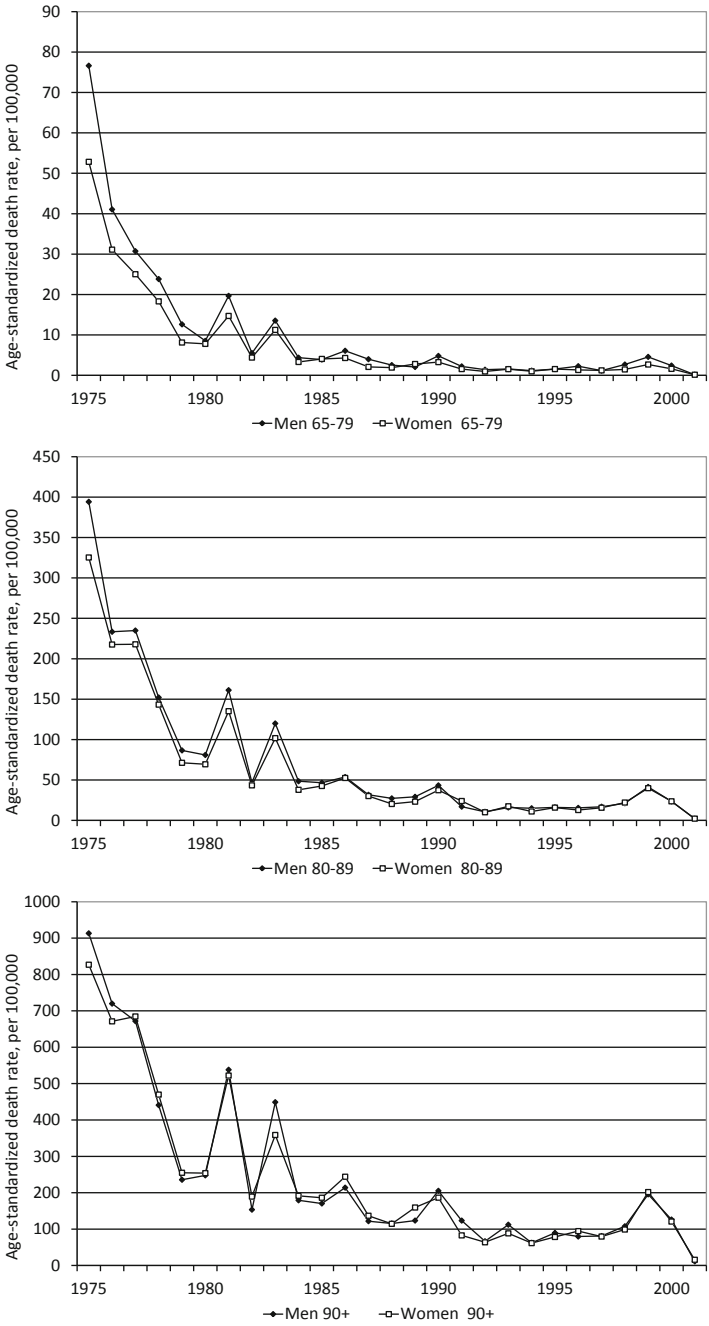

Fig. 9.13 Mortality from influenza. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

