Chapter 1

INTRODUCTION

1.1 Introduction

“Throughout man’s history, population size has fluctuated, at times widely, mainly in response to variation in mortality. While direct observations are lacking, it seems probable that numbers increased substantially whenever the conditions of life improved, for example after cultivation and domestication of plants and animals at the time of the first agricultural revolution ...” (McKeown, 1976).

Sixty years ago, Notestein et al. (1944) proposed the demographic transition theory to explain how changes in mortality and fertility influenced population growth. The basic demographic transition model describes a three-stage process during which slow population growth gives way to a period of rapid population growth, before reverting back to slow growth. In the pre-transitional stage, both fertility and mortality rates are high, although mortality rates fluctuate in response to intermittent epidemics, wars and famines. During the pivotal transitional stage mortality falls while fertility remains high. Finally, in the post-transitional stage, fertility rates fall and eventually converge to mortality rates, such that the near equilibrium between birth and death rates that occurred in the pre-transitional stage is restored (Rockett, 1994). Due to this lag in the transition from high to low vital rates, there was a wave of population growth that moved across Europe with the current of modernisation (Notestein et al., 1944). However, the widespread introduction of modern methods of contraception in the 1960s caused the fall in fertility levels to accelerate and, by the end of the 1990s, fertility levels in all European countries except Albania were below the replacement level of 2.1 children per woman. Meanwhile, in much of Europe over the course of the 20th century life expectancy at birth has risen by about 30 years. The combination of these two trends has caused the population to age but, because of the postponement of death, in most Western European countries birth and death rates have yet to converge. The main exception is Germany that has experienced substantial natural decreases in the population since 1972 (Council of Europe, 2001, own calculations). In Eastern Europe the highest relative excess numbers of deaths are now found,
particularly in Latvia, Ukraine and Russia, as fertility has plummeted to extremely low levels and the declining trend in mortality during the course of the 20th century has stagnated since the 1960s and at times reversed. If the Western and Eastern European trends combined, we see that there has not been a natural increase in the total European population since 1993 (ibid.). Therefore, the only reason why the population is larger today than in 1993 is immigration from outside of Europe, with Western Europe being the main destination.

In other words, the main force of population growth is no longer dependent on the improvement of living conditions that augment the propensity to survive. That is, while during most of human history, population dynamics were determined by fluctuating rates of mortality, for the greater part of the 20th century the population has increased because the decline in fertility lagged behind the decline in mortality. Today, births rates are either similar to or less than death rates, which has made migration the main force of population growth.

It is clear that future demographic patterns will have a major impact on all facets of society, as ageing affects consumption patterns, the demand for health care, pension schemes and labour supply, and an increase in the population of people of foreign descent has far-reaching social consequences, and population growth in general has an impact on the physical environment and the housing market (De Beer and Van Wissen, 1999). What the three demographic components have in common is that economic factors play a major role in all this. For instance, migration is strongly influenced by economic differences between the place of origin and the place of destination (Massey et al., 1993). At the same time, economic deterioration and political instability have been vital determinants in the sharp decline in fertility levels in Eastern Europe, while institutional support to those with children in several Nordic countries have allowed their fertility levels to remain only slightly below replacement level (Pinnelli, 2001). Mortality, like fertility, is also the result of biological processes, but unlike fertility, there is no choice in the matter as everyone eventually dies. However, differences exist in the timing, because the genetically determined rates of functional loss can be accelerated (e.g. by the effects of smoking on pulmonary function) or slowed down (e.g. the effects of restricting fat intake on atherosclerosis) by changes in behaviour (Manton et al., 1991). These changes are, in turn, strongly influenced by socioeconomic factors.

The main purpose of this thesis is to identify the most important socioeconomic factors that cause mortality differences in Europe over time and space. The two other demographic components, fertility and migration, are dealt with in concurrent projects. Each project is part of the umbrella project entitled “Towards a scenario model for economic determinants in population dynamics” that seeks to design a new methodology to formulate consistent European population scenarios based on an explicit association between economic and demographic processes in Europe, and that falls under the auspices of the Netherlands Organisation of Scientific Research (NWO). The goal of this scenario instrument is to make clear the consequences of the continuation in the socioeconomic development in Europe, and the enlargement of the European Union in future demographic
developments. Other factors are only of interest if they intervene in the association between socioeconomic factors and mortality, or if their effect is considerable. The main contribution of this thesis is the quantification of the sensitivity of these factors that can be incorporated in mortality scenarios. Before the objectives and research questions are explained in more detail, some background information is given on how the current mortality patterns in developed countries have come to exist.

