Gabriele Doblhammer,
Rembrandt Scholz (Ed.)

Ageing, Care Need and Quality of Life

The Perspective of Care Givers and People in Need of Care

DEMOGRAFISCHER WANDEL –
HINTERGRÜNDE UND HERAUSFORDERUNGEN

VS RESEARCH

Gabriele Doblhammer · Rembrandt Scholz (Ed.)

Ageing, Care Need and Quality of Life

VS RESEARCH

Demografischer Wandel – Hintergründe und Herausforderungen

Herausgegeben von

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Unsere Gesellschaft verändert sich tiefgreifend: Immer mehr Menschen erreichen in Gesundheit ein hohes Lebensalter, immer weniger Kinder kommen zur Welt, neue Partnerschafts- und Familienstrukturen entstehen, Menschen wandern über regionale und nationale Grenzen hinweg. In Zeiten einer alternden und schrumpfenden Bevölkerung sind neue Entwürfe für Biografien, für das Zusammenleben, für den Arbeitsmarkt, für den Wohlfahrtsstaat aber auch für die Regional- und Stadtplanung gefragt. Mit dieser Schriftenreihe wollen die Herausgeber zur verantwortungsvollen Diskussion um die Hintergründe und Herausforderungen des Demografischen Wandels beitragen und aktuelle Forschungsergebnisse in kompakter, allgemein verständlicher Form darstellen.

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Preface

Steadily increasing life expectancy is one of the great achievements of industrialised societies over the last century. Life expectancy has not only been growing among the young and those reaching retirement age, but also, especially in recent decades, among people ages 80 and above. These improvements in life expectancy have led to the emergence of the so-called third age, when people retire, but are still youthful, healthy and able to participate in society. Nevertheless, closer to the end of life, a fourth age of decrepitude and dependence on others has to be anticipated. Despite the postponement of functional limitations and severe disabilities into higher ages, the debate continues over whether the additional years gained are healthy years, or years with severe care need, particularly among the oldest old, the fastest growing segment of the population.

Future improvements in life expectancy and the health status of the elderly will determine the need for care in the future. While different assumptions about these trends based on expert opinion or the extrapolation of past experiences can be made, there will always be a degree of uncertainty about future trends. A third important factor driving the extent of future care need is, however, already determined by the history of the past century and is embedded in the age structures of our populations. From 2030 onwards, the large cohorts of the baby boomers, or those born between 1950 and the middle of the 1960s, will reach ages at which the need for care may be expected to rise. Care need projections extending up to 2030 do not include the ageing of the baby boomers, and therefore do not account for the likelihood that the growth in the need for care may be much steeper after 2030 than before.

But it is not just cohort sizes that have varied over the last century; individual biographies have also changed, and the elderly of the future will differ from today's older people in many respects. Patterns of family formation and dissolution have undergone an extensive transformation. Childlessness decreased among those cohorts born at the beginning of the 20th century to those born in the 1940s, only to increase again among later cohorts. Educational achievement, income and labour force participation, particularly among women, changed from cohort to cohort. If we want care need projections to go beyond the sheer numbers, these changing characteristics have to be taken into account.

This book is an attempt to combine the expertise available in the field of health, care need and care resources, with a strong focus on Germany, but also including other European countries, such as the UK, Belgium and Finland. It is divided into three parts. The first part presents various care need projections for Germany. The data bases used and methods applied, as well as the underlying assumptions and diverse main focuses, lead to a variety of innovative projections of future care need. The second part deals with trends in health, care need and care need determinants. Changes are explored at the individual level, as well as for population averages. Finally, the third part is devoted to an equally important topic: the care providers, their living circumstances and their quality of life.