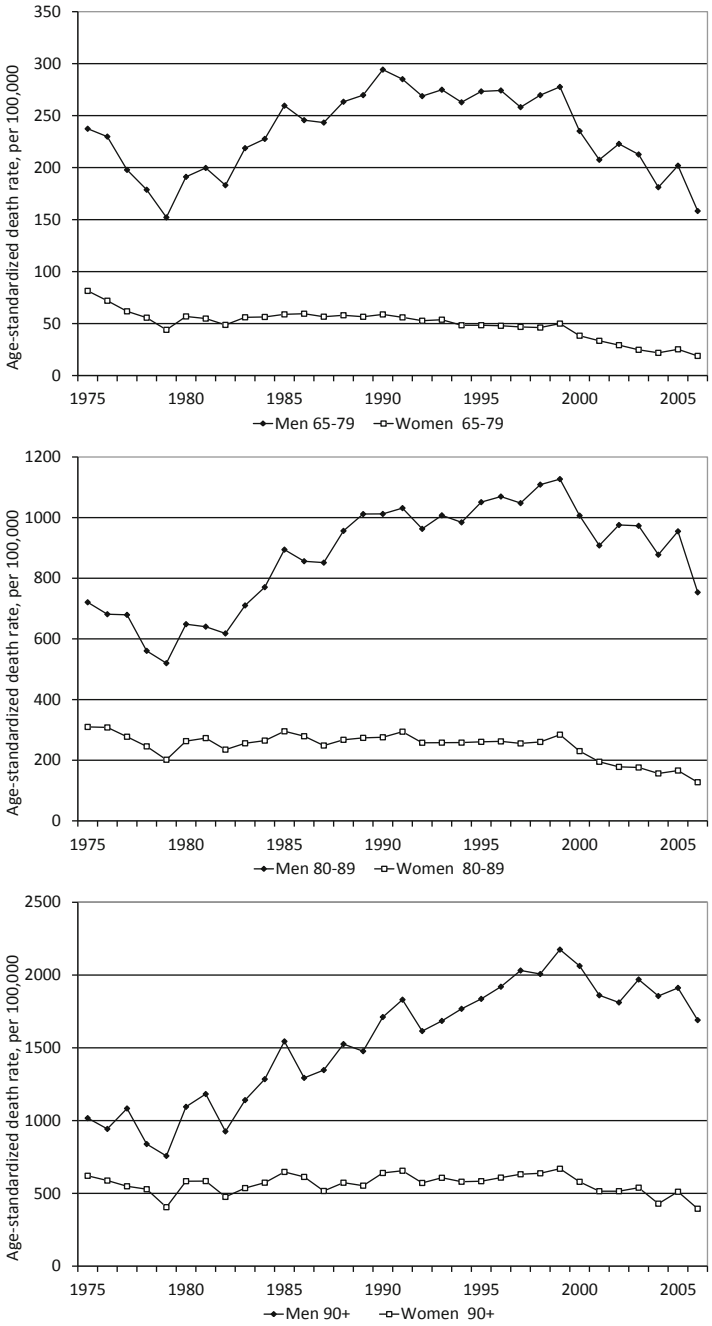

Fig. 9.14 Mortality from chronic lower respiratory diseases. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

