Health and Elderly Care Expenditure in an Aging World

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RR-00-21
September 2000

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International Standard Book Number 3-7045-0139-5

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Cover design by Anka James.

Printed by **Rema***print*, Vienna.

Contents

Abstract

The world's population is aging, albeit at different rates in different countries. The International Institute for Applied Systems Analysis (IIASA) is building an economic–demographic model for exploring the consequences of population aging on the global economy. So far it has concentrated on impacts mediated through public and private pension systems. It now wishes to extend the model to cover other sectors whose provision is also highly age sensitive, including health and elderly care services. This report explores the consequences of population aging for these vital services and considers the basic mechanisms fueling their growth. These mechanisms fall into essentially two categories: The first is related to the biomedical processes of aging, which can lead to chronic illness and disability in old age. The second concerns the costs of treatment and long-term care, which in turn are a function of medical technology and institutional factors, how services are delivered, and who bears the costs.

Using simple but explicit projection methodologies, we project health care and disability-related expenditure in two major world regions, corresponding to more developed countries (MDCs) and less developed countries (LDCs). The key policy-related conclusions are as follows:

- Aging will overtake population growth as the main demographic driver of health expenditure growth, but its effect will be less than that of technological and institutional factors.
- Health expenditure will expand rapidly in LDCs (relative to gross domestic product) to reach levels currently observed in MDCs.
- The number of people with disabilities will grow substantially, but will level out in MDCs by 2050 (earlier for all but the oldest age groups), while the number of people with disabilities in all age groups will continue to grow in LDCs. Assuming that most care for the disabled continues to be provided by the family and community, projected increases in disability-related expenditure are modest.

Acknowledgments I am grateful to my colleagues at IIASA for the stimulating discussions on the issues raised in this paper, particularly to Landis MacKellar, who heads IIASA's Social Security Reform Project.

1 Introduction

The impact of population aging on the global economy is now a major issue. This report, a contribution to the project on global social security reform at the International Institute for Applied Systems Analysis (IIASA), focuses on health and elderly care services (MacKellar and Reisen, 1998; MacKellar and Ermolieva, 1999). While these expenditure areas are less economically significant than pensions, the other main area of impact, they still account for over 10% of gross domestic product (GDP) in developed countries. They are major consumers of public expenditure; they straddle the public and the formal and informal private sectors, and are sensitive to the size and age distribution of the population and to patterns of morbidity. Their growth and development over the past 30 years or so, however, are only partly explained by aging and population growth. More important are factors such as technological change (new treatments and drugs), higher utilization per capita, institutional behavior, higher labor costs, etc.

Our focus is on population and aging because of the very different population trajectories in developed and developing regions and their different starting positions. It is now firmly established, for example, that older people consume more health services per capita than any other age group except perhaps the newly born. On average, their ability to perform daily tasks slowly erodes until, at some stage, they become dependent on others for home help, or possibly residential care or long-term care in a hospital. The degree of dependency, and sometimes also the need for medication, reaches a maximum in the period just before death (Seale and Cartwright, 1994). The economic consequences are therefore varied, directly or indirectly involving the work place, households, and agencies in the public, private, and voluntary sectors (see, e.g., Jackson, 1998). Not surprisingly, governments are becoming increasingly aware of the need for coordinated policies in the fields of employment, pensions, disability, and health.

Some trends, though, will pull in opposite directions. It is expected, for example, that future generations of older people will be better prepared to live independent lives into advanced old age, particularly with the aid of modern technology and medical breakthroughs such as body-part replacement, which may improve the quality of life for some. There is some evidence that older people already have healthier lifestyles and are better educated and informed than previous generations, with the result that the threshold for frailty and disability is being pushed later into old age in some instances (ONS, 1997). Estimates of future health- and disability-related expenditure depend crucially on whether the longevity revolution is adding healthy life years or years of illness and dependency to the human life span.

Despite the uncertainty arising from countervailing forces, and certainly based on experience over the past 50 or so years, it is expected that demand will continue to grow and that health care services will continue to consume a rising share of GDP in all major world regions. To some extent, this merely reflects the changing consumption basket of aging societies (in the case of the more developed countries, or MDCs) and societies undergoing structural economic and social change, including rapid health transition (in the case of less developed countries, or LDCs). A rising health-sector share of GDP is not necessarily an adverse trend (Aaron, 1996). However, the health sector's increasing claim on resources is not without consequences for the real economy and represents an important index of structural change.

While in some countries health systems confer universal coverage, the same is not true of elderly care services, which continue to be dominated by care within the family unit or immediate community, the so-called informal sector. A central issue in this case is the extent to which services provided by third parties (state or private residential and nursing homes, etc.) in the formal sector should be paid for out of personal income, sales of assets, and so forth. Again, the picture varies substantially, even within countries, because of differences in income and social factors such as deprivation and home and family circumstances.

The aim of this report is to provide greater clarity and a firmer empirical basis for analysis of these issues in the context of IIASA's global economic–demographic model, which is aimed at the medium to long term. Using recently available data, we attempt to separate aging effects from other contributors to growth, focusing on aging and disability and the demands older people and the disabled make on health and other services. In IIASA's model, the world is divided into two regions. One region comprises the MDCs and includes the newly independent countries in the European part of the former Soviet Union. This region accounts for 82% of world GDP, but only 22% of global population. The other region comprises LDCs and includes China, India, and the newly independent Central Asian countries of the former Soviet Union.

The differences between the economies and population age profiles of the two regions are telling, providing important clues as to the future impact of population aging on health and elderly care services. *Figure 1.1* shows two population pyramids based on IIASA's central population projections at two points in time, 1995 and 2050. The horizontal axes are scaled to show the percentage of population by age group rather than population number in order to emphasize the differences in

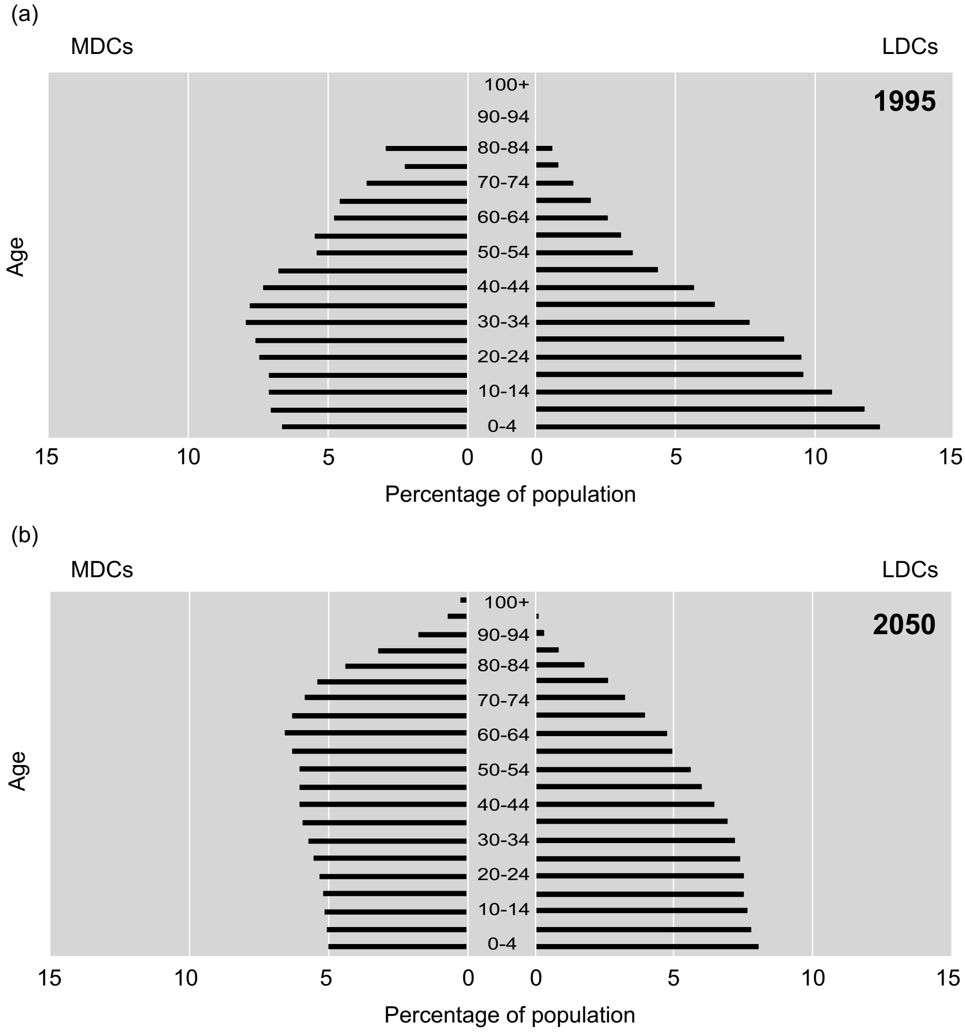

Figure 1.1. Population pyramids in (a) 1995 and (b) 2050. Population in each age group is expressed as a percentage of the total population in a region. *Source*: IIASA central population projections (Lutz, 1996).

shape between regions and between years. In 1995, the MDC pyramid is highly tapered but still quite broad at the base, whereas the LDC pyramid is dominated by younger generations, with relatively small percentages of older people. By 2050 the aging process reaches maturity in MDCs, with the majority of the population concentrated in older age groups. In LDCs the pyramid is substantially transformed, resembling the MDC pyramid for 1995.

Sources of Information on Health and Elderly Care Services

In considering the scope of health and elderly care services, we are dependent to a significant degree on the availability of suitable data in the private and public sectors. For this report, elderly care services are defined to include personal and social services such as social care in the home or in an institution such as a nursing or residential home. These services may include help with daily living, advice on financial affairs, companionship, and so forth. A key problem with elderly care services is how to evaluate the relative importance and size of each sector – whether state-funded, private, or informal. Details about the informal sector are especially scarce, and its economic value remains an unknown quantity, although it is certainly very large (usually assumed to be over 80% of the total). The size of the formal sector, which provides residential, day, and home (domiciliary) services and benefits in kind (such as meals), is better reported, but there remain many hidden transfers which are categorized elsewhere in national accounts. One example is the cost of residential care, part or all of which may be paid directly by the state or by the individual, or indirectly through social security benefits. These and other hidden transfers, the opportunity costs of unpaid care, and benefits provided in kind from many sources, including voluntary organizations, increase the difficulty of piecing together the elderly care jigsaw puzzle.

There is no single or complete source of data on all aspects of these issues. Expenditure in each country is sensitive to cultural, behavioral, and institutional factors; to morbidity and mortality profiles; and to the level of economic development. Set against this, however, are the similarities in demography within each major region, the increasingly shared experiences of medical advances, and common outlooks and values, for example, in terms of national and international policies toward the disabled, in which emphasis is on equality within society.[1] It should be noted that while the picture that emerges is coherent and persuasive, it is built up partly from information available in every country and partly from fragmentary information from one or more countries that has been extrapolated to the rest of the region. It follows that the structure of the approach is as important as the results themselves, because the framework, including the IIASA model, can be updated as new and better information becomes available.