Part 1 opens with care need projections for Germany at the federal level up to 2030 and for the Länder up to 2020, carried out by Heiko Pfaff. Based on the 11th coordinated population projection of the Federal Statistical Office, Pfaff developed two different scenarios for predicting the future course of care need: one scenario of stable and one of declining care need prevalences. His findings project an increase in the number of people in need of care in both scenarios, but a dampening effect of the decreasing prevalences of poor health. Furthermore, the results anticipate a very high increase in care need in the eastern part of Germany, especially Mecklenburg-Western Pomerania and Brandenburg and the lowest increases in the city-states of Bremen and Hamburg. Eckart Bomsdorf, Bernhard Babel and Jens Kahlenberg develop four different scenarios for future population trends, while conducting probabilistic population projections up to the year 2050. They assume two scenarios of trends in health, one with constant and one with decreasing prevalences of care need. Additionally, they carry out a sensitivity analysis that examines the impact of different parameters on the future need of long-term care. The results show an increasing need for long-term care in absolute and relative terms. Life expectancy is shown to have the strongest effect on future care need trends, while fertility and migration are found to have only slight effects. To what extent is the increase in care need a consequence of the changing age distribution up to the year 2020 and to what degree can improvements in the health of the elderly compensate for the increase? Rainer Unger addresses these questions in a cohort analysis and finds – in contrast to all other studies in this book – that improvements in health, measured as decreasing prevalences (here for women) up to 2020, result in a decline in the number of women in need of care. His analysis is based on the population projections of the Federal Statistical Office of Germany and on data from the German Socioeconomic Panel (GSOEP) on cohort-specific health transitions. Whether and to what extent demand for and supply of care will change in the near future is the main focus of the dynamic household projection, "Future Elderly Living Conditions In Europe" (FELICIE). The core objective of this study, by Gabriele Doblhammer and Uta Ziegler, is to forecast the need for care among the population aged 75+ by family status and childlessness through 2030, while applying two assumptions regarding future trends in care need prevalences. Results of this study show that the demand for care will rise, but that the potential supply of informal care giving by children and partners will also grow numerically until 2030. Erika Schulz offers projections of the number of people likely to need care while living at home, as well as of the care giving potential within families in Germany through 2050. The projections are based on the DIW population forecasts. In order to measure the future ratio of informal care givers to dependent people living at home, she takes into account in her analysis household size, family status and the number of children, as well as the labour market participation of women and the changing living arrangements of the elderly. The findings suggest there will be a decline in the number of potential care givers aged 65 or younger and an increase in the number of potential care givers among the elderly. At the same time, the number of people who will require care at home is expected to increase significantly through 2050, especially if better overall levels of health are assumed. The final chapter of the first part focuses on the development of a disease that is attracting considerable attention: dementia. Uta Ziegler and Gabriele Doblhammer pose the question: How will the number and the age-specific prevalence of people with dementia develop in Germany in the coming years? By using three different assumptions for future life expectancy, the authors carry out three different scenarios of population projections through 2050. They apply constant prevalences of dementia and, based on the overall development of healthy life years, prevalences that follow a dynamic equilibrium. The projection results reveal that the number of people with dementia will definitely increase up to 2050, but that the increase is determined more by the development of overall life expectancy, than by the future trend in the prevalence of dementia.

The role of risk factors in the development of the need for care in general and of care determinants in particular, is discussed in the second part of the book. A statistical meta-analysis that summarises existing studies on the effects of sex, obesity and smoking on health transitions marks the beginning of this section. The analysis by Gabriele Doblhammer, Wilma Nusselder, Rasmus Hoffman and Elena Muth shows the connections between risk factors and health transitions. They confirm the common paradox that women, compared to men, have a higher risk of becoming dependent, but exhibit a lower mortality risk. In line with recent findings about obesity, they show that, compared to overweight and underweight people, obese people become disabled more often and have worse chances of recovery, but have lower mortality risks. This is particularly true among the elderly. Linked to the risk of becoming dependent on long-term care in old age is the risk of becoming dependent on acute hospital care. In their analysis, Mike Murphy and Pekka Martikainen discuss the different drivers for these two forms of care and the associated costs. They carry out projections of age distribution for different countries, and focus particularly on four different factors that have a significant influence on the demand for long-term care and hospital care, today and in the future: proximity to death, marital status, sex and age. Observing these influencing factors in a case study with Finnish data, they confirmed that age is a more important determinant for long-term care, while proximity to death is of greater relevance for acute care need. Additionally, they conclude that the marital status differentials and future changes in marital status distribution are substantial for both types of care. The subsequent study by Elke Hoffmann und Juliane Nachtmann focuses on the hypotheses of the compression or expansion of morbidity. By using a scientific use file of the Research Data Centre of the Federal Statistical Office and the Statistical Offices of the Länder, they published for the first time the prevalences of care need for single age year intervals. The focus of their study is to measure the trend in numbers of life years without care need, as well as the ratio of these years to total life expectancy for men and women between 1999 and 2005. Their main result suggests that, in terms of care need, a "relative expansion of morbidity" occurred during the observed period. In addition to the level of health and disability, which is strongly determined by changes in health status over time, changes in individual pathways can also be seen as factors relevant to the question of whether a compression or expansion of morbidity has taken place. Hence, in the last chapter of the second part, Gabriele Doblhammer and Uta Ziegler study individual health trajectories of West Germans aged 50+ over two time periods (in the 1980s and the 1990s) using data on health limitations in the GSOEP. The results reveal that individual health trajectories have become more similar between the two time periods and that there is a general shift towards better health, with a particularly strong trend towards stable health trajectories that involve minor limitations.