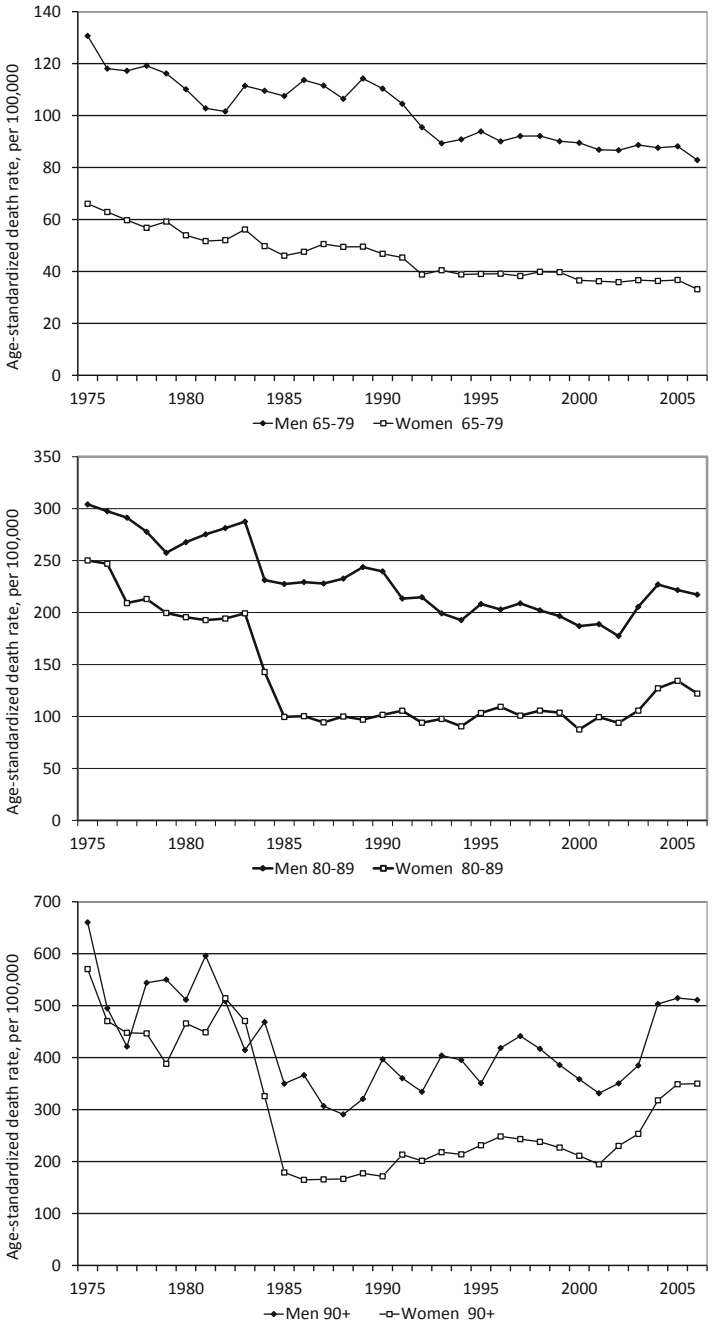

Fig. 9.15 Mortality from external causes. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

The data series on nervous diseases and mental disorders are affected by the introduction of the ICD10. We will study them in parallel in order to allow the detection of potential diagnostic transfers between them. It is worth pointing out here that one of the most relevant among nervous system diseases, Alzheimer, determines the evolution of the whole group.

In the last few years there has been a trend towards the stabilization of mortality caused by mental disorders but this, in turn, has been counterbalanced by an increase in the number of deaths caused by nervous system diseases during the same period. Although the stabilization of mortality from mental diseases may be influenced by the above mentioned revision of the ICD, we cannot eliminate the possibility that improved medical care and therapies that affect the quality of life of old people suffering from mental disorders could have a certain impact on their health conditions. In any case, the situation is quite different from the one these age groups experienced in the past (Figs. 9.16 and 9.17). Regarding these two sets of causes, there is a slight over-mortality among men in the younger age group (65–79). Nevertheless, there are almost no differences between men and women at more advanced ages, although a slight women's over-mortality has been observable during the last years, contributing to a certain convergent trend.

All in all, in elderly populations such as the Spanish one, it is not necessary to insist on the importance of the rise in morbi-mortality associated with this kind of illness, due to the growing longevity of the Spanish population (Puga and Abellán 2004) these illnesses generate a longstanding dependency among the elderly, and this should be a main target when setting the corresponding public policies.

These two sets of causes constitute a potential brake on the extension of healthy life and on the achievement of the final objective of demographically advanced societies, which is to live longer without disability. The existence of long-lived populations in the absence of disability may represent a new stage in the mortality transition (Vallin and Meslé 2004), but this stage may not be reached if mental and nervous diseases continue to spread in aged societies. On the other hand, if that happens, the feminization of disability will also continue to rise as a result of the existing sex-based differences in mortality and disability. It is for this reason, and because their evolution in recent years will play a determining role in the existing relationship between the extension of the median life span once old age has been reached and the extension of the period of social dependency at the end of the life cycle, that we have paid special attention to these two causes of death.

9.5 Discussion

Understanding the epidemiological profile of the elderly population today is essential in order to estimate the evolution of future life expectancy. In this sense, in order to contribute to the theoretical framework of the health transition in Spain, it is necessary both to follow the evolution of the main causes of death determining survival and to focus on those causes that show signs of changing trends.