A key source of information for this report was IIASA's central scenario for world population projections from 1995 to 2100 (Lutz, 1996), although for the most part we concentrated on the period to 2050, for which information was the most reliable. Also invaluable were Organisation for Economic Co-operation and Development (OECD) databases covering health and social expenditure, including some information on activity levels and unit costs (OECD, 1998a, 1998b); the European System of Social Protection Statistics (Eurostat, 1996, 1998); United Nations (UN) and World Bank data (UN, 1998; World Bank, 1993, 1999), especially macroeconomic and some health expenditure data for LDCs and miscellaneous sources and studies drawn from countries as diverse as the UK, USA, Canada, Australia, Finland, Japan, and China; and relevant conference proceedings. There were major shortcomings with respect to health and disability data for LDCs; consequently, key issues are only scratched at the surface. In the case of MDCs (comprising OECD countries and countries in Eastern Europe and the former Soviet Union), the analysis prior to 1995 is based on OECD databases only.

The results presented are therefore a mixture of the firm and not-so-firm, the relatively precise and the merely indicative. Therefore, where necessary, appropriate assumptions and qualifications are spelled out. To a significant degree, this report builds on established trends over long periods, relatively stable features of the population such as the onset and prevalence of disabilities, and underlying trends in economic growth. No attempt is made to predict technological changes that may have an impact on the delivery of health care and other services, or major breakthroughs in medical treatments that may otherwise have an impact on longevity, health service costs, and so forth. These are presumed to be subsumed in the underlying growth rate.

Part 2 of this report considers health care services. Part 3 looks at disability and elderly care services. Conclusions are presented in Part 4.

2

Health Care Services

2.1 Measuring Health Expenditure

Medical expenditure is high in the first few years of life and increases again in old age with the onset of chronic illnesses and disability. To determine the contribution of population growth and aging to future expenditure, we need to separate the proportion of growth attributable to population trends and aging from growth attributable to other causes. The OECD publishes data on health expenditure per capita in selected older age groups as a ratio of expenditure in the 0 to 64 age group (OECD, 1998a). Although there are many gaps, a coherent picture emerges across countries showing expenditure in older age groups to be significantly greater than that in other age groups apart from the very young (see van der Gaag and Preker, 1998; European Commission, 1997).

Data from England and Wales (see *Figure 2.1*) are consistent with the wider OECD picture and have the advantage of being available in time series over the entire age spectrum. They are also consistent with general examples provided by Cichon *et al*. (1999). Although the period is relatively short (1982–1993), the data are remarkably stable in most age groups. An exception occurs in the case of the 85+ age group, where the increase and subsequent downturn in the mid-1980s marks a change of policy concerning the appropriateness of keeping very old people in hospitals (we return to this point later). Otherwise, the flatness of the curves is noteworthy, especially given increases in health service utilization, changes in treatments, improvements in quality, decreasing lengths of hospital stay, and the growing use of, for example, day services.

The stability evident in *Figure 2.1* suggests that relative age-specific expenditure indices should be fairly stable over time, at least in MDCs. *Table 2.1* presents such indices calculated from the data plotted in *Figure 2.1*, with the lowest age group (0–4) as the baseline. We will presently apply these indices to project how the changing age structure of the population in MDCs is likely to affect growth in health care expenditure. Note that our assumption is not that levels of age-specific per capita health care expenditure in England and Wales are representative of levels of expenditure in MDCs as a whole, but that the age profile of such expenditure is

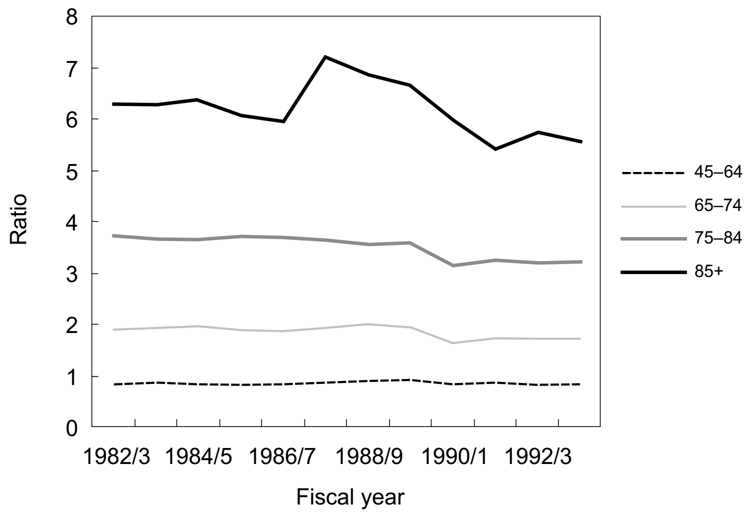

Figure 2.1. Ratio of per capita health expenditure in different age groups to average per capita health expenditure calculated over all age groups (only older age groups shown for clarity), England and Wales, circa 1982 to 1992. *Source*: UK Department of Health, personal correspondence.

Table 2.1. Relative per capita health care expenditure by age group, England and Wales, circa 1980 to 1990 (age 0–4 = 1.00). *Source*: Calculated from data presented in *Figure 2.1*.

Age group	Relative expenditure
0–4	1.00
5–14	0.40
15–44	0.53
45–64	0.82
65–74	1.70
75–84	3.20
85+	5.52

representative, a much weaker assumption. We are saying simply that health care expenditure nearly doubles in moving from one age group to the next.

For LDCs, the issues are substantially different; moreover, equivalent data are unavailable. The nature of the problem is illustrated in *Table 2.2* (based on data from Murray and Lopez, 1996), showing the estimated percentage of deaths by major causes in different world regions in 2000 and 2020. In MDCs the majority of deaths are currently from noncommunicable diseases, whereas in LDCs

Table 2.2. Pattern of mortality in MDCs and LDCs, in 2000 and 2020 (projected). *Source*: Based on data from Murray and Lopez (1996), baseline scenario in tables 12a to 12h and 16a to 16h on pp. 616–647, 760–791.

	MDCs		LDCs	
Cause of death	2000	2020	2000	2020
All deaths (millions)	12.6	13.5	43.5	54.8
Communicable (%)	5.8	5.0	32.6	17.5
Noncommunicable (%)	87.3	88.6	55.4	68.8
Injuries (%)	6.9	6.4	12.0	13.7

communicable diseases are still a major cause of death. As the table shows, this situation is expected to change in the medium term, so that LDCs will eventually look more like MDCs, with a gradual convergence over a period presumably accompanied by commensurate changes in health care services.

At the present time, expenditure on communicable diseases in MDCs is only a small percentage of total health care expenditure. For example, based on Murray and Lopez's classification, in England and Wales communicable disease accounts for only about 5.5% of hospital costs and 3.3% of primary care costs, whereas injury and poisoning account for 5.8% of costs. The rest of the costs are associated with noncommunicable diseases such as neoplasms, psychiatric disorders, and cardiovascular malfunctions. So the distribution of expenditure in this case is quite close to the distribution of mortality by cause.

It makes little sense to apply the MDC indices in *Table 2.1* to LDCs, which are characterized by a different morbidity and mortality structure. An alternative is to use mortality rates as a proxy variable, based on the crude assumption that age-specific per capita health expenditure is proportional to age-specific mortality rates, the coefficient of proportionality being invariant over the age spectrum. (If we knew how the coefficient varied with age, we could calculate relative age-specific health expenditure indices directly on the basis of mortality data.) One way to build on this approach is to assume that all medical expenditure takes place in the year prior to death and that, given the current medical technology in use in LDCs, the cost of this care is invariant with respect to age.

This procedure gives a spread of weights for 1995 ranging from 1 to 8, which is slightly more extreme than in the example in *Table 2.1*. They fall below the weights shown between the ages of 4 and 60, at which point they cross. As mortality in future years decreases, the weights for the oldest age groups fall, giving a spread of 1 to 7 (compared with about 1 to 5.5 in MDCs); thus some general convergence seems likely. To take the argument one step further, we can scale the weights for both regions by the expected population in each age group to obtain profiles of relative total health expenditure by age group. It should be noted that, because all

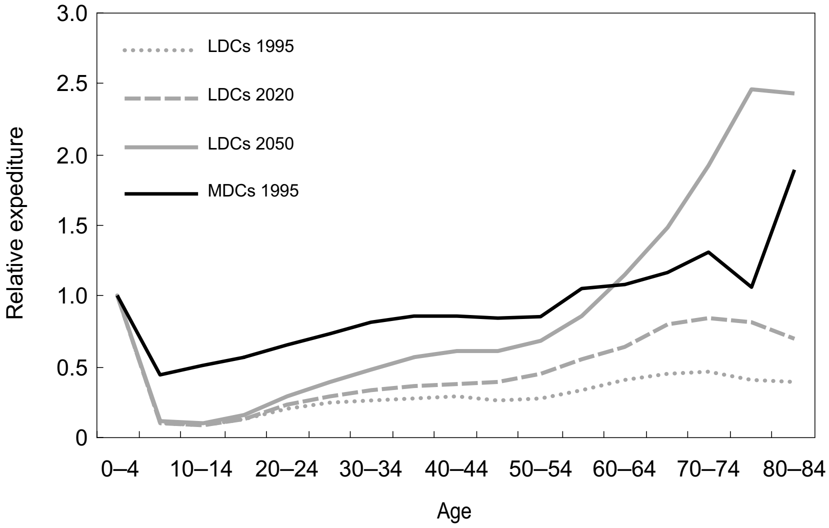

Figure 2.2. Relative health care expenditure by age group (age 0–4 = 1.0), MDCs (1995) and LDCs (1995–2050) compared.

regions and time periods are scaled so that the index is equal to 1.0 at the 0 to 4 age group, differences in the health care costs in MDCs and LDCs cannot be inferred.

As can be seen in *Figure 2.2*, the estimated age profile of health expenditure in LDCs is projected to evolve over time. The comparable profile for MDCs for 1995 is also shown. The figure shows that, by the end of the period, age-related expenditure in LDCs overtakes that experienced in MDCs in 1995 for the oldest age groups. Underlying the projections are changes in the age structure of mortality, as age-specific mortality rates of the aged rise relative to age-specific mortality rates of the young (i.e., mortality rates decline less for older people than for the young). If medical spending is linked to mortality at the level of the individual, as we hypothesize, then the population-wide mortality transition will be accompanied by a similar shift in the age pattern of health expenditure.