Finally, Part 3 of the book is dedicated to the other side of the care need equation: the care givers, especially the informal care givers. Since informal care constitutes the majority of all care provided to the elderly in Germany - as well as in many other European countries – analysing this increasingly important sub-group in a population is of considerable interest. Benedicte De Koker looks at the well-being of care givers in Flanders/Belgium. The data used stem from a postal survey of informal carers that was performed in 2003. In her analyses, she investigates differences in the levels of perceived burdens experienced by care givers who are either spouses or children and examines to what extent the differences between these two groups could be explained by the different care giving situations they are confronted with. The differences between spouses and children are significant, and it seems as if the emotional relationship between care givers and care takers constitutes a significant factor in care givers' perceptions of the weight of the burden they carry. Tatjana Mika and Michael Stegmann analyse voluntary care giving in the life courses of younger and older female birth cohorts in East and West Germany after the establishment of the public long-term care insurance in 1996. They study how care giving episodes are positioned in the life courses of women and seek to answer the question of whether the implementation of care allowances for informal care at home, and the fact that informal carers get pension contributions from care insurance, influences the decision of women to exit the labour market and care for a family member. The study concludes that compulsory care insurance simply provides a premium to women who have a strong family orientation and who were already periodically engaged in caring for the elderly.

This book is the result of a workshop that took place at the Max Planck Institute for Demographic Research in Rostock in January 2008. Rembrandt Scholz is among the many people who provided important support in organising the workshop. Many others have helped in compiling and preparing the presentations for publication in this volume. I wish to extend my gratitude above all to the authors of the chapters, who demonstrated considerable understanding and patience in the process of editing and harmonising the various manuscripts. In addition, I would like to thank all those who helped in the preparation of this book. My special thanks go to Juliane Steinberg for organising and editing the texts, to Marlen Toch for formatting and to Miriam Hils for English editing.

Gabriele Doblhammer

Part I: Projections of Care Need and Care Resources

People in Need of Long-term Care: The Present and the Future

Heiko Pfaff

1. Introduction

The demographic projections of the statistical offices predict an increasing ageing of the population in the Federal Republic of Germany over the coming decades (Federal Statistical Office and the Statististical Offices of the Länder 2007(a-d), Federal Statistical Office 2006). This contribution examines what impact the older demographic structure may have on the expected number of people in need of long-term care at federal and Land levels. By way of introduction, the contribution outlines the development of the number of people requiring long-term care from 1999, when the statistics on long-term care were introduced, until today and then describes the principal relationship between old age and the need for long-term care.

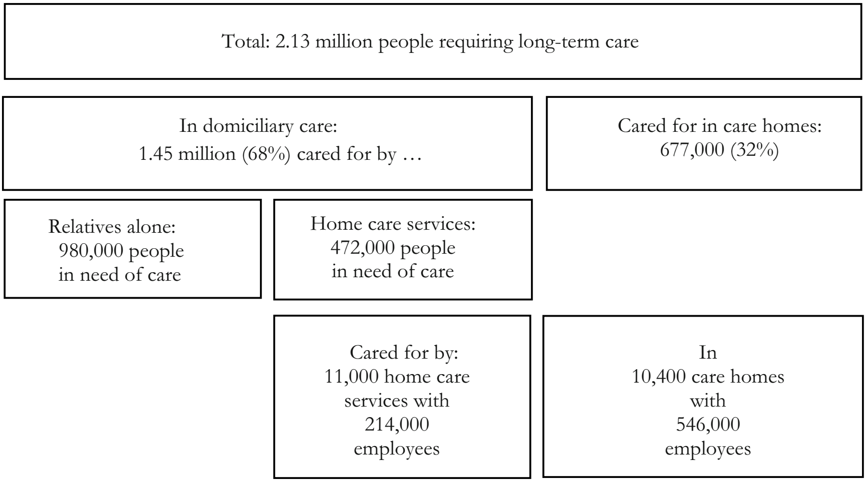
2. In Retrospect: The Development of the Number of People in Need of Long-term Care from 1999 to 2005

In December 2005, a total of 2.13 million people in Germany required long-term care as defined by the Long-term Care Insurance Act. The majority (82%) of them were 65 years old or older, while a third (33%) was aged 85 or over. Women accounted for 68% of those in need of care.