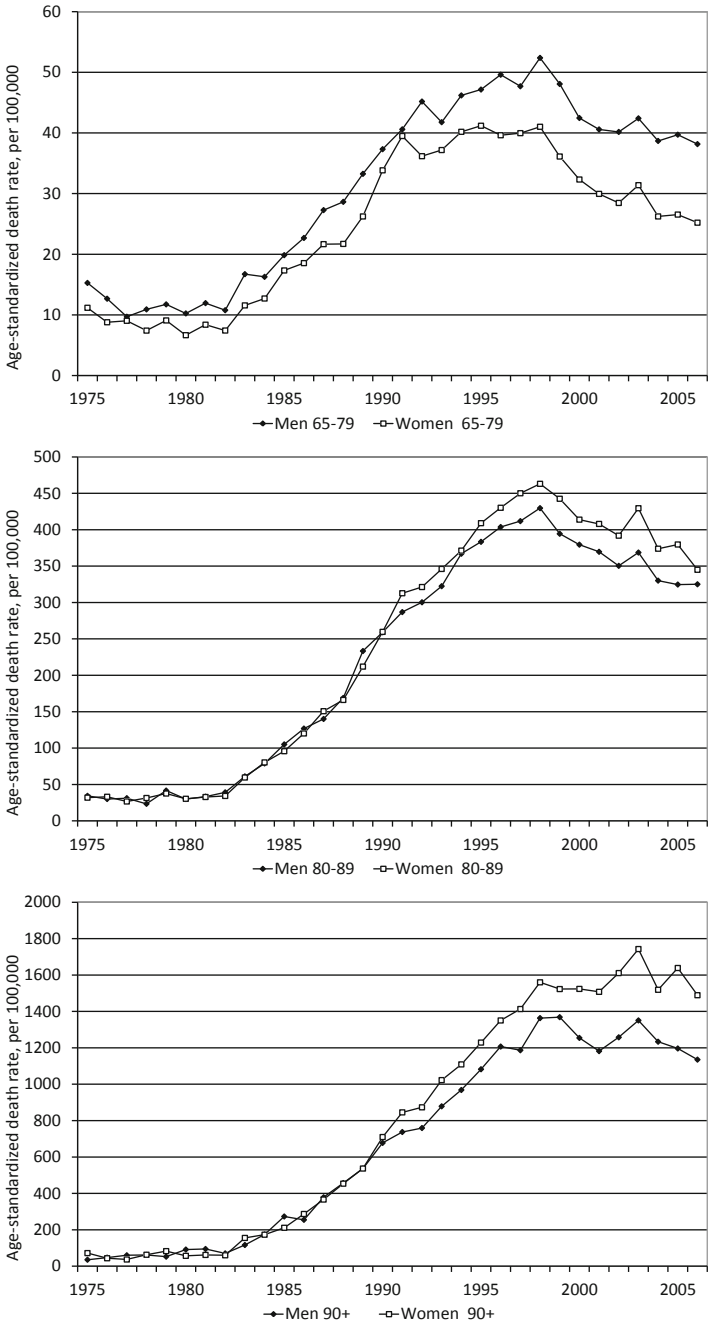

Fig. 9.16 Mortality from mental disorders. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