However, there is universal agreement that the increase in health expenditure in MDCs can be attributed mostly to development and application of new diagnostic procedures, drugs, and medical interventions (see, e.g., Cutler, 1995). The impact of these technological changes has primarily benefited older people. Thus, the steeply rising weights in *Table 2.1* represent not only the fact that older people have poorer health than young people, but also that there exist technologies developed over the past 50 years for treating the health conditions associated with old age. Indeed, this finding may be compared with that of Cutler and Meara (1997) that the spending profile in 1953 was relatively flat compared with today’s profile. It is probably reasonable to speculate that the age expenditure profile of the USA (and by inference, MDCs as a whole) in 1953 was similar to that shown in *Figure 2.2* for LDCs in 1995.

While the evolution of the LDC age-expenditure curves in *Figure 2.2* reflects changes in the age structure of mortality, it does not take into account the fact that if the coefficient of proportionality were replaced with an age- and time-indexed coefficient, projected health expenditure for older age groups would probably rise even faster. Accelerating this process will be the fact that, whereas new medical technologies were developed from scratch in MDCs, LDCs are able to import existing technologies. Therefore, in presenting the projections in *Figure 2.2*, we are aware that, if anything, they understate the rapidity of the changes in health expenditure that may be anticipated.

2.2 Method of Analysis

We use a "growth factor" method to analyze trends in health care expenditure. Estimated health expenditure in time *t*, *H(t)*, is related to a base period as follows:

$$H(t) = H(0)e^{t(r_P+r_U)} \ . \tag{2.1}$$

We hypothesize two growth rates, one of which (r_P) reflects demographic change (change in total population and change in age structure), and the second of which (r_U), calculated as a residual, is interpreted as an underlying rate for new technology and the growth in factor costs.

Let *I(t)* be an index of population size and structure, and let r_P be the rate of change in this index:

$$r_P(t) = \frac{1}{t} \ln I(t) \ . \tag{2.2}$$

Then it is easy to confirm that

$$r_U(t) = \frac{1}{t} \ln \frac{H(t)}{H(0)I(t)} \ . \tag{2.3}$$

If we define the demographic index so that *I(0)* = 1, then the underlying rate can be written

$$r_U(t) = \frac{1}{t} \ln \frac{\frac{H(t)}{I(t)}}{\frac{H(0)}{I(0)}} \ , \tag{2.4}$$

so that r_U can be interpreted as the rate of growth of total health care expenditure normalized by an index of population size and structure.

The underlying rate reflects technological change, changes in per capita utilization, shifts in the care provided, and other factors, whereas the demographic rate combines population trends and aging, and is designed to capture the health needs of a growing population and the costs of treating an older population. These assumptions mean, for example, that even if the underlying rate of change were zero, health care expenditure would continue to grow (or fall) depending on changes in population size and age structure. It also means that if the underlying rate were to fall (as has occurred, for example, in some transition economies of the former Soviet Union), the GDP share of health could still increase depending on the direction of population change.

As our index of population-related growth in health expenditure, we define

$$I(t) = \frac{\sum_i P_i(t)c_i(t)}{\sum_i P_i(0)c_i(0)} \ , \tag{2.5}$$

where $P_i(t)$ is population in age group *i* and $c_i(t)$ is the age-specific relative expenditure index. Note that $I(0) = 1$.

It is possible to decompose $I(t)$ into components related to population change ("volume effect") and aging ("distribution effect") by rewriting as follows:

$$I(t) = I_P(t)I_A(t) \ , \tag{2.6}$$

with

$$I_P(t) = \frac{\sum_i P_i(t)}{\sum_i P_i(0)} \ , \tag{2.7}$$

and

$$I_A(t) = \frac{\sum_i p_i(t)c_i(t)}{\sum_i p_i(0)c_i(0)} \ , \tag{2.8}$$

where $p_i(t)$ is the proportion of population in age group *i*.

Based on the discussion in the previous section, we assume that $c_i(t)$ is constant over time at the values given in *Table 2.1* for MDCs:

$$c_i(t) = \mathrm{c}_i(0) \ , \tag{2.9}$$

so

$$I^{MDC}(t) = \frac{\sum_i P_i(t)c_i(0)}{\sum_i P_i(0)c_i(0)} \ . \tag{2.10}$$

In the case of the LDCs, we have assumed that health expenditure is proportional to age-specific mortality, an approach that leads to the expression

$$c_i(t) = m(0)d_i(t) \; , \tag{2.11}$$

where m is a constant of proportionality and d is the age-specific mortality rate. Because m cancels, the index is then

$$I^{LDC}(t) = \frac{\sum_i P_i(t)d_i(t)}{\sum_i P_i(0)d_i(0)} \; . \tag{2.12}$$

The population growth term of the multiplicative decomposition is

$$I_P^{LDC}(t) = \frac{\sum_i P_i(t)}{\sum_i P_i(0)} = \frac{P_T(t)}{P_T(0)} \; , \tag{2.13}$$

where the *T* subscript refers to total population in all age groups and the aging component is

$$I_A^{LDC}(t) = \frac{\sum_i p_i(t)d_i(t)}{\sum_i p_i(0)d_i(0)} \; . \tag{2.14}$$

$I(t)$ and $I_A(t)$ for LDCs have an immediate interpretation in terms of total deaths and the crude death rate (total deaths over total population):

$$I^{LDC}(t) = \frac{\sum_i D_i(t)}{\sum_i D_i(0)} = \frac{D_T(t)}{D_T(0)} \; , \tag{2.15}$$

where $D_i(t)$ is deaths in age group *i* and the *T* subscript refers to total deaths; and

$$I_A^{LDC}(t) = \frac{\sum_i \frac{P_i(t)}{P_T(t)} \frac{D_i(t)}{P_i(t)}}{\sum_i \frac{P_i(0)}{P_T(0)} \frac{D_i(0)}{P_i(0)}} = \frac{CDR(t)}{CDR(0)} \; , \tag{2.16}$$

where *CDR* is the crude death rate.

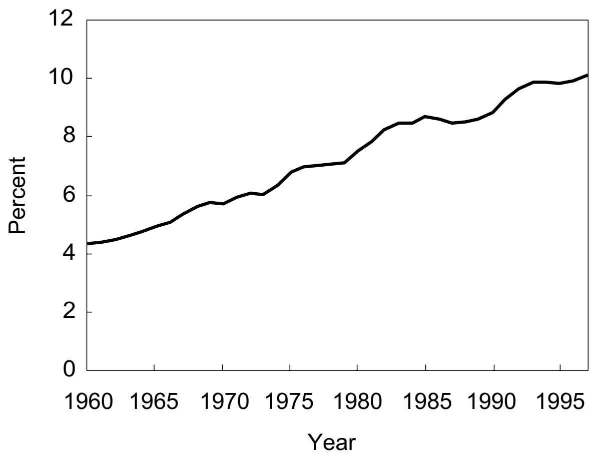

Figure 2.3. Health care expenditure as a percentage of GDP in OECD countries, 1960 to 1997. *Source*: OECD, 1998a.

2.3 More Developed Countries

In this and the next section, we consider the application of the growth factor model to health care expenditure in both world regions. In OECD countries, health care expenditure increased at a rate of 5.7% per year between 1960 and 1995 in real terms. GDP, meanwhile, grew at 3.4% per year, with the result that health care now accounts for 9.8% of GDP, compared with 4.3% in 1960 (*Figure 2.3*). Based on application of the growth factor model, of the total "headline" rate of growth in health expenditure of 5.7%, 1.3% was caused by population changes and aging. The remainder (4.4%, by far the larger share) represents the underlying rate, which we have attributed elsewhere to technological, institutional, and other effects. These results are shown in column one of *Table 2.3*. Note from the model equations that the effects are actually multiplicative, although allowing them to be additive turns out to be an accurate approximation.

How will population change and aging affect future MDC health expenditure, and what will be its share of GDP? Answering these questions involves three judgments, one about demographic change, another about the underlying rate of growth of health care, and a third about the rate of economic growth. Of these, the underlying rate for health care is perhaps the most difficult to judge. As noted, health care expenditure in the OECD grew continuously between 1960 and 1995 except for a brief period during the early 1980s, when it faltered for a year or two. All the signs are that this level of underlying growth is set to continue, albeit possibly at a slightly slower rate as a result of cost containment policies. Extrapolation of the

Table 2.3. Development of health expenditure and GDP in MDCs, 1960 to 2050, in percent. Note: 3.4% for 1960 to 1995 is an estimate based on OECD region only.

	1960–1995	1995–2020	2020–2050
GDP growth per annum	3.40	3.00[a]	3.00[a]
Health care expenditure growth per annum	5.70	4.10	3.70
Underlying rate	4.40	3.00[a]	3.00[a]
Age and volume	1.31	1.06	0.74
Due to population change	0.96	0.27	–0.05
Due to aging	0.35	0.79	0.79
As percentage of GDP (end of period)	9.84	12.80	16.00
Private	40	40	40

[a] Assumed rate.

past 30 years of OECD experience suggests, therefore, that the underlying rate of growth for the MDC region should be a bit less than 4% per annum (pa).

However, the MDC region in the IIASA model includes not only OECD countries but Eastern Europe and most of the former Soviet Union as well. In these regions, GDP has fallen dramatically in recent years (one assumes temporarily) with the introduction of market reforms. Interestingly, these countries provide an illustration of what happens to health care expenditure when an economy is in rapid decline. Data from Chellaraj *et al*. (1996) indicate that the GDP share of health care has increased as GDP has fallen in absolute terms. This suggests that even if there is a prolonged period of economic transition, including rigorous health cost containment policies, the underlying growth rate will remain positive in this part of the world even where absolute expenditure declines.

Taking these factors into account, we assume 3% pa for the underlying rate of future growth in health care expenditure in the MDC region, which is about 1% pa below the OECD rate prior to 1995.

Combining this assumption with the IIASA central scenario population projection results in the health care expenditure projections shown in *Table 2.3*. Demographic change contributes 1.06% pa to health expenditure growth between 1995 and 2020, declining to 0.74% pa between 2020 and 2050 (see *Table 2.3*). Of the 1.06% pa between 1995 and 2020, most (0.79% pa) is due to aging and the rest (0.27% pa), to volume (i.e., population increase). Between 2020 and 2050, 0.79% pa is due to aging, with a small offset (–0.05% pa) due to a declining population. These results can be compared with the more substantial impact (1.3% pa) of population change and aging in the period from 1960 to 1995, most of which (0.96% pa) was due to population increase. A major conclusion to be elicited from *Table 2.3*, therefore, is that, notwithstanding underlying growth, future demographic pressures on health services will come not from population increase, as in the recent past, but from population aging.