2.1 Persons in Need of Long-term Care by Type of Care

More than two thirds (68% or 1.45 million) of people in need of care received domiciliary care in December 2005. Of them, 980,000 only received long-term nursing care allowances, which mean that, as a rule, they were cared for at home by relatives alone. Another 472,000 people in need of care lived in private households, but received full or part-time home care services. 677,000 (32%) of the people requiring care were accommodated in residential care or nursing homes (Figure 1).

Figure 1: People in need of care in 2005, by type of care



Source: Long-term care statistics of the Statistical Office of the Federation (2007).

Ever since long-term care statistics were first compiled, the number of people requiring long-term care has risen continuously at federal level: From 2.02 million in 1999, it grew to 2.13 million in 2005, which was an increase of about 6%, or 112,000, over that period. The proportion of those requiring long-term care in the total population showed a slight increase from 2.5% to 2.6%. One of the important factors for this increase was the ageing of the population. In 1999, 3.6% of the population were 80 years old or older. In 2005, their share had increased to 4.5%.

A comparison over time shows that there is a trend towards professional care in care homes or by home care services: The number of persons receiving care in residential care or nursing homes rose by about 6% (+36,000) and that of persons cared for by home care services by 5% (+21,000) as compared to 2003. In contrast, the number of those cared for by relatives, i.e., of persons who only received nursing care allowances, decreased by 1% (-6,000). As compared to 1999, residential care increased by 18% (+103,000 people in need of care) and home care services by 14% (+56,000), while the number of recipients of nursing care allowances dropped by 5% (-47,000). This development also led to a decline in the proportion of people in domiciliary care from 72% in 1999 to 69% in 2003 and to 68% in 2005.

Only a small part of this development can be explained by the fact that elderly people who require long-term care tend to be accommodated in care homes and that the age structure of those in need of care has changed somewhat over time. The changing trend may also be seen as an indication that the opportunities for relatives to provide care have started to decline. It is frequently expected that the opportunities for family-based domiciliary care will be limited in future years, for instance, because of increasing social mobility. Children will be less likely to live close to their parents who may require long-term care. At present, daughters and daughters-in-law are the main care givers who provide the bulk of domiciliary care to family members (see Doblhammer et al., Chapter 7 in this proceedings).

2.2 Explanations of Terms Relating to Long-term Care Statistics

The statistics cover all persons who receive benefits under Book XI of the German Social Code (SGB XI). The general requirement for coverage is that a statutory long-term care insurance fund or a private insurance company has decided that a need for long-term care exists and has assigned the person in need of care to one of the care levels from I to III (including cases of hardship).

As defined by SGB XI, a need for long-term care exists if, due to a physical or mental illness or disability, a person requires frequent or substantial help (Section 15) with normal day-to-day activities on a long-term basis, that is, for an estimated period of six months or longer (Section14 subsection1 of SGB XI).

The category "cared for in care homes" covers all persons in need of care who receive full care (permanent and short-term care) or part-time care (day care/night care) in residential care or nursing homes licensed under SGB XI.

The category "cared for by home care services" covers all persons in need of care who are cared for by home care services licensed under SGB XI (including combined cash and non-cash care benefits or domiciliary stand-in care when the normal carer is unavailable).

The third category "cared for by relatives" covers all persons in need of care who receive nursing care allowances for care helpers they have recruited themselves, as specified by Section37 of SGB XI.

As regards the provision of benefits under the relevant law, persons in need of care have to be assigned to one of the following three care levels (Section15 subsection1 of SGB XI): care level I (considerable need for care), care level II (severe need for care), care level III (extreme need for care).

2.3 The Development of Persons in Need of Care by Care Level

The distribution of care levels has also changed over time: Care level I has become more important since 1999. While about 46% of the people in need of care were assigned to care level I when the statistics were compiled for the first time, the survey of 2005 recorded a percentage of well over 50%. A model computation of the Medical Service of the Central Associations of Health Insurance Funds concludes that one reason for this increase may lie in the fact that persons in need of care remain at care level I much longer than at the other care levels (Medizinischer Dienst der Spitzenverbände der Krankenkassen 2007).