1.2 A background to declining levels of mortality

In parallel to the stages of the mortality component of the demographic transition model, Omran (1971) developed the epidemiological transition theory as he recognised several limitations of the demographic transition theory and the need for comprehensive approaches to population dynamics. The theory focuses on the complex change in patterns of health and disease and their demographic, economic and sociological determinants and consequences. Omran recognised that the changing pattern in mortality in the developed world, as indicated by the demographic transition, is defined by a number of successive phases. The first stage, “the age of pestilence and famine”, lasted until around 1875. Mortality was high and fluctuated due to epidemics, famines and wars, denying the population to follow a continuous growth path. Life expectancy was low and variable, varying between 20 and 40 years (Omran, 1971; see also Table 1.1). Around 1875 “the age of receding pandemics” started and this lasted until about 1930. During this period a rise in average life expectancy from about 30 to 50 years occurred that resulted in sustained population growth which began to follow an exponential curve. In this second stage, life conditions that were previously conducive to the spread of infectious and parasitic diseases, such as tuberculosis and diarrhoeal diseases, were rapidly replaced by more sanitary living conditions, improved medical technology and better lifestyles (Olshansky and Ault, 1986). Nevertheless, such diseases remained the leading causes of death, although non-infectious diseases did become more significant.

The third phase of the epidemiological transition is known as the “age of degenerative and manmade diseases” (Rockett, 1994). This stage is distinct from the earlier period because chronic conditions such as cancer and ischaemic heart disease (IHD1) gradually replaced communicable diseases as the leading causes of mortality. Mortality profiles in the developed world changed as large improvements were made in childhood survival rates that contributed largely to the advances made in life expectancy at birth. The level of mortality became low and stable, and the average life expectancy exceeded 70 years. It is during this stage that fertility becomes the crucial factor in population growth. During the second half of the century, improved survival rates at older ages also took place, resulting in a further increase in life expectancy. This occurred at a time when countries modernised and social, economic and health conditions improved. However, Omran is unclear as to

1 A list of all abbreviations that are used in the text are given in the Glossary.
when exactly the end of this stage will be reached, and if there will be a subsequent stage. In the updated version of 1983 he stated that during the third phase other diseases might replace certain degenerative and man-made diseases in terms of importance, depending on changes in medical knowledge, health care, lifestyles and the physical environment. He mentions a decline in mortality from IHD, but argues that the incidence of other diseases such as lung cancer have increased, resulting in only small net gains in life expectancy. He also indicated the possibility of a cessation in the decline in mortality, or even a temporal reversal, and acknowledged that communicable diseases had not totally disappeared as he had suggested earlier. Some communicable diseases would continue to exist as causes of death, such as influenza-pneumonia, and new communicable diseases might appear (Omran, 1983; Wolleswinkel-van den Bosch, 1998). AIDS is a good example of the latter.

Table 1.1  Life expectancy in several European countries (1750-2000)

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<tr>
<td>England</td>
<td>36.9</td>
<td>37.3</td>
<td>40.0</td>
<td>43.3</td>
<td>48.2</td>
<td>60.8</td>
<td>69.2</td>
<td>72.0a</td>
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<tr>
<td>France</td>
<td>27.9</td>
<td>33.9</td>
<td>39.8</td>
<td>42.1</td>
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<td>56.7</td>
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<td>Germany</td>
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<td>37.9</td>
<td>44.4</td>
<td>61.3</td>
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<td>71.0</td>
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<td>Italy</td>
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<td>35.4</td>
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<td>Netherlands</td>
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<td>32.2</td>
<td>36.8</td>
<td>41.7</td>
<td>49.9</td>
<td>64.6</td>
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<td>Sweden</td>
<td>37.3</td>
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<td>43.3</td>
<td>48.5</td>
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<td>63.3</td>
<td>71.3</td>
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<td>USSR</td>
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a United Kingdom; b Russian Federation.