Based on a long-term GDP growth assumption of 3% pa, the projections in *Table 2.3* imply that health care's share of GDP will grow from 9.8% in 1995 to 12.8% by 2020 and 16.0% by 2050. This proportion is broadly equivalent to that currently seen in the USA, whose own expenditure on health care has been forecast, in one estimate, to increase to 27.1% of GDP by 2040 (Warshawsky, 1999). The MDC average will be reached unless there is more pressure to bear down on costs (e.g., through rationing of medical interventions), more recognition is given to preventive care, or there are other changes in policy or technology. If GDP growth is slower – for example, if improvements in productivity fail to compensate for slower labor force growth – then the health share will be even higher.

A potentially important unknown is whether the assumed age-specific relative health expenditure indices shown in *Table 2.1* will continue at the levels indicated or will fall – for example, as a result of cost containment policies or improving health. If it is assumed that present relative expenditure indices for the 85+ age group are set equal to those for the 75 to 84 age group, which are lower, the GDP share of health expenditure is reduced only marginally. If the expenditure indices for age groups over 75 are set equal to those for the 65 to 74 age group, the reduction is about 0.5% of GDP in 2020, rising to just under 2% in 2050. This is a more substantial reduction, but it also provides a good illustration of the limitations of cost containment policies aimed solely at older people. In comparison, if, for example, the underlying rate of growth were to be reduced from 3% to 2%, the GDP share of health expenditure would fall to 10% and 12% in 2020 and 2050, respectively, which is a far more substantial reduction. The key conclusion therefore is that aging, while becoming more important, is only one relatively small part of the upward drive in health expenditure.

From the standpoint of applying the IIASA model, it is also important to know how much of health expenditure is publicly financed and how much is privately financed. The relative merits of different forms of provision are not our concern here, only the extent to which they affect the financing of health services and the various contribution rates. The part of total health expenditure that is privately financed is defined as the difference between total and public expenditure. Based on OECD data, private expenditure dropped from 59% of the total in 1960 to about 40% in 1975 (*Figure 2.4*), and has since stabilized. This somewhat counterintuitive finding (intuitively, one might expect private expenditure to increase its share) is consistent with the findings of other studies that private medical expenditure is negatively related to GDP per capita (e.g., see Musgrove, 1996). Equally interesting, however, is the fact that the decline of the private-sector share seems to have been arrested, possibly reflecting the success of cost containment policies in the public sector. In the absence of any obvious trends or other changes in government policies, we assume that private health expenditure will continue at around 40% of the total.

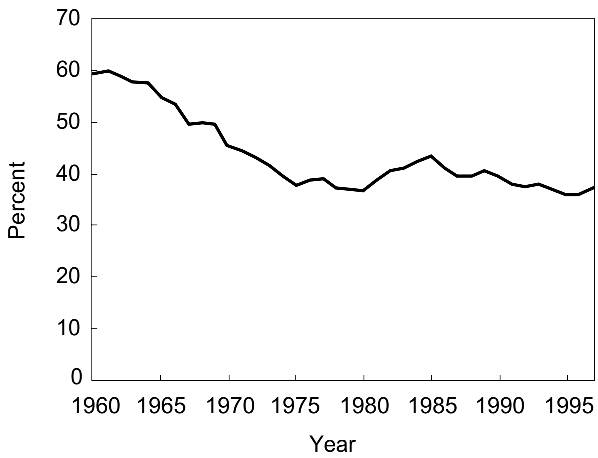

Figure 2.4. Private expenditure on health as a percentage of total health care expenditure, 1960 to 1996. *Source*: OECD, 1998a.

2.4 Less Developed Countries

There are too many gaps in the data for LDCs to produce an analysis as detailed as that for MDCs. This means that coverage of the key indicators is sparse and the conclusions are necessarily weaker. As far as can be determined, however, the economies of LDCs grew at an average rate of 3.2% pa between 1960 and 1995. We assume this rate of growth continues at 3% pa, which is the same as our assumed GDP growth rate for MDCs. Public expenditure on health care is about 2.7% of GDP (World Bank, 1999), with the level of private medical expenditure unclear, but potentially double this. In any event, total expenditure is a much smaller proportion of GDP (very roughly half) than in MDCs. Because no reliable figures are available for years prior to 1960, it is not possible to provide accurate estimates of the historical underlying growth rate of health care expenditure. For projection purposes, it seems reasonable to assume a growth rate of 3% pa, as we have done for MDCs.

It is possible, however, to estimate the contribution of population change and aging to health expenditure based on the mortality-linked hypothesis described in Section 2.3. Analysis (see *Table 2.4*) shows that the effective contribution of population change and aging in LDCs between 1960 and 1995 was about 0.4% pa, much less than in MDCs. Of particular interest is the fact that this rate breaks down into a 1.9% pa increase due to population growth (double the volume effect in MDCs), but a 1.5% pa *decrease* due to population age structure changes. Rapid fertility decline has decreased the number of very young persons (vis-à-vis the number of young persons in the absence of fertility change), who have relatively high health

Table 2.4. Development of health expenditure and GDP in LDCs, 1960 to 2050, in percent.

	1960–1995	1995–2020	2020–2050
GDP growth per annum	3.20	3.00[a]	3.00[a]
Health care expenditure growth per annum	n.a.	4.80	4.62
Underlying rate	n.a.	3.00[a]	3.00[a]
Population and aging	0.40	1.80	1.62
Due to population change	1.90	1.54	–0.73
Due to aging	–1.50	0.26	2.35
As percentage of GDP (end of period)	2.70[b]	4.20	6.90

[a] Assumed rate.
[b] Public expenditure only.

care costs, but has only recently started to translate into a growing number of older people. Both MDC and LDC populations have "aged" in terms of rising average (and median) age; in MDCs, however, aging has occurred from the top of the population pyramid, whereas in LDCs it has occurred from the bottom of the pyramid. Since young adults have the lowest health costs of any age group, the result has been downward pressure on total health expenditure in LDCs in this period.

In the future, deceleration of overall population growth will ease pressure on LDC health expenditure, but population age structure change will switch from braking expenditure growth to accelerating it. The combined effect of population growth and aging produces a growth rate of 1.8% pa between 1995 and 2020, which then falls to 1.62% pa between 2020 and 2050. Of these totals, in the period up to 2020, 0.26% pa (one-seventh) is attributable to aging and the rest is attributable to population growth; after 2020 the effect of aging increases to 2.35% pa, but the effect of population growth turns negative (–0.73% pa). Thus we conclude that the demographic sources of growth in LDC health expenditure are quite different from those in MDCs. In the latter, most (1995–2020) or all (2020–2050) population-related growth is due to aging. In the former, the aging component is only beginning to be felt, but its impact is increasing.

With an assumed underlying growth rate of 3% pa, total public expenditure on health care as a proportion of GDP is set to increase from 2.7% in 1995 to about 4.2% in 2020 and 6.9% in 2050, with the final percentage being higher when private expenditure is added in. Doubling the 4.2% GDP share of public-sector health expenditure expected in 2020 to arrive at an estimate of total (public plus private) health expenditure of 8.4% implies that in 2020 LDCs will face a situation not unlike that of MDCs in 1995. Doubling the share expected for 2050, total LDC health expenditure at 13.8% of GDP is not projected to differ appreciably from expenditure in MDCs (16%). Add to this the possibility that the underlying rate of growth may be more rapid in LDCs than in MDCs because of rapid assimilation of

MDC medical technology (and, perhaps, less effective cost containment measures) and it is striking how rapidly the LDCs are projected to approach the situation of today's MDCs. In other words, any differences are basically due to the time lag rather than to fundamentally different behavior.

3

Disability and Elderly Care Services

3.1 Measuring Disability

Disability may be congenital or a result of illness, injury, or physical deterioration, especially in old age, when many find it difficult to manage without the support of others. Knowing the severity of a disability is therefore important because it is an indicator of dependency on others, such as friends or family, the state, or other agencies. Thus it is helpful to think of disability as occurring on a continuum rather than being a precise condition, and so distinguishable from ill health in the sense that it describes a physical inability to carry out a particular activity. The medical conditions primarily associated with disability in old age are circulatory diseases, mental deterioration, and arthritis.

More precise descriptions and definitions of disability are given in numerous texts and in statistical surveys and compendia. The World Health Organization, for example, has adopted the International Classification of Impairments, Disabilities and Handicaps (ICIDH) as a measurement framework, which is intended to be complementary to the International Classification of Diseases (ICD) system for diseases (see the annex to this report). Partly because of the expense and difficulty of measuring disability, even on a sample basis, it will take time to build a consistent and comparable database for all countries.

Estimates of the prevalence of disability are based on the number of people with disabilities above a certain threshold. Therefore, unless all countries adopt the same threshold, definitions and estimates of the number of disabled are bound to vary. Administrative data on receipt of disability benefits are a potential source of information, but not all countries offer disability benefits, and those that do have different eligibility rules.

In many countries, family and household surveys or censuses include questions about the state of health of individuals that could potentially provide the basis for international comparison. How disability questions are posed can give rise to different estimates, even among the same population, although distributions across age groups tend to be similar.

Some years ago the UN published a volume on disability statistics that is illustrative of the problem (UN, 1990). This work showed that Austria headed the disability league, having a disability prevalence rate 20 times that of Egypt, a result most observers would find implausible (e.g., see Metts *et al*., 1998). The reason for the difference in this admittedly extreme case was that in Egypt disability was measured on the basis of impairments (e.g., blindness) and in Austria, on the ability to carry out the tasks of daily living. There is also anecdotal evidence that Austrian social security disability benefits are very generous, which could encourage overreporting.

Any analysis must therefore be based on a choice between data produced under different definitions or data taken from a smaller, representative population under strictly controlled conditions. Our starting point is an in-depth survey of disability carried out in the UK during the 1980s. This highly detailed study, regarded as the "gold standard" in its field, is still widely used and quoted, and is even used for resource allocation purposes by some local service providers. The methodology is described in the annex to this report, including examples from categories ranging between 1, "least disabled," and 10, "most disabled." It is convenient to group these 10 categories into three larger groups. We arbitrarily chose the cutoffs to be categories 1 to 4 (least severe), 5 to 7 (intermediate severity), and 8 to 10 (most severe). *Figure 3.1* shows how disability rates increase with age in each category; *Table 3.1* shows the actual rates on which the graph is based as well as the overall disability rate per thousand.

Table 3.1 shows that the overall disability rate is about 14% of the population. This is roughly equivalent to values obtained in household and census-based survey questions about "limiting long-standing illness." These gave percentages for the UK in the range of 12% to 18% (ONS, 1998), but obviously using less detailed survey instruments. Although not broken down by severity, recent work at the Disability Statistics Center at the University of California, San Francisco (Kaye *et al*., 1997), using the National Health Interview Survey (NHIS) provides confirmatory evidence. This work shows, for example, an overall US disability rate of 15% in 1994, up from 11.7% in 1970 as a result of changes in the population age structure. Age-specific rates in the over 60 age group are around 40% in the USA, which is reasonably close to the 47% obtained using Office of Population Censuses and Surveys (OPCS) prevalence rates.