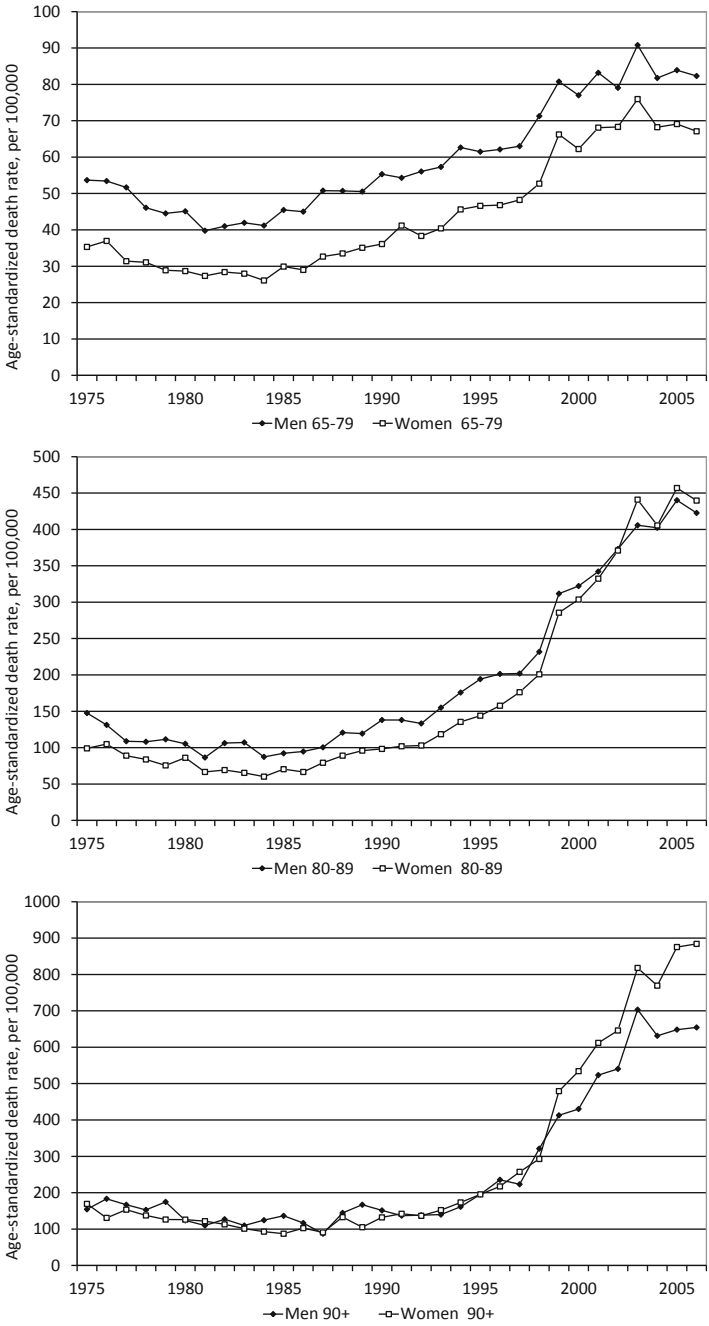

Fig. 9.17 Mortality from diseases of the nervous system. Men and women. 65–79, 80–89, and 90 + years. 1975–2006. (Source: Own elaboration with data from the HMD and the INE)

Our results confirm that the significant decrease in mortality among the elderly population during the period under study was largely driven by a decline in circulatory diseases, especially cerebrovascular illnesses. This constant fall in mortality is a trend induced by an authentic cardiovascular revolution—the main agent behind the observed increase in longevity among Spaniards. While the decrease of mortality from respiratory diseases also contributed to this decline, it did so to a much lesser extent and its contribution was more irregular.

On the other hand, within the group of death-causing diseases that grew in prevalence over the course of these three decades, the key role is played by tumors (mortality from stomach and liver cancer was the only tumor-induced mortality to decline during this period). Without a doubt, the evolution of mortality caused by malignant tumors will determine the rise or stabilization of life expectancy in upcoming years, given its enormous importance in relation to overall mortality.

Regarding sex differences, the maintenance of important sex-based differences is mainly due to higher male mortality, caused, first of all, by tumors and, secondly, by respiratory diseases. The differential evolution of these causes has led to the existence of a 25 year lag in men's, as compared to women's, longevity.

After defining the evolution of the main causes of death, we have focused especially on those causes which have affected men and women differentially. Our results show that some of them (basically tumors) show indications of potentially convergent trends. These signs are more prominent in the case of larynx, trachea, bronchus and lung tumors, which are decreasing among men aged 65–70. Consequently, this might contribute to men's mortality approaching the demographic position of women in the future.

In the case of Spanish old women, and taking into account the cohort factor, we have not yet detected the effects of the younger generations' changing unhealthy habits and behaviors during the last decades. This might be an additional potential convergence factor between male and female mortality, although empirical evidence must still be obtained. Also, advances in the treatment of prostate tumors have guaranteed an increase in the life span of men below 89 years. Nevertheless, the disappearance of women's over-mortality due to diabetes is no less relevant, just as much as the decrease of breast cancer among women aged 65–79 years. Regarding the privileged situation of women, we observe a single exception to traditional male overmortality: the diseases of the nervous system and mental disorders at very old ages.

In conclusion, we have found that, while the general decreasing trend in mortality is maintained, several recent changes in the Spanish older population may be pointing to modifications in the known trends of differential sex mortality. The final balance must take into account the new signs of convergence, but also the foreseeable obstacles for the increase of the life span of both men and women.

Acknowledgments This work was supported by Grant CSO2010–18925 from the Spanish Ministry of Science and Innovation. We would like to acknowledge the former members of the group for their past contributions to our previous project SEJ2006–10972. We especially want to express our recognition to Elena Robles for her contribution to the database of causes of death which was developed in the previous research project.

9.6 Annex. Causes of death. European Shortlist. Eurostat

Nr	**All causes of death**			ICD–10 code	ICD–9 code	ICD–8 code
				A00–B99	**001–E999**	**000–E999**
01	*Infectious and parasitic diseases*			A00–B99	001–139	000–136
02		Tuberculosis		A15–A19,B90	010–018,137	010–019
03		Meningococcal infection		A39	036	036
04		AIDS (HIV-disease)		B20–B24	042–044	–
05		Viral hepatitis		B15–B19	070	070
06	*Neoplasms*			C00–D48	140–239	140–239
07		Malignant neoplasms		C00–C97	140–208	140–209
08			of which malignant lip, oral cavity, pharynx neoplasms	C00–C14	140–149	140–149
09			of which malignant esophagus neoplasms	C15	150	150
10			of which malignant stomach neoplasms	C16	151	151
11			of which malignant colon neoplasms	C18	153	153
12			of which malignant rectum and anus neoplasms	C19–C20–C21	154	154
13			of which malignant liver and intrahepatic bile ducts neoplasms	C22	155	155
14			of which malignant pancreas neoplasms	C25	157	157
15			of which malignant larynx and trachea/bronchus/lung neoplasms	C32–C34	161–162	161–162
16			of which malignant skin melanoma	C43	172	172
17			of which malignant breast neoplasms	C50	174–175	174
18			of which malignant cervix uteri neoplasm	C53	180	180
19			of which malignant neoplasms of other parts of uterus	C54–55	179,182	182
20			of which malignant ovary neoplasms	C56	183.0	183.0