2.4 Past Developments of the Number of Persons in Care at Länder-level

There are significant differences in the development of long-term care in some of the Länder: In the period from 1999 to 2005, the highest increase in the number of people requiring long-term care, at approximately 19%, was observed in the city states of Berlin and Bremen (see Figure 2). High rates of growth were also recorded in Brandenburg (16%) and Sachsen-Anhalt (14%). The increases in Brandenburg and Sachsen-Anhalt can be explained to a considerable extent by the ageing of the population. As regards to the two city states, however, the strong rise was accompanied, in part, by significant increases in the proportions of people requiring care in the individual age groups. This means that only a small part of the rise can be attributed to changes in the demographic age structure.

A slight decrease or marginal increase was observed in Nordrhein-Westfalen[1] (-2%), Hamburg (-1%), Sachsen and Schleswig-Holstein (+2% each) from 1999 to 2005.[2]

The provision of long-term care also varies considerably across the Länder from a structural perspective: Care homes were most important in Schleswig-Holstein, with 40% of all persons in need of care receiving residential care. In contrast to that, only about 26% of the people requiring care in Hessen were accommodated in care homes, while the corresponding percentage for Brandenburg was 27%. The total for Germany was 32%.

The relatively small proportion of persons in residential care in Hessen can be explained, in particular, by the central importance of family-based care: Some 55% of the people requiring long-term care in Hessen were cared for by relatives alone. The corresponding percentage for the whole of Germany was 46%. In Branden-

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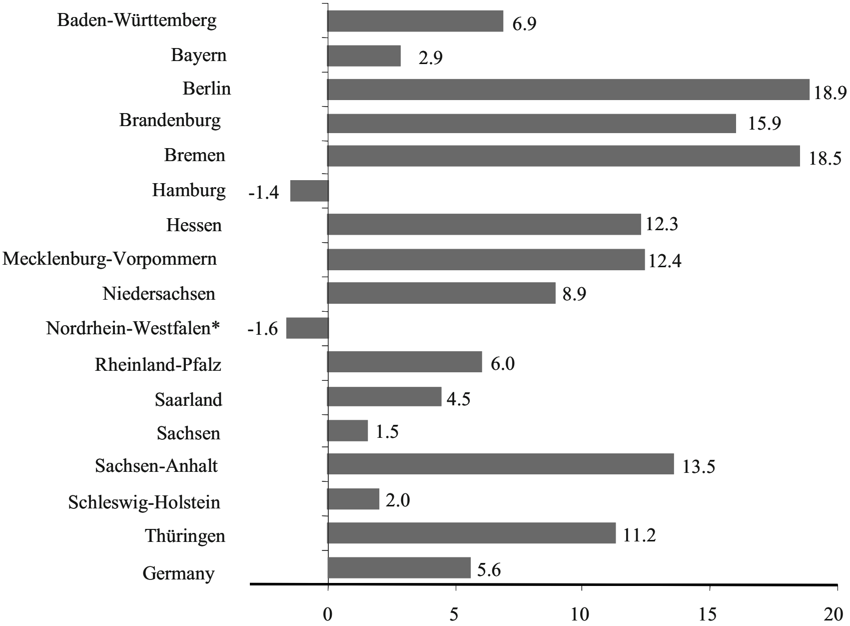
[1] Concerning the value for Nordrhein-Westfalen, comparability over time is limited; please refer to the methodological note below Figure 2.

[2] The regional allocation of people cared for in care homes or by home care services depends on the care home's or service's address. This can have the following effect: A home care service may also attend to persons residing in an adjacent Land. In this case, the persons receiving care are allocated to the Land where the home care service is located and not to their Land of residence. However, these cases are likely to represent only an insignificant proportion of the total number of people in need of long-term care. As regards to persons in residential care, the place where they are cared for is usually the same as their place of residence. Prior to their accommodation in a care home, they may however have moved from one Land to another.

burg, home care services played a notable role, attending to 28% of the people in need of care. The average for Germany was 22%.