As far as *Figure 3.1* is concerned, the prevalence rate is accurately described by an exponential equation of the form $\delta_x = A\exp(bx)$, where δ_x is the prevalence rate at age x and b is the rate of increase in disability with age. Calibration yields a value for b of 0.052 and for A of 7.92 per thousand, which could be loosely interpreted as the congenital rate of disability (R-squared = 0.996). Each severity category can be similarly described, although the goodness of fit becomes inferior as prevalence levels decrease.

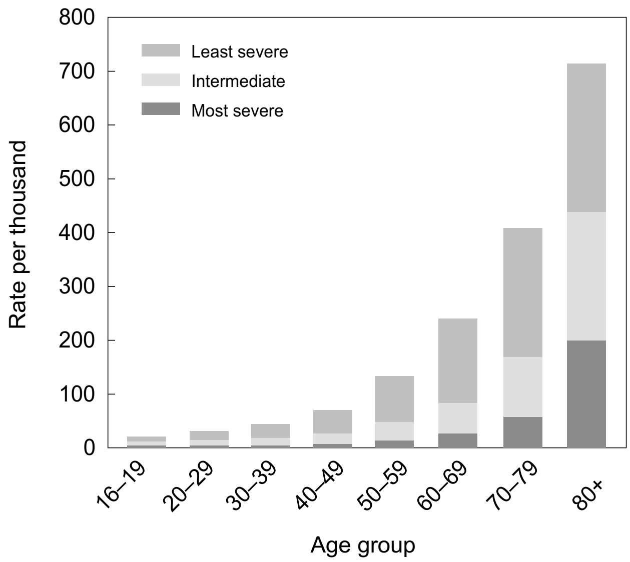

Figure 3.1. Prevalence of disability by age and severity category. *Source*: OPCS, 1988.

Table 3.1. Disability rates per thousand by age and severity (adapted from OPCS, 1988).

	Age group								
Severity	16–19	20–29	30–39	40–49	50–59	60–69	70–79	80+	All
Most	5	5	5	7	14	27	57	200	22
Intermediate	7	10	13	23	34	57	112	238	40
Least	9	16	26	40	85	156	239	276	80
All	21	31	44	70	133	240	408	714	142

The period of most severe disability – and, therefore, greatest dependency – is concentrated in the last years of life. Reviewing studies carried out in six countries in 1980 and 1993 (Australia, Japan, Canada, UK, France, and Norway), the OECD observed that this period had hardly changed over that time frame and that it was significantly higher for women than for men, with a combined average of around two years. By combining these data with mortality schedules, it is possible to obtain an estimate of the number of severely disabled that is independent of the prevalence rate.

3.2 Method of Analysis

In a stationary life table population, the following relationship will tend to hold for small values of *a* relative to life expectancy at age *x*:

$$_\infty L_x {}_\infty\delta_x = {}_\infty D_x a \ , \tag{3.1}$$

where $_\infty L_x$ is the number of person-years lived above age *x*, $_\infty\delta_x$ is the disability rate above age *x*, $_\infty D_x$ is the number of deaths above age *x*, and *a* is the average period with disability before death. Since

$$_\infty D_x = l_x \ , \tag{3.2}$$

where l_x is the number of members of the life table population who survive to age *x*, then

$$\frac{_\infty L_x}{l_x} = e_x = \frac{a}{_\infty\delta_x} \ , \tag{3.3}$$

where e_x is life expectancy at age *x*, from which we can express prevalence above age *x* as average duration of disability divided by life expectancy at age *x*:

$$_\infty\delta_x = \frac{a}{e_x} \ . \tag{3.4}$$

The stock of disabled people above age *x* is therefore given by

$$_\infty S_x = \frac{_\infty L_x a}{e_x} \ . \tag{3.5}$$

These relationships, which should hold at least approximately in the real world, encapsulate the healthy versus unhealthy life-years issue in the longevity debate. If the duration of disability prior to death is fixed and longevity is increasing, one would expect the prevalence rate to fall. This would correspond to a situation in which a population was living longer, disability-free lives; in other words, increments to life expectancy would consist of disability-free life years. If, in contrast, increments to life expectancy consisted of disabled life years, then the prevalence rate would be expected to rise over time. Note the implicit, strong assumption that people do not recover from their disability. For the "least severe" categories this assumption contradicts some evidence (see, e.g., Liu *et al*., 1995), but for the "most severe" category it holds up well, and so we assume accordingly.

Say, for example, life expectancy at age *x* is 10 years and the duration of disability prior to death is 2 years. Then, if life expectancy and number of years spent in disability rise in lockstep, we might observe prevalence rising as 2/10, 3/11, 4/12, … . Using a different example, if the duration of disability remains in constant proportion to life expectancy, then prevalence is constant (e.g., 2/4, 4/8, 8/16, …). Thus, our projections of disability prevalence rates depend crucially on whether the longevity revolution is producing healthy or disabled life years.

For a range of reasons the evidence is mixed. Kaye *et al*. (1996) found age-specific disability rates to be almost static over 20 years and even increasing in some younger age groups. However, Manton *et al*. (1997), using both longitudinal data from the National Long-term Care Survey and cross-sectional data, found small but statistically significant reductions in prevalence rates. Freedman and Martin (1998), working with a longitudinal household survey produced by the US Census Bureau, found "large declines in the crude prevalence of functional limitations" between 1984 and 1993. One reason for these differences is that, compared with cohort studies, cross-sectional data are not sensitive enough to pick up small changes over time.

In Britain, a different trend is evident. For example, Bebbington (1991) found that healthy life expectancy has improved more slowly than life expectancy and that disability rates have increased slightly. Dunnel (2000) also found that healthy life expectancy has increased, but not by as much as total life expectancy. Grundy *et al*. (1999), in a follow-up to the OPCS work, found that disability rates had increased substantially, although they encountered significant sampling problems. Further work is needed to understand these differences and the accuracy of the estimates. In the meantime, there is uncertainty about how disability will develop, and our projection methodology is designed to reflect this.

Disability projections can be made using either a prevalence rate approach (i.e., combining assumptions on prevalence rates with assumptions on mortality, from which duration would follow) or a duration approach (i.e., combining assumptions on duration and mortality, from which prevalence would follow). Each approach has advantages and disadvantages. When applied to historical data from the UK, the duration-based approach (assuming the same duration of disability prior to death over the entire age spectrum) correctly predicts a steep exponential increase in prevalence at ages over 60; however, it overestimates prevalence for younger age groups.

The etiology of disability in younger age groups differs from that in older age groups, and deaths prior to old age do not follow the same pattern as for older people. Because we place a premium on estimating disability across the age spectrum, we employ the prevalence approach, using the duration approach only for comparison purposes in older age groups and only for the most severe disability category. We assume prevalence rates are fixed at their initial-year values, recognizing that the results are likely to be at the upper end of disability estimates for older age groups.

In LDCs, both the prevalence and duration approaches are difficult to implement because of the lack of disability data. Murray and Lopez (1996) have produced global regional tables of disability based on a different methodology in which levels and duration of disability are associated with the incidence of disease conditions. Inconveniently for IIASA's purposes, the results are expressed in "severity-weighted" whole-year equivalents, making it difficult to obtain estimates of the *stock* of people with disabilities, by severity, at a given point in time. Nevertheless, their results provide useful pointers and background.

The issues are complex, but their findings suggest two reasons why direct comparisons between MDCs and LDCs will be of only limited value. The first is that risk factors differ in the two regions. In LDCs disability at younger ages is common owing to the generally poorer health status of the population, which is associated with risk factors such as poor nutrition, inadequate housing, high incidence of infectious and parasitic diseases, HIV/AIDS, etc. In MDCs, they argue, the main disability risk factor is simply growing old (others include accidents and the use of tobacco and alcohol). The second reason is that, because of more limited access to health care services, in LDCs long-standing disabilities often arise from untreated medical conditions.

As risk factors change with overall economic development and access to medical care expands, it is likely that age-specific disability prevalence rates will change significantly. With this qualification in mind, we present the results of applying the fixed-prevalence assumption to LDCs (see Section 3.4). We use MDC prevalence rates, recognizing that these are likely to result in lower-bound estimates of the disabled population in any age group. It may be, however, that projected age structure changes are much greater than likely changes in age-specific rates, in which case projected rates of change in the total disabled population should not be too far wrong.

3.3 More Developed Countries

Applying the OPCS UK disability rates to IIASA population estimates indicates how the stock of people with disabilities will develop through time if these rates stay the same. *Table 3.2* provides the key details, indicating that the number of people with disabilities is set to rise from 127.7 million in 1995 to 181.7 million in 2020 (1.4% growth pa) and 238.3 million in 2050 (0.9 % pa), an 87% increase over the period. The most rapid growth is set to occur in the most severe disability category, a function of the growing share of the population in advanced old age (80+). *Figure 3.2* shows the change in the disabled population through time summed over all three severity categories. It shows that disability in advanced old age becomes dominant after around 2030.

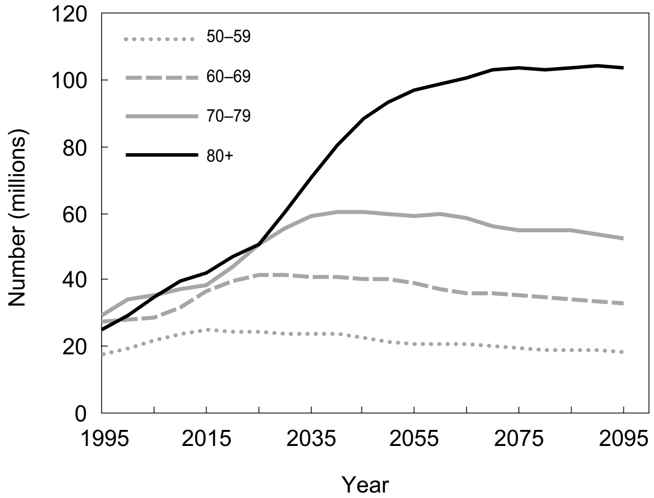

Figure 3.2. Projected number of people with disabilities in MDCs by age group, 1995 to 2095.

Table 3.2. Projected number of people with disabilities (in millions) in MDCs, in 1995, 2020, and 2050, by severity category.

Severity	1995	2020	2050
Most	19.6	29.6	44.1
Intermediate	35.8	51.4	69.6
Least	72.3	100.7	124.6
Total	127.7	181.7	238.3

After 2050 all age groups tend to level off or fall slightly as the age structure stabilizes. *Figure 3.3* shows the distribution by age and severity category at two points in time, (a) 1995 and (b) 2050. Whereas in 1995 the number of people with disabilities tails off in older age groups, by 2050 the oldest age groups are the most numerous across all severity categories. Those in the least severe category are always in the majority, although there is convergence at very old ages as transfers take place to more severe categories.