As a result of several of the previously mentioned shortcomings of the epidemiological transition theory as proposed by Omran in 1971, and to take into account recent developments in morbidity and mortality, various researchers have proposed a fourth phase. For example, in response to the decline in mortality in the 1970s and 1980s that contradicted several of Omran’s earlier prepositions, Olshansky and Ault (1986) incorporated an ‘age of delayed degenerative diseases’ into the epidemiological transition. In particular, rapidly declining death rates were being seen in the advanced age groups, as mortality levels at young ages had already reached very low levels. As a consequence, life expectancy at birth increased, albeit less dramatically than in earlier phases. Although the distribution of degenerative causes of death had not changed much since the third phase, the age at which people died had progressively increased. A shift had occurred within the grouping of degenerative diseases as cancer mortality slowly increased and circulatory system diseases decreased. Most of the improvements in life expectancy were made at advanced ages, and mortality was declining at the same pace for men and women. Determinants that were identified for these epidemiological changes included medical technology and public health measures that
favoured older over younger people, health care programmes for elderly and poor people, as well as reductions in risk factors (Olshansky and Ault, 1986; Wolleswinkel-van den Bosch, 1998). As levels of mortality among young adults became very low and death rates among the more advanced age groups rapidly declined, the relative mortality from so-called social pathologies, such as homicide, cirrhosis of the liver, suicide and AIDS increased. At the same time, mortality was increasingly being influenced by lifestyle and individual behaviour. For this reason, Rogers and Hackenberg (1987) proposed naming the fourth phase of the epidemiological transition the “hybristic” stage, derived from the Greek word hybris that means “a feeling of invincibility or overweening self-confidence”.

While the epidemiological transition theory in this research is not used to investigate the validity of the theory, or to pinpoint in which phase a particular country belongs, it does provide the historical context in which this research is set. According to Omran (1971), the epidemiological transition theory forms an integral part of an attempt

“to crystallise the mechanisms of interaction that characterise the patterns, determinants and consequences of health changes in a variety of social contexts. The basic strategy is not only to describe and compare the mortality transitions of various societies, but more importantly, to lend theoretical perspective to the process of population change by relating mortality patterns to demographic and socioeconomic trends – both longitudinal and cross-sectional – through the developments of models”.

Therefore, within the framework of this thesis, the epidemiological transition aids the understanding of mortality differences over time and space, because it places current mortality patterns in a historical context that not only includes the description of mortality trends, but also the explanatory framework that caused them. In the context of European mortality, all countries are in one of the two final phases. In the case of much of Eastern Europe, the mortality pattern may still be considered to be in the third phase of the epidemiological transition as improvements in old-age survival have stagnated since the 1960s. However, these countries may eventually follow a similar pattern to ‘more advanced’ countries, although this will largely rest upon political and economic developments since such factors have played an important role in recent mortality trends of former Soviet Republics (Hertrich and Meslé, 1999) and other Eastern European countries (Guo, 1993). On the other hand, future changes in life expectancy in those regions that are currently at the forefront –

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2 Examples of detailed country-specific analyses include Nusselder (1998) for the Netherlands and Manton et al. (1991) for the US.

3 Not all AIDS deaths are considered as social pathological, particularly HIV acquired through mother-to-child transmission and blood transfusions. However, the proportion of HIV cases caused by both transmission types is small in Europe, as persistently high levels of risky behaviour among young people, especially injecting drug use, but also unsafe sex, is driving the epidemic, particularly in Eastern Europe (UNAIDS/WHO, 2003).
well into the fourth stage – may be largely determined by the development of social pathologies. Stagnation in the growth, or even a decline in the survival rates of individuals, will for the greater part be a reflection of developments in behaviour if they occur at young ages. In other words, factors that have been identified as either causing or preventing mortality – both directly or indirectly – are important in the explanation and development of mortality differences and patterns in both time and space. In terms of this thesis socioeconomic (and thus indirect) factors that affect mortality are of major importance.