Nr	**All causes of death**			ICD–10 code	ICD–9 code	ICD–8 code
				A00–B99	**001–E999**	**000–E999**
21			of which malignant prostate neoplasms	C61	185	185
22			of which malignant kidney neoplasms	C64	189.0	189.0
23			of which malignant bladder neoplasms	C67	188	188
24			of which malignant neoplasms of lymph./hematopoietic tissue	C81–C96	200–208	200–209
25	*Diseases of the blood(-forming organs), immunologic disorders*			D50–D89	279–289	280–289
26	*Endocrine, nutritional and metabolic diseases*			E00–E90	240–278	240–279
27		Diabetes mellitus		E10–E14	250	250
28	*Mental and behavioral disorders*			F00–F99	290–319	290–315
29		Alcohol abuse		F10	291,303	291,303
30		Drug dependence, toxicomania		F11–F16,	304–305	304–305
31	*Diseases of the nervous system and the sense organs*			G00–H95	320–389	320–389
32		Meningitis (other than 03)		G00–G03	320–322	320
33	*Diseases of the circulatory system*			I00–I99	390–459	390–444.1
34		Ischemic heart diseases		I20–I25	410–414	410–414
35		Other heart diseases		I30–I33,	420–423,	420–423,
36		Cerebrovascular diseases		I60–I69	430–438	430–438
37	*Diseases of the respiratory system*			J00–J99	460–519	460–519
38		Influenza		J10–J11	487	470–474
39		Pneumonia		J12–J18	480–486	480–486

Nr	**All causes of death**			ICD–10 code	ICD–9 code	ICD–8 code
				A00–B99	**001–E999**	**000–E999**
40		Chronic lower respiratory diseases		J40–J47	490–494,496	491–493,518
41			Of which asthma	J45–J46	493	493
42	*Diseases of the digestive system*			K00–K93	520–579	520–577,444.2
43		Ulcer of stomach, duodenum and jejunum		K25–K28	531–534	531–534
44		Chronic liver disease		K70,K73–74	571.0–571.9	571.0–571.9
45	*Diseases of the skin and subcutaneous tissue*			L00–L99	680–709	680–709
46	*Diseases of the musculoskeletal system/connective tissue*			M00–M99	710–739	710–738
47		Rheumatoid arthritis and osteoarthrosis		M15–M19	714–715	712–713
48	*Diseases if the genitourinary system*			N00–N99	580–629	580–629,792
49		Diseases of kidney and ureter		N00–N29	580–594	580–594
50	*Complications of pregnancy, childbirth and puerperium*			O00–O99	630–676	630–678
51	*Certain conditions originating in the perinatal period*			P00–P96	760–779	760–779
52	*Congenital malformations and chromosomal abnormalities*			Q00–Q99	740–759	740–759

Nr	**All causes of death**			ICD–10 code	ICD–9 code	ICD–8 code
				A00–B99	**001–E999**	**000–E999**
53		Congenital malformations of the nervous system		Q00–Q07	740–742	740–743
54		Congenital malformations of the circulatory system		Q20–Q28	745–747	746–747
55	*Symptoms, signs, abnormal findings, ill-defined causes*			R00–R99	780–799	780–782.3, 782.5–791, 793–796
56		Sudden infant death syndrome		R95	798.0	–
57		Unknown and unspecified causes		R96–R99	798.1–9,799	795–796
58	*External causes of injury and poisoning*			V01–Y89	E800–E999	E800–E999
59		Accidents		V01–X59	E800–E929	E800–E929, E940–E942
60			Of which transport accidents	V01–V99	E800–E848	E800–E845
61			Of which accidental falls	W00–W19	E880–E888	E880–E887
62			Of which accidental poisoning	X40–X49	E850–E869	E850–E877
63		Suicide and intentional self-harm		X60–X84	E950–E959	E950–E959
64		Homicide, assault		X85–Y09	E960–E969	E960–E969
65		Events of undetermined intent		Y10–Y34	E980–E989	E980–E989

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