Figure 3.4 compares alternative projections of the most severely disabled population aged 60 and above and 70 and above. The projections plotted with continuous lines were derived using the fixed-prevalence rate approach. Those plotted with dashed lines were calculated by combining an assumed duration of disability of 1.8 years (the figure derived from the OECD study mentioned in Section 3.1) with IIASA projections of life expectancy at 60 and 70. As can be seen, there is a

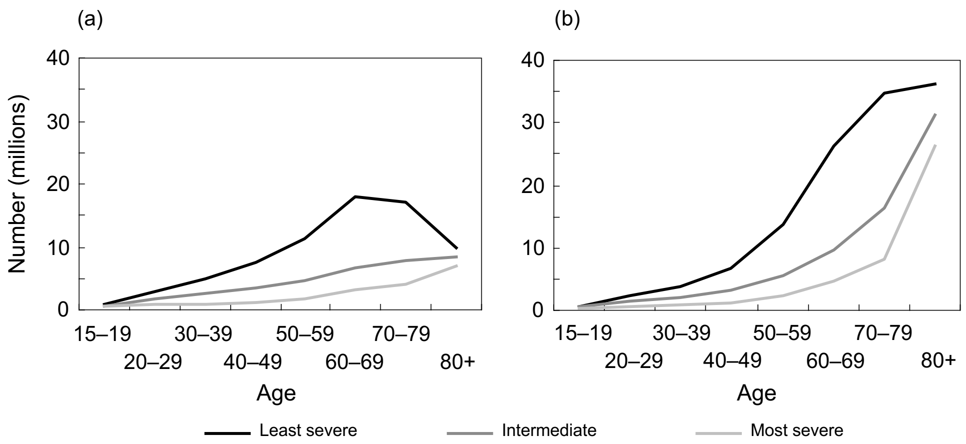

Figure 3.3. Projected number of people with disabilities in MDCs in (a) 1995 and (a) 2050, by age group and severity category.

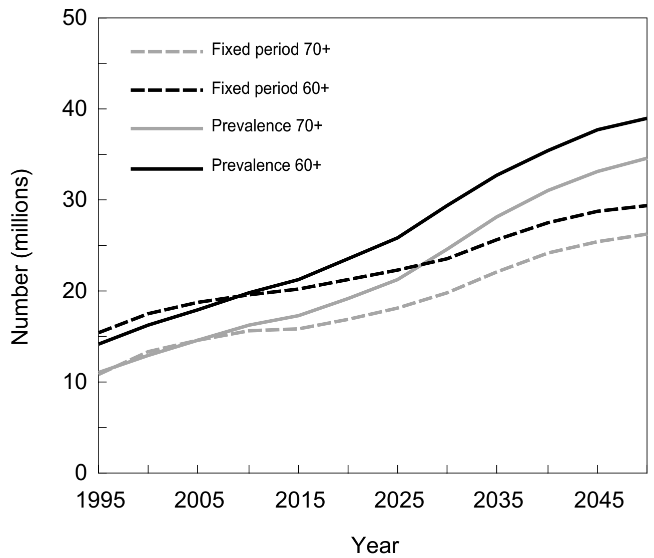

Figure 3.4. Comparison of estimation methods for number of "most severely" disabled people over 60 years and over 70 years based on prevalence and fixed-period approaches, MDCs, 1995 to 2050.

close correspondence between the two sets of projections in the early years, but estimates diverge thereafter. The reason for this divergence is that the fixed-duration method scales by number of deaths, which declines over time as age-specific death rates decline, whereas the fixed-prevalence method scales by population, which

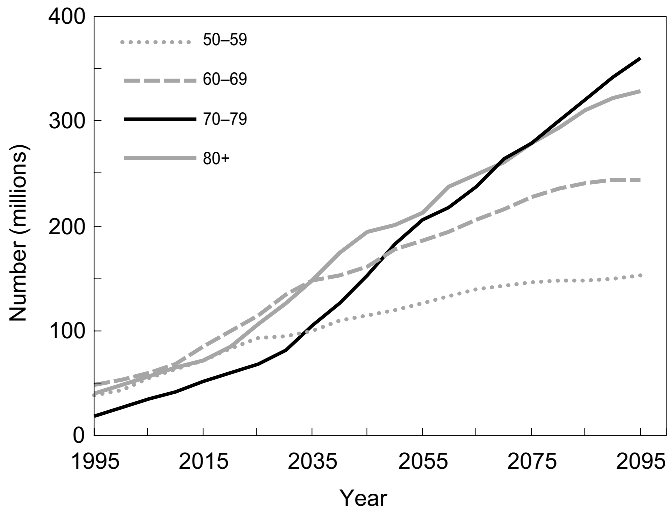

Figure 3.5. Projected number of people with disabilities in LDCs by age group, 1995 to 2095.

Table 3.3. Projected number of people with disabilities (in millions) in LDCs, in 1995, 2020, and 2050, by severity category using OPCS prevalence rates.

Severity	1995	2020	2050
Most	32.6	66.5	134.5
Intermediate	66.3	129.7	242.4
Least	138.1	269.2	482.6
All	236.9	465.4	859.4

increases (obviously, elderly mortality rates are declining faster than the elderly population is growing). The gap between the two sets of projections is around 2 million in 2020, but increases to between 8 and 10 million by 2050 – a difference of 25%. As far as this study is concerned, we conclude that the overall disability projections are broadly robust in the early years but need to be treated with more caution in later years, especially for older age groups.

3.4 Less Developed Countries

The results of applying MDC prevalence rates to LDCs are shown in *Table 3.3* and *Figure 3.5*. The results for the initial year are much lower than UN global estimates of the disabled population (see endnote [1]). The UN estimated the number of people with disabilities in MDCs in 1981 to be 100 million, which is in the same neighborhood as our estimate of 127.7 million for 1995 (see *Table 3.2*). Roughly speaking, the UN estimate of the disabled population in LDCs (400 million in 1981) is almost twice as high as the estimate given in *Table 3.3* (236.9 million in 1995). In part, this may be because we exclude age groups under 15; however, age-specific disability rates under 15 are low. The UN does not elucidate how they arrived at their estimate, so it is difficult to reconcile the difference. However, it is clear that further research and data collection on LDC disability rates would have a large payoff.

We have already argued that, while we have little confidence in our estimates of the number of people with disabilities in LDCs, we have more confidence in our ability to predict rates of growth. It appears safe to conclude that the disabled population in LDCs is set to grow more rapidly than that in MDCs. In *Table 3.3*, we project growth at an average rate of 2.7% pa between 1995 and 2020 and 2.0% pa between 2020 and 2050, for a total increase of 263%. As in MDCs, the most rapid expansion is likely to be in the most severe category, whose numbers are projected to double between 1995 and 2020 and then double again between 2020 and 2050. Moreover, whereas in MDCs growth of the disabled population is projected to decelerate for all age groups save the very old (see *Figure 3.4*), in LDCs we expect continued growth across the age spectrum (see *Figure 3.5*).

3.5 Disability and the Provision of Elderly Care Services

Whereas our projections of health care costs were based directly on age-specific expenditure data, in the case of disability no such data are available. A consideration of the sources of care, and the costs of each type of care, is required before we can project expenditure.

Caregiving services present a diverse and complex structure. The majority of caregiving services are provided by family and friends – the informal sector. It is estimated that up to 80% of all care is channeled through the informal sector in MDCs, and this rate is probably over 95% in LDCs. In Japan, it is usual for older people to live with their children, with the oldest child usually taking on this responsibility (Kojima, 1995). In the 1970s the proportion cared for in the family was 70%, but by 1995 this had fallen to around half (Endo and Katayama, 1998), with the rest living either alone (approximately 45%) or in institutions. The public, private, and voluntary sectors therefore complement the informal sector rather than dominate it and provide a variety of services ranging from long-term care in hospitals to day services, home help, and other benefits in kind such as transport and home meals. The aim of this section is to present reasonably coherent estimates of how services may develop to meet projected increases in demand.

3.5.1 Supply of caregivers

Only fragmentary information on the supply of caregivers in LDCs exists. In these countries, most caregiving takes place within the family or local communities where there are strongly ingrained traditions of looking after people in old age. In some communities, having children is still regarded as an alternative to establishing a pension (World Bank, 1994), although other societal pressures and family planning policies are changing this view. Some LDCs facing the prospect of aging populations, such as China, are developing more formal services, particularly in cities, although it will be a long time before rural traditions built around family structures change. For these reasons, in this section we focus mainly on MDCs, although some of the findings may also apply to LDCs.

The supply of caregivers is a factor determining future patterns of care, with demographic pressures (aging of the baby boom generation and the consequent increase in the elderly dependency ratio) appearing to favor the formal sector. An increase in the very aged (80+) population, it is argued, will put pressure on children, who are the mainstay of the informal sector, forcing them to seek alternative arrangements for caregiving. In practice, the age structure of caregivers and their relationship to the persons being cared for are quite complex, and so-called carer ratios, comparing the number of individuals over a certain age with the number in the age groups immediately below, give an oversimplified representation of trends. Indeed, the people with caregiving responsibilities are spread fairly evenly among older age groups (over 60, say) and, in addition to children, include spouses, friends, and close relatives of the same age as those being cared for (DSS, 1997). It may therefore be better to ignore generational age differences altogether and use an entirely different proxy for dependency, one that is based, not on age, but on a comparison of the total number of “disabled” individuals to the number of “able” ones.

If this approach is applied to the previous disability and population projections, then in MDCs the ratio of disabled to non-disabled persons over 55 years old stays at 0.5 until 2020, rising to 0.6 in 2050, indicating a slight tightening in supply of caregivers in the later period. In LDCs, the ratio remains at 0.5 throughout the projection period. Unlike in the informal sector, professional caregivers in the formal sector are drawn entirely from people of working age. A comparable index of the supply of formal-sector caregivers would be the ratio of the disabled population over 55 to the non-disabled population aged 15 to 55. In MDCs, this ratio is projected to rise from 0.18 in 1995 to 0.37 in 2050; in LDCs it is expected to rise from 0.10 to 0.18 over the same period.

This approach is an oversimplification because it ignores other effects that might limit the supply of caregivers in the informal sector, such as changes in female labor participation rates, relative wages, or increases in retirement age. It

Table 3.4. Care options for a severely disabled person in the formal sector (adapted from "Improving the balance of elderly care services," Bowen and Forte, page 78, in Cropper and Forte, 1997).

	Care package			
Service	Option 1	Option 2	Option 3	Option 4
Geriatric ward in hospital (weeks per year)	52			
Residential home (weeks per year)		52		
Day hospital (visits per week)			2	
Home visits (hours per week)			5	5
Home help (hours per week)			12	16
Preference order	2	4	1	3
Relative cost	5.8	1	3	1.4

suggests, however, that whereas public concern has focused on the tightening of the supply of informal caregivers, it is the supply of formal-sector caregivers that is more likely to be stretched as a result of slower labor force growth. Focusing on children caring for parents, as opposed to the more complicated and nuanced picture observed in reality, can be misleading.