1.3 Filling the research knowledge gap

In the field of modelling mortality, there has been a shift from the traditional trend-oriented approach to a more process-oriented one. In other words, the mechanisms of disease and mortality, rather than simple extrapolation, are used in model formulation (Manton and Stallard, 1984; Tabeau et al., 1998). It is thought that this not only improves the projection of mortality, but also the explanation for mortality differences, over time. As a result, there have been several epidemiological studies that have based their cause-specific or total mortality projections on behavioural risk factors (e.g. Gunning-Schepers and Barendregt, 1998; Van Genugten et al., 1997). However, such risk factors may be a reflection of contextual factors. In the context of mortality forecasting from a demographic perspective I know two related studies where contextual factors were used, namely by Van Hoorn and De Beer (1998) and Van Hoorn and Broekman (1999), although this was only carried out in a qualitative manner and without consideration of changes in the cause-of-death structure in the scenarios. The first study produced three regional and national scenarios for the countries of the European Economic Area, where the value of future life expectancy at birth up to 2050 for both sexes in each country were determined by, among other “tools”, assumptions that were made regarding the development of country and gender differences in life expectancy in the future. The second study published two scenarios for 33 European countries, also covering the first half of the 21st century, which were based on the key question as to whether Europe will be characterised primarily by economic and cultural similarities, or by differences.

Although no mortality scenarios are produced in this thesis, the added value is that a more integrated approach is taken than before and that this will lay down the foundations for improved mortality projections. The effect of socioeconomic and other factors are quantified for both total mortality and the most important causes of death. Moreover, the age- and sex-structure of mortality as well as the time delay between the exposure to health-promoting and -damaging factors and mortality are also considered as vital components. Considerations are also given to the diverging economic and social history of Eastern and Western Europe through separate analysis. One reason for this is that the construct validity of several factors that affect health may be questioned. For instance, unemployment did not officially exist in Eastern Europe prior to the start of the economic transition
period, but within two years several countries had a rate of more than 10% (Večerník J., P. Matějů, 1999). Since there was initially little financial support from the government to compensate those who no longer received an income, the health effects at the population level could be expected to be more severe in the East than they would be in the West with similar levels of unemployment. For this reason unemployment was not considered to be internationally comparable.

1.4 The present study: objectives and research questions

The main objective of this thesis is to assess the importance of socioeconomic factors on mortality differences across Europe over time and between countries or regions to determine which factors should be incorporated into future mortality scenarios. Non-socioeconomic factors are only of interest if they influence the association between socioeconomic factors and mortality, or if their effect is considerable. The reason for emphasising socioeconomic factors is because they can initiate change in the proximate, i.e. direct, factors of disease that could then lead to changes in mortality. They are also more stable than the proximate factors.

Each analysis presented in this thesis is an example of an ecological study. Although studies that use individual-level data have more explanatory power, this was not the main aim of the thesis. Rather, by improving our understanding of associations between mortality and socioeconomic and other factors at the macro-level, and by subsequently integrating these factors into mortality models, the accuracy of current mortality scenarios could be improved. Individual-level studies do form an important basis for the selection of exogenous variables for the various analyses, although there is no guarantee that the same variables will be important at the macrolevel. This is because, firstly, such factors would have to be differently distributed across space and/or time and, secondly, if only a few people are exposed to something that has a high health risk, it will not be observable at high levels of aggregation (e.g. asbestos). According to Elford and Ben-Shlomo (1997) it may also be that different variables are more important in explaining ecological variations than between individuals, or that there may be important interactions between different risk factors which may be more marked at the ecological than the individual level.

Causes of death form an integral part in the dynamic of the epidemiological transition, as each phase is typified by a particular cause-of-death structure. However, the transition from one phase to the next not only signifies a change in mortality structure, it also implies a change in the prevalence and type of disease determinants. A first step in improving mortality projections is therefore to analyse cause-of-death patterns, as each disease has its own aetiology (cause). This also includes, besides biological causes such as the proliferation of cells as in cancer or the thickening of arteries that can lead to IHD, what instigated these biological changes, such as nutritional status, medical factors and wealth. For example, the rise of IHD in the middle of the 20th century which was much more
pronounced in western\(^4\) and northern Europe than in the Mediterranean countries has been partly
ascribed to the regular consumption of red wine and olive oil in the latter (Renaud and de Lorgezil,