3.5.2 Projecting services in the formal sector

The costs of informal-sector care consist mostly of the opportunity costs of time spent in unpaid caregiving at the expense of remunerated employment. The relationship between caregiving and employment is complicated, and it is known that many caregivers choose to continue in paid employment, performing their caregiving duties during non-working hours. This is a particularly complex issue to unravel, at least in a satisfactorily general way, and therefore we limit ourselves here (and in the projections that follow) to estimating the costs of formal-sector care.

The pattern of consumption in the formal sector partly reflects demand, including the availability and affordability of different services, and partly reflects other factors. For persons with a given level of disability – and, therefore, needs – it is evident that there may be several ways of providing equally effective care packages based on different combinations of services in both sectors. There are different ways of demonstrating this; *Table 3.4* gives an example taken from the health management literature. It shows how the same level of care can be provided for severely disabled persons using different "care options" (Bowen and Forte, 1997). One care option might be to keep people in geriatric hospitals; another might be to care for them in a day center.

According to Bowen and Forte, “care experts” ranked the alternatives according to preference; as can be seen, the most expensive form of care is not always the best in their view. For example, 52 weeks a year in a geriatric hospital is ranked higher as a care option than 52 weeks in a residential home. The best “package” identified in this table for this group of clients is the home-based option backed up by home visits and time in a day hospital. The key points to note are that alternative care packages are suitable for different levels of disability and tend to be a mix of home help and institutional care, and each care package has a different cost structure depending on the mix of services within it. When this framework is extended to other groups of less disabled people, the tendency, not surprisingly, is for the number and level of services – for example, visits from health care professionals and social workers, physiotherapy, “meals on wheels,” and laundry services – to taper off to, say, one checkup visit a year or no service at all.

For expenditure projection purposes, it is convenient to base our analysis on similar concepts in which different care options are linked to severity of disability and, in turn, to the relative costs of care in each mode. Ideally, each disability category would be allocated to a unique care package; in reality, each category will be distributed across options depending on the local institutional environment and cost structures. Moreover, data deficiencies prevent a full and accurate analysis.

Detailed studies by the UK Department of Health during the 1980s using the “Balance of Care” model recognized 29 disability categories and 10 care options (for description of model, see McDonald *et al.*, 1974). Each care option was broken down into component services, so that for a given client group and care option it was possible to identify the number of home visits per week by type of worker, the number of weeks spent in hospital per year, and so on. The categories were based on physical health (severity of handicap), mental health (dementia and behavior), continence, and social circumstances (whether supportive or adverse).

Although there are conceptual differences between the disability categories and the OPCS disability scale, it is relatively straightforward to map each of the 29 categories onto the three much broader categories used earlier (least severe, intermediate severity, and most severe). In addition, to investigate the possible consequences of aging and disability on provision of care, we defined four basic care options: hospital care, care at a residential home, day care, and home care. As might be expected, the results of this mapping (see *Table 3.5*) show a tendency for the most severely disabled to be cared for in hospitals or residential homes, although it is noteworthy that the majority, regardless of severity category, are looked after in a home environment.

It is particularly interesting to note that the most severely disabled do not automatically receive institutional care. This finding is consistent with the more representative survey conducted by the OPCS, but is in conflict with some other studies that assume the severely disabled are all in long-term care institutions (e.g., see

Table 3.5. Distribution of severity by type of care (adapted from "Balance of Care" studies in the UK).

Severity	Hospital	Residential	Day	Home	Total
Most	12.9	12.8	10.5	63.8	100
Intermediate	3.1	17.1	7.4	72.4	100
Least	0.4	10.9	9.8	78.9	100

Jacobzone *et al*., 1998). Such assumptions seem unhelpful in trying to understand properly how these allocative processes operate, and they ignore the desire of many of the disabled, regardless of their condition, to remain at home.

We used these distributions to provide exploratory indications of demand in MDCs for different types of care, assuming previous population projections and age-specific disability prevalence rates, and assuming the split between formal and informal care remains at 20:80. The results show a growth of between 40% and 45% in the number of clients in each care category. However, to obtain the full picture, one needs to address not only market shares, but also financial flows. There are several reasons why this is difficult (Carr-Hill and Dalley, 1999).

One reason is changes in government policies in which the trend is to place more responsibility on the individual for care in old age (see, e.g., Sutherland, 1999). There is a lack of information about the private sector in particular, as well as some hidden "subsidies" through help with housing costs within the social security benefits system. Another issue is the relationship between hospitals and residential and community care sectors, which tend to be the responsibility of different government departments and agencies. Some of the growth in the residential care sector from the mid-1980s can be attributed to policies that moved long-term elderly patients out of hospitals and into cheaper accommodation, a trend in accordance with the general views of those experts who argue for community and home care over hospital care.

A second reason is the issue of the relationship between the formal and informal sectors, with the formal sector comprising state-run, private, and voluntary institutions. One might expect the formal sector to grow faster if the public sector decides to spend more on elderly care services than in the past; if old people change their established behavior based on independent living to behavior based on greater dependency; or if the opportunity costs of informal care rise relative to costs in the formal sector.

In this study, we restricted ourselves to areas where there is sufficient information to draw some general conclusions about how health and elderly care services might develop in the future based on trends in aging, population change, and needs of older people. We used the above-mentioned studies to investigate the level and type of resources used within three care options – residential, day, and home care.

Table 3.6. Cost weightings for different care options used in index (adapted from study by UK Department of Health).

	Care option			
Severity	Hospital	Residential	Day	Home
Most	10.0	2.8	1.6	0.9
Intermediate	4.0	2.8	1.0	0.7
Least	3.9	2.6	0.4	0.3

We excluded hospital care because its effects are subsumed in previous projections of health care costs, but we tabulate the cost weights for comparison.

Altogether, 3 types of accommodation, 3 types of community (day) service, and 10 types of home service were considered. Each care option includes a mix of services, so, for example, "day care" includes a certain amount of home-based and medical services. As with the Bowen–Forte example presented in *Table 3.4*, resource usage was expressed in relative terms according to each care option and level of disability, giving 12 cost weightings in all (see *Table 3.6*), 9 of which are incorporated into the estimation methodology.

Using the severity-based disability projections and probability distributions of individuals being cared for in each care environment (assumed to remain constant), we weighted the results by the cost weightings (also assumed to remain constant) to generate an expenditure index, which is a function of disability numbers, care options, and relative costs. We then anchored the index to 1995 for reasons that will become apparent below.

The index is expressed as follows:

$$I_k(t) = \frac{\sum\limits_{i,j} P_i(t)\delta_{ij}(0)\sigma_{jk}(0)c_{jk}(0)}{\sum\limits_{i,j,k} P_i(0)\delta_{ij}(0)\sigma_{jk}(0)c_{jk}(0)} , \tag{3.6}$$

where $I_k(t)$ is the index of expenditure for option *k* (residential care, day care, home care); $P_i(t)$is the population in age group *i* at time period *t*; δ_{ij} is the proportion of age group *i* in disability severity class *j*; σ_{jk} is the proportion of severity class *j* cared for in care option *k* (hospital care is excluded); and c_{jk} is the relative cost of option *k* in severity class *j*.

As in the case of the health expenditure discussed in Part 2, the rate of growth of this index can be decomposed into two rates, one related to population and the other an underlying rate. Assumptions concerning the latter can be combined with IIASA's population projections to project the index forward in time.

The OECD social expenditure database provides public expenditure figures on services for older people in our three categories from 1980 to 1995. It shows a dip in the early 1980s, corresponding to the recessionary period, followed by strong growth in the sector, averaging over 7.5% pa between 1984 and 1995. Only a small proportion of this growth is related to aging, with the rest more suggestive of rapidly evolving market conditions (growth of the public sector at the expense of the private sector, growth of the private formal sector at the expense of the private informal sector). Unfortunately, data are only available as of 1980, and so the series is not long enough to enable us to infer long-run trends. It seems, however, that the two main areas of growth have been in residential care and home services, with day services remaining relatively static. Total public expenditure on disability-related services accounts for a much smaller proportion of GDP than public expenditure on health. The figures suggest something between 0.5% for countries like the USA and over 2.5% for some Scandinavian countries. As far as can be determined, these differences are attributable to differences in reliance on the private sector (for which few comparative data are available) rather than to fundamental differences in approach to disability.

To provide some measure of comparison, we used the OECD public expenditure historical time series (1980–1995) to create a new statistical series, in which we set 1995 equal to 100. We then applied growth rates calculated from projections of the index above to project the OECD data series into the future.

In the health sector, we assumed an underlying growth rate of 3% pa. We expect, however, that governments will be more effective in containing the cost of disability care than they have been in containing heath care costs. First, health care is, to a significant degree, demand driven, as those who would not otherwise consume health care do so as their incomes rise, as services become more easily available, etc. Second, governments have traditionally contained costs of elderly care services and long-term care by rationing public formal-sector care, effectively concentrating care in the informal sector, where most caregivers are women. There is no sign that they are likely to abandon this strategy, although it will come under increasing strain as the supply of caregivers declines relative to the number of older people. On the assumption that the underlying rate of growth in disability-associated expenditure will be no higher than the underlying rate for health care, we therefore consider three growth scenarios, 1%, 2%, and 3% pa. The same underlying growth rate is applied to each of the three care arrangements (residential, day, and home care).

Figure 3.6 plots the results for the case of 1% pa underlying growth, with the period up to 1995 representing OECD data and the period after 1995 representing the forward extrapolation based on projected growth in our index. Note that each of the three curves “splices” on to the OECD series reasonably well, that is, there is no abrupt change of slope to be observed in 1995.

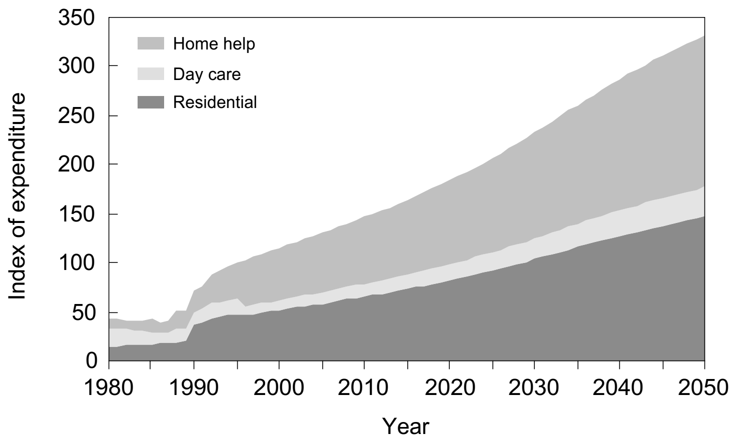

Figure 3.6. Growth in public expenditure on elderly care services based on population aging and an assumed 1% pa underlying rate of growth.