The concept of the epidemiological transition also implies an ordering of populations from
“leading” to “lagging”, as the mortality decline that occurred over the course of the 20\(^{th}\) century
differed between populations with respect to timing, as well as to pace. For instance, since WWII
East-West differences in life expectancy at birth were at their lowest point in the late 1960s, when
just 1.8 years separated the two ‘Europes’ (United Nations 2001; own calculations\(^5\)). The
subsequent onset of a renewed progressive mortality decline in the West, particularly from IHD, has
yet to take place in the East and a large part of the current East-West mortality differences can be
related to this cause of death (Bobak and Marmot, 1996). One arrives at the question why these
differences exist and persist. Why has IHD mortality consistently declined in the West and not in the
East? What are some of the underlying societal and other factors? We know also that within
individual countries the prevalence of (cause-specific) mortality is not equally distributed among
various segments of the population. Many epidemiological studies in recent years have shown that,
at the individual level, socioeconomic characteristics, such as education, occupation and income are
negatively associated with premature mortality (e.g. Balarajan and McDowall 1988; Davey Smith
et al. 1990, 1994, 1998b; Kunst, 1997; OPCS, 1978). With the exception of high-risk jobs such as
mining, these mortality differences have less to do with the job or income itself, but more with the
type of behaviour and lifestyles it brings with it. It is recognised that, today, higher socioeconomic
status (SES) groups smoke less than lower SES groups (Marmot et al. 1991). However, at the same
time, the economic basis of regions and countries also shows diversity and dynamism. In part, as a
result of the internationalisation of the world economy and technological innovations, workers in the
developed world have gradually moved away from jobs in the industrial sector, particularly
production, to jobs in the service sector. One of the consequences has been that jobs are becoming
less labour intensive, and many people have been forced to seek employment elsewhere, often
requiring more education. Still, within Europe, large regional and international differences do exist
in terms of the proportion of people employed in the agricultural, industrial, and service sectors. As
a result, regions well known for their industrial production and pollution show higher than national
average levels of both total mortality and pollution-related causes of death such as lung cancer, as is
for instance the case in Northumberland, Tyne & Wear and Merseyside in the United Kingdom, and

\(^4\) Throughout this thesis a distinction is made between ‘western’ and ‘Western’ Europe in which the former
excludes countries of northern and southern Europe. When reference is made to ‘Eastern’ Europe it pertains to
the countries of both ‘central’ Europe and ‘the former Soviet Union’ (see also Table 4.5).

\(^5\) The classification of “Western” and “Eastern” Europe that is referred to here differs from that used by the UN.
Western Europe includes Denmark, Finland, Norway, Sweden, Austria, Belgium, Switzerland, Germany, France,
Ireland, Luxembourg, the Netherlands, United Kingdom, Spain, Greece, Italy and Portugal. Eastern Europe
includes Albania, Bulgaria, Czech Republic, Croatia, Hungary, FYROM, Poland, Romania, Slovenia, Slovak
Republic, Yugoslavia, Bosnia-Hercegovina, Armenia, Azerbaijan, Belarus, Estonia, Georgia, Lithuania, Latvia,
Republic of Moldova, Russia and Ukraine. Calculations take into account relative population size.
in the regions of Upper Silesia in Poland (Spijker et al. 1998). Pollution has also been held responsible for some of the mortality differences between Eastern and Western European countries (Bobak and Feachem, 1995). However, the composition of the population according to occupation also plays a part in these regional and international differences because of differences in lifestyles between occupational groups. A wide range of variables therefore needs to be incorporated in the analyses in order to account for potentially confounding factors, even though such factors may not be of primary interest. With the distinctiveness of causes of death, and the spatial and socioeconomic dimensions in mind, the following research goal has been reached:

To assess the importance of socioeconomic factors in the explanation of cause-specific mortality differences in Europe.

The dependent variable in this research is a mortality statistic. The mortality indicator used depends on the goal of each analysis, e.g. life expectancy is used in Chapters 5 and 7 and standardised death rates in Chapter 4. The most important independent variables include macro- and socioeconomic indicators, including per capita levels of GDP (GDPc), education and the proportion of manual-labour workers.

Some of these associations, however, are not linear. The best example of this is perhaps income. While anyone who earns just €1,000 per year can do a lot less for their health than someone who earns €50,000, the question is if this person is disadvantaged to the same degree as someone who earns another 50 times more (i.e. €2.5 million)? The same could be said at the country level and, indeed, it has frequently been shown that above a certain level of economic development, the association between living standards and mortality levels weakens (Mackenbach and Looman, 1994). In developing countries, life expectancy increases steeply with increasing GDPc, but for developed countries the curve is much flatter. This is probably due to two different mechanisms. The first mechanism is the effect of diminishing returns when more is spent on improving living circumstances, which suggests that other factors also play a role in increasing life expectancy. The second mechanism that may explain why the association between living standards and mortality levels has become weaker with increasing wealth is the rise of degenerative diseases such as cardiovascular disease and neoplasms, particularly in the 1950s and 1960s. Lifestyle factors, such as certain dietary patterns and smoking habits have been attributed to part of this rise. At the same time, public consciousness of the negative health effects of certain types of behaviour, together with advancements in medical technology, have counteracted this development to such an extent that in many Western European countries a decline has been observed in circulatory system diseases.