Table 3.7. Public expenditure of elderly care services, rates of growth, and GDP share.

	1995–2020	2020–2050
Growth due to aging (% per annum)	1.44	3.65
Percentage of GDP (at end of period) with underlying rate of growth of		
1% pa	0.98	1.50
2% pa	1.10	2.40
3% pa	1.40	4.20

The results show a roughly 50% increase in expenditure between 1995 and 2020, followed by a doubling between 2020 and 2050. As can be seen from *Table 3.7*, however, the impact on the share of disability-related expenditure in GDP is relatively small, even at higher assumed underlying growth rates. The main conclusion, therefore, is that elderly care services exert less pressure on public expenditure than might be expected from the large increases expected in the number of people with disabilities. This conclusion is based, as we have stressed, on the assumption that the informal sector continues to supply the bulk of care and that the public–private split in the formal sector remains unchanged. This assumption may be untenable in the longer term. The figures in *Table 3.7* should not be construed to mean that the broad economic impact of disability is therefore modest, as such an assessment would require much more analysis of the informal sector.

4

Conclusions

Our results indicate that health care will continue to consume an increasing share of national income in both regions. In MDCs, where population growth was the main cause of growth between 1960 and 1995, aging will take over as the main demographic cause of health expenditure increase. In LDCs, population growth will also give way to aging, but not until after 2050. These conclusions are fairly robust in the sense that quite large changes in the per capita health expenditure weights for the very old make only a small difference to the outcome in terms of GDP share.

Thus, even if it is assumed that countries will achieve some success in controlling health care costs for higher age groups, health expenditure will still rise unless there are accompanying reductions in the underlying growth rate, through, for example, greater use of rationing or effective preventive programs. As far as the IIASA model is concerned, the historical pattern of development and the altruistic, high-profile nature of the health care system suggest that it is more realistic to assume that the underlying growth rate is exogenous, with additional growth deriving from population aging and change. Precise assumptions about the underlying growth rate can be adjusted for use in different scenarios.

The other impact of aging considered in this study is that on elderly care services related to disability and chronic illness. Large increases in disability due to aging are predicted, regardless of the methodology used. The association between aging and disability will lead to potentially large increases in the numbers of people requiring personal care in both MDCs and LDCs, although the estimates for LDCs are much less certain than those for MDCs. Whereas in MDCs the number of people with disabilities is projected to plateau by around 2050 (earlier for all age groups except the very old), the number of individuals with disabilities in LDCs will continue to grow. In the medium term, the amount of growth is sensitive to how disability is measured and to assumptions about the biological processes of aging and whether healthier lifestyles will reduce the incidence of chronic disease. Thus, there remains much uncertainty as to the precise level of disability.

The future role and scope of elderly care services are also difficult to predict, partly because of this uncertainty and partly because of the dominance of the informal sector. For example, if all informal care were to be charged at the same rate as formal care, elderly care services would count for as great a share of GDP as health care (see Laing and Buisson, 1998).

Data for the formal sector indicate a fast-growing but relatively immature industry whose growth is susceptible to government intervention and regulation. The future is therefore inherently difficult to predict, and experience indicates that the expected demographic pressures may not translate mechanistically into more nursing or residential accommodation. Insurance markets for disability-related nursing care are still in their infancy, but if they take off, they may induce more flows from the informal to the formal sector. In any event, the share of GDP on long-term care is likely to remain at fairly low levels for some time, and therefore its impact within the IIASA model will be small overall.

However, the impact within the relevant age groups is likely to be greater. Analysis suggests that the supply of informal caregivers is likely to decline in MDCs, although not by as much as expected. It is possible that those older people needing institutional care will have to contribute more from their personal income and wealth than in the past. In addition, a shrinking work force may lead to shortages in professional caregivers, which could lead to increases in wage costs or, in extreme cases, to the neglect of older people. Any shortfall might well lead to additional migration of labor from LDCs to MDCs, particularly women in caring professions.

Throughout this report, the arguments put forward have been based purely on an analysis of the trends. The cynic says, “But haven’t we been here before?” After all, populations have been aging for centuries and societies have adjusted as necessary. It is also widely accepted that demographers have been wrong in the past – for example, failing to predict the 1950s baby boom or the subsequent rapid declines in fertility in the 1960s. In addition, countries such as Germany, where the aging process is well advanced, seem to be coping reasonably well. But these are not matters that can be left to chance, and all countries still need to face up to the same two policy issues:

- How to provide an affordable health care system, given rapidly changing technology and the ever-increasing take-up of services such as screening and elective surgery, and the fact that these changes seem to be impacting on older people more than on the young.
- How to look after older people given the changing nature of the informal sector and the fact that care providers are split between different types of institutions, both public and private.

Annex: Overview of Method Used to Measure Disability

This annex gives an overview and examples of the measures and scales developed by the Office of Population Censuses and Surveys (OPCS) in the UK (Martin et al., 1988), which were used to produce age- and sex-specific disability prevalence rates for 10 different severity categories. The original methodology, which has been used many times and is still being developed and refined, draws on the conceptual framework developed in the World Health Organization's International Classification of Impairments, Disabilities and Handicaps (ICIDH).

The ICIDH identifies the following separate consequences of disease:

- Impairment: "any loss or abnormality of psychological, physiological or anatomical structure or function," in other words, parts or systems of the body that do not work (e.g., vision)
- Disability: "any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being," or things people are unable to do (e.g., seeing)
- Handicap: the relationship between impaired and/or disabled people and their surroundings, referring to "a disadvantage for a given individual, resulting from an impairment or disability, that limits or prevents the fulfillment of a role (depending on age, sex and social and cultural factors) for that individual" (e.g., orientation)

Disablement refers to all three consequences of the disease or trauma. To give an example, someone with a particular impairment, such as diabetes, would not be considered disabled if the disease had no effect on his or her ability to undertake normal activities. If, however, the disease or its sequelae (perhaps because of consequent vision or heart problems) restricted such activities, then he or she would be classified as disabled. If these disabilities disadvantaged a person in his or her daily life, such as an inability to work or participate socially, then the person would be considered handicapped. Preparatory work for the OPCS survey included construction of separate measurement scales in 10 areas of disability:

- Locomotion
- Reaching and stretching
- Dexterity
- Seeing
- Hearing
- Continence
- Communication
- Personal care

- Behavior
- Intellectual functioning

Input was provided by professionals with expertise in disability, researchers, professional caregivers, members of voluntary organizations, and members of the Departments of Health and Social Security (over 100 individuals in all). Judges were asked to rate combinations of different disabilities on a 15-point scale. The combinations differed according to the disabilities included, their levels of severity, and so on. Using statistical techniques to model the judges' ratings for each combination of disabilities, it was found that by taking into account only the three most severe disabilities and their severity scores, a high correlation between the judges' ratings and the model could be achieved. Using regression techniques, this produced the following formula:

$$\text{Worst} + 0.4(\text{second worst}) + 0.3(\text{third worst})\,. \tag{A.1}$$

To give an example, suppose the three highest disability scores for an individual are 12, 8, and 6. The combined score would be $12 + (8 \times 0.4) + (6 \times 0.3) = 17$.

Scores are placed in bandwidths equal to 1.95. They are converted to 10 categories ranging between 1 (least severe) and 10 (most severe). Someone with a score of between 17 and 18.95, as is the case in the example above, would be placed in category 9, whereas someone with a score between 15 and 16.95 would be placed in category 8. Note that persons with only one or two minor disabilities score zero. How these categories are related and how people can be judged may be seen from the examples presented below, also based on Martin *et al*. (1988).

This scale was applied to everyone in the survey. Note that there is no absolute meaning to terms such as "severe" and "very severe." In our study the 10 categories are grouped into three larger categories for convenience only:

- "Most" severe (categories 8–10)
- "Intermediate" severity (categories 5–7)
- "Least" severe (categories 1–4)

A selection of examples is presented here to give a picture of what is implied by allocation to a particular severity category. Many more examples are provided by Martin *et al*. (1988).

Examples of Placement into Severity Categories

Severity Category 1. Man aged 59: deaf in one ear. *Overall severity score* 1.5 (severity category 1). *Hearing score* 1.5 – difficulty hearing someone talking in a normal voice in a quiet room.

Severity Category 2. Woman aged 71: angina; eye problems. *Overall severity score* 4.25 (severity category 2). *Locomotive score* 3.0 – cannot walk 200 yards without stopping or severe discomfort. *Seeing score* 1.5 – cannot see well enough to recognize a friend across the road; has difficulty seeing to read ordinary newspaper print.

Severity category 6. Man aged 65: arthritis in spine and legs; stroke affecting right side; heart condition. *Overall severity score* 11.55 (severity category 6). *Locomotion score* 7.0 – always needs to hold on to something to keep balance; cannot bend down and pick up something from the floor and straighten up again; can only walk up and down a flight of 12 stairs if holds on to handrail and takes a rest; cannot walk 200 yards without stopping or severe discomfort. *Reaching and stretching score* 6.5 – has difficulty holding arm in front to shake hands with someone. *Dexterity score* 6.5 – has difficulty picking up and pouring from a full kettle or serving food from a pan using a spoon or ladle; has difficulty unscrewing the lid of a coffee jar or using a pen or pencil; can pick up a small object with one hand but not the other.

Severity category 10. Man aged 55: stroke. *Overall severity score* 19.05 (severity category 10). *Locomotion score* 11.5 – cannot walk at all. *Personal care score* 11.0 – cannot feed self without help; cannot carry out following without help: get in and out of bed; wash all over; get in and out of chair; wash hands and face; dress and undress; get to toilet and use toilet. *Dexterity score* 10.5 – cannot carry out any activities involving holding, gripping, and turning. *Reaching and stretching score* 9.0 – cannot put either arm up to head to put a hat on; cannot put either hand behind back to put jacket on or tuck in shirt; has difficulty holding either arm in front to shake hands with someone. *Communication score* 5.5 – is very difficult for strangers to understand. *Continence score* 2.5 – loses control of bladder at least once a month. *Seeing score* 1.5 – cannot see well enough to recognize a friend across the road; has difficulty seeing to read ordinary newspaper print.

Note

[1] The United Nations has been especially active in raising the profile of disability and health care issues. In 1981, the International Year of Disabled Persons, it estimated that there were 500 million people with disabilities worldwide, of which 400 million were in developing countries. It declared 1983 to 1991 to be the Decade of Disabled Persons and asked each country to prepare long-term strategies and policies for helping the disabled. It has also been active in the field of statistical collection, designing frameworks and helping countries design their population censuses, the main means of data collection.

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