If further improvements in life expectancy at birth occur, it will most likely be due to such types of factors. However, as results show that socioeconomic differences in mortality are not declining (Kunst et al., 1998a), it would appear that certain underlying factors liked to socioeconomic status need to be identified. Country-specific characteristics may also be important here, as certain well-
known important causes of death do not display socioeconomic differences in mortality in some countries, while they do in others. For example, in the late 1980s, the mortality rate ratio for cardiovascular diseases between manual classes and non-manual classes for men aged 45 to 59 years equalled 1.0 (i.e. no difference) in Portugal and about 1.5 in both Finland, and England & Wales (ibid.). This is why good quality time series of both cause-specific mortality and economic variables are essential in order to make any valid assertion.

1.5 Structure of the thesis

The next chapter sets out the theoretical framework. Although many improvements have been made in health in developed countries over the last 30 years, differences nonetheless remain, as these improvements did not occur ubiquitously or to the same degree. While life expectancy has increased steadily in western4 Europe, it has increased more rapidly in southern Europe, and stagnated in central Europe and even declined in the former Soviet Union (see also Chapter 4). At the same time, mortality differences continue to exit between population groups within countries, such as between married and divorced people (e.g. Joung, 1996; Valkonen, 2001), between manual and non-manual workers (e.g. Kunst, 1997) and between subnational regions (e.g. WHO, 1997), as health -damaging and -enhancing factors are distributed differently within populations. For this reason several such factors are also tested in the analytical chapters in order to establish if changes in the association between the compositional factors and mortality also occurred in order to ascertain their independent association with mortality differences. Specific data on these factors were, however, not available for different population groups, but their inclusion is considered important because of their known association with mortality and large within country differences and changes and over time.

Mortality is usually registered according to the age and sex of the deceased, place of residence and cause of death. As the cause of death already provides knowledge of the disease determinant, it can be considered as the first step towards a possible explanation for mortality differences. Why then should one want to incorporate exogenous variables in order to improve the current mortality scenarios? There are several reasons. Firstly, certain disease determinants take a long time to have an effect on mortality. In other words, the cause-of-death trend always lags behind that of the most important disease determinants, as is the case for instance with smoking and lung cancer. If lung cancer mortality shows an increasing trend, the logical assumption, without any extra information, is that mortality will continue to increase. However, if smoking prevalence rates have recently stagnated or declined, a different scenario is likely. The prediction of lung cancer mortality rates would be further enhanced if time series data were available for age-specific smoking prevalence rates. It is possible, for instance, that lung cancer mortality rates will continue to increase for older
age groups because they smoke more than previous cohorts, while the opposite trend can be predicted for younger groups. Another reason for incorporating exogenous variables is the interrelationships between disease determinants at various levels of aggregation. To give an example, smoking and a diet rich in saturated fatty acids can both cause IHD, and both of these behavioural factors are more common among manual workers than among non-manual workers. One consequence of this combined effect is that the population as a whole will become healthier as more people become non-manual workers, even if manual and non-manual workers maintain the same lifestyles. A similar example to that given for time changes can be provided for differences between countries. However, because socioeconomic differences in behaviour are not the same in all countries, it is not valid to use the population according to occupational class as a proxy for behaviour-related determinants, and the overall prevalence and the time-trend of certain types of behaviour will differ between countries. Moreover, determinants may affect more than one disease (see for example Figure 1.1). For these reasons, the effect of direct factors such as smoking, as well as of indirect factors such as occupation, will need to be separately estimated for each cause of death.

**Figure 1.1** Example of interrelationship between disease determinants at various levels and sublevels, and the subsequent multi-causality of one specific risk factor.

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**Indirect health effects** → **Direct health effects** → **Morbidity** → **Mortality**

- No education
- Unemployed
- Psychosocial stress
- Excess alcohol consumption
- High blood pressure
- Hypertensive disease
- IHD
- Stroke

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Time

It would be too ambitious to analyse all the existing causes of death, and so a selection was made. How this was done is explained in Chapter 3, but it basically comprised of two elements: causes of death were selected on the basis of their prominence relative to mortality from all causes of death, and if the associated mortality rates were known to be different among socioeconomic groups. The reason for the latter criterion is that this relates to the overall goal of the project: that is to identify socioeconomic factors that are associated with international differences in mortality in Europe and with changes over time. Chapter 3 also includes a description of the data used for the main analysis in Chapter 4, as well as issues related to the cause-of-death statistics.
Chapters 4 to 7 contain the various analytical studies whose main purpose is to identify the most important socioeconomic factors in explaining mortality differences in Europe over time and space. The studies were extended to include the effect of further variables that might confound the association between socioeconomic variables and mortality, and/or show a clear independent effect. The theoretical chapter formed the basis for the selection of the variables.

Chapter 4 takes on a broad context by analysing mortality differences in Europe at the national level from around 1980 until the late 1990s. Due to the different social, political and economic backgrounds between Western and Eastern Europe, two sets of analyses are conducted. In this chapter, an attempt is made to incorporate aspects of the life course into ecological mortality analysis, given that the influence of socioeconomic and other variables on mortality patterns are not contemporaneous, but rather the result of many years of exposure. For each variable this is achieved by calculating a time lag and, depending on the cause of death and the length of the time series, this ranged between no lag at all up to 20 years. Differences also exist between the analyses for Western and for Eastern Europe and this shows the importance of considering the different historical backgrounds. For instance, changes in the national average per capita income has an immediate effect on mortality for most causes of death in Eastern Europe, while a substantial lag is linked to the strongest associations with the same causes in Western Europe. Although the main results pertain to all-age standardised male mortality, some age-specific analyses of ‘robustness’ were performed since certain exposures may be different for women or more profound at older or younger ages. The results from this chapter will form part of the direct input into the mortality scenarios for the NWO research project “Towards a scenario model for economic determinants in population dynamics”.

There are also several case studies that focus on regional mortality differences, each with a specific emphasis. Chapters 5 and 6 are studies on mortality differences in the Czech Republic (CR) and Chapter 7 looks at the Netherlands. One reason for carrying out ecological studies at the regional level, as opposed to the national level, is that the interpretation of results are less subject to ecological bias because regions are more homogeneous than countries. Indeed, the identification of statistical associations between mortality and exogenous factors at the small area level may even be interpreted in conjunction with, and may be suggestive of, epidemiological investigations at the microlevel (Higgs et al., 1998), although the Czech and Dutch regions are perhaps too large for this. Regional-level studies thus allow more precise analyses to be conducted, since country-specific elements that may confound possible associations, such as differing economic and educational systems, health policies, as well as cultural factors, particularly those associated with lifestyle (e.g. diet), are not or less relevant in the regional context. Although regional studies for one country cannot be generalised to other countries, potentially important factors for international studies may be more easily identified. It should be noted that an ecological effect, and also the mechanisms, may vary with the level of aggregation. For example, at the neighbourhood level, possible underlying mechanisms of income inequality on health may be the relative perceptions of social hierarchy,
whereas at the national level they may come from policies that affect individual’s access to life opportunities and material resources such as health care and education (Blakely and Woodward, 2000).

The main purpose of the Czech studies is to ascertain whether regional differences in socioeconomic development in a former communist country were associated with regional differences in mortality. It is postulated that different associations will be found in the CR between socioeconomic characteristics and mortality at the regional level than are commonly found in market economies, because former communist countries have pursued economic development on the basis of different principles. For instance, education was not rewarded by higher income or other material privileges, but instead those in arduous manual occupations, such as mining, received the highest wages.

Chapter 5 begins with an overview of socioeconomic conditions in the CR before and after the period of economic and social transition, covering the period 1987-97. Regions are clustered according to a selection of socioeconomic variables, centred on the year 1992, and subsequently cause-specific mortality analyses are performed on those clusters. The capital region, Prague, functioned as the reference region as it is easily identifiable in terms of socioeconomic characteristics and could be considered as the political, cultural and economic centre of the country. The mortality analyses examine the position of Prague in relation to the other clusters; sees if this position changes, and if there are regional differences in male-female mortality and between age groups. One question that is subsequently asked is whether regional mortality patterns have diffused from the main cultural and economic centres to peripheral regions. In other words, can we say that there are also leading and lagging regions in terms of mortality?

Chapter 6 explores the temporal and spatial structures of age- and sex-specific mortality in the CR in more detail for a selection of cause-of-death categories. There are two parts to the study. Firstly, it is verified whether causes of death should be modelled separately rather than in combination (i.e. all-cause mortality) and to what extent socioeconomic and other factors are needed in the explanation of the age, sex, time and spatial differences in mortality. The argument here is that if, for instance, mortality from a specific cause of death shows little regional variation in the age or sex structure then there is little reason to include age- or sex-specific exogenous variables in the analysis. Similarly, if mortality equally declines in all regions for a particular cause of death after considering the different age- and sex-structures, it suggests that national rather than regional factors should be incorporated in the explanatory analysis. The actual explanatory analysis forms the second part of the study and explores if the regional and time differences in mortality that were established in the previous analyses can be explained by socioeconomic and other factors, and if the effect of these factors differ across age and/or sex. To the best of the author’s knowledge, this way of establishing the effect of exogenous variables on mortality in an ecological study has not been tried before. As the units of analysis are medium-sized regions with an average population of about 136,000, the opportunity is provided to conduct a more detailed analysis of age and/or sex interactions between mortality and exogenous variables than was possible in the country analysis of Chapter 4 allowing
more to be said about possible mechanisms. For example, if the effect of a variable increases with age it might, within the framework of the life course, suggest an accumulative effect. The relevance of this type of result is that a change in this variable will instigate a change in mortality much later than a variable that shows an effect across all age groups.

Chapter 7 is the final analytical chapter and investigates the closing of the male-female mortality gap in the Netherlands that started in the early 1980s, a phenomenon that has also occurred in other Western European nations and that has been preceded by changes in lifestyle, educational level, family roles and female employment. This trend has important implications for mortality projections, because it is plausible that future levels of life expectancy differences between men and women will converge to the biological difference of around three years if this trend continues. The purpose of this chapter is to identify gender-equality related factors associated with the decrease in the male/female mortality difference. The analysis is conducted at the regional level for the periods 1980-83 and 1996-99, in which various measures of gender inequality are regressed against male-female mortality differences. In doing so, a framework that was recently developed by Ingrid Waldron to analyse changes in sex differences in mortality in the US (Waldron, 2000) is followed as far as possible. She related changes in the sex differences in mortality to gender-specific changes in smoking behaviour, labour force participation, emancipation, and gender role changes, such as a decrease in childbearing and increased female participation in the labour force. Given the clear behavioural aspects of these factors, both in terms of economic participation and lifestyle, this framework can also be placed within the life course approach. The relevance of this chapter within the context of future scenarios is twofold. Firstly, it is important to realise when drawing up scenarios that there is not only a gap between male and female mortality trends of about 20-30 years, but that there are also regional differences in the onset of the sex gap mortality decline. Both trends are well-detected in the cause-of-death patterns. Also here, the concept of leading and lagging regions are applicable, as the differences during the period 1996-99 were smallest in the culturally more progressive regions, and will apply internationally (see suggestions made by De Beer and Van Wissen, 1999). Secondly, there are clear differences in the types of variables that are responsible for male-female mortality differences when the gender gap is highest, compared to when differences have declined. There are particular differences in the role of social and economic variables in this change process.

Chapter 8 concludes the thesis and, besides summarising the main results, looks at important theoretical considerations that should be taken into account when making mortality projections. These include the theoretical maximum life expectancy of a population; the position of a country in the epidemiological transition; integrating aspects of the life course approach into the modelling assumptions of the exogenous variables; the changing effects of exogenous variables on mortality (e.g. the non-linear association of GDPc); and the idea that mortality or behavioural trends of regions/countries that are considered to be “leading”, in particularly with regard to the
epidemiological transition or the smoking epidemic, could facilitate the mortality projections of the “lagging” countries. Empirical considerations are also briefly discussed, including why causes of death are analysed, different reasons for clustering or pooling of countries and regions, the concept of competing causes of death and the associated problem of inaccuracies in the cause-of-death statistics. The social and scientific relevance of the research is outlined before concluding with some final remarks on important future considerations for mortality projections.