Figure 2: Change in the number of persons in need of care from 1999 to 2005, in %



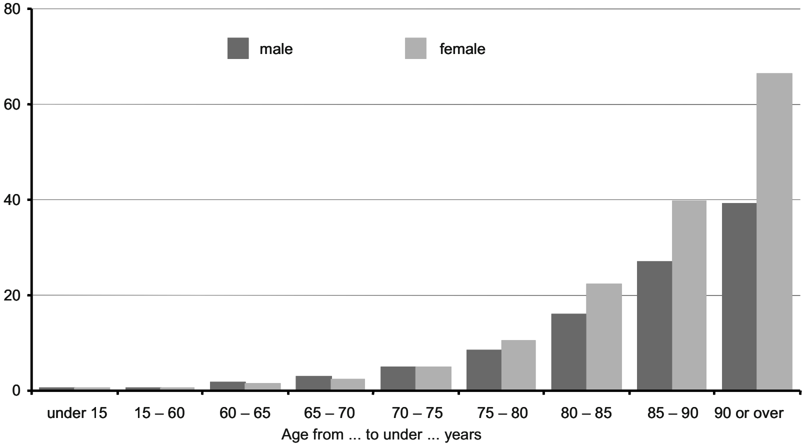
* The comparability over time of the result for Nordrhein-Westfalen is limited because of an adjustment in the register of a long-term care insurance fund in 2003, which involved about 13,000 recipients of nursing care allowances. The adjusted rate of change from 1999 to 2005 was probably around +1%.
Source: Long-term care statistics of the Statistical offices of the Federation and the Länder.

3. Age-specific Rates of Long-term Care in December 2005

As they get older, people are likely to develop a need for long-term care. While "only" every twentieth (5%) of those aged 70 to 74 years required long-term care, the highest rate of long-term care was observed for the people aged 90 years or over. In that age group, the proportion of people requiring care amounted to 60%. It is a remarkable fact that women aged about 80 years or over showed a significantly higher care rate – meaning that more of them needed long-term care – than men of the same age group. Hence, the long-term care rate for women aged 85 to 89 years was 40%, while it was only 27% for men of the same age group (Figure 3).

Apart from differences in the health development of men and women, one reason for the diverging rates of long-term care may lie in the fact that the numbers of applications submitted vary between men and women. Older women often live alone. If they require care, they may need to apply for nursing care benefits very soon. Men in need of care are often cared for by their wives and initially do not apply for benefits (Medizinischer Dienst der Spitzenverbände der Krankenkassen e.V. 2005).

Figure 3: Long-term care rates in 2005, by age and sex, in %



Source: Long-term care statistics of the Statistical Offices of the Federation and the Länder.

The rates of long-term care vary across the Länder. Regarding to the older age groups, these rates were lowest in Baden-Württemberg, where, for example, the age group from 85 to 89 years accounted for 31% of the people in need of care. Hamburg, too, recorded a long-term care rate of about 31% for that age group. The highest rates were observed in Brandenburg (46%) and Mecklenburg-Vorpommern (47%), i.e., in the northeast of Germany. There, more people seem to develop a need for long-term care in old ages than indicated by the average rate for Germany.

On account of the differences in the age- and gender-related structures of the population and in the rates of long-term care, the proportions of people requiring care in the total population vary as well. In Bremen and Sachsen-Anhalt, 3.1% of the population required long-term care. The corresponding proportion in Baden-Württem-berg was just 2.1%.

4. Development of the Numbers of People in Need of Care in Germany up to 2030 and in the Länder up to 2020 - Status-quo Scenario

4.1 Projection for Germany

The following calculations are based on a simple model: The projection transfers the current status quo of long-term care rates (broken down by sex, stratified according to 5-year age groups and determined for the years 2003 and 2005) to the changed demographic structures in the years up to 2020 (2030 for Germany as a whole). The 11th coordinated population projection of the Federal Statistical Office (viz. the variant representing the lower threshold of the "medium" population) is used to describe the changed demographic structure (Federal Statistical Office and the Statistical Offices of the Länder2007, Federal Statistical Office 2006). The calculation is made for each of the Länder and the federal result is obtained by adding up the Länder results.

As mentioned above, the calculations are based on constant rates of long-term care. Accordingly, no account is taken of possible medical-technical progress in this field. Likewise, the model computation is based on the assumption that the expected increase in life expectancy will have no effect on the long-term care rates in the individual age groups. It is still open to debate whether improved means of diagnosis, therapy and rehabilitation will help to postpone the need of long-term care or whether the increasing life expectancy will only result in longer care periods[3].

An example for a status-quo scenario will reveal the underlying calculation: In the years 2003 and 2005, an average of 28.4% of men and 42.2% of women aged 85 to 89 years required long-term care in Hessen. The population projection assumes that 43,660 men and 72,750 women will be aged from 85 to 89 years in 2020. Hence, the following number of people aged from 85 to 89 years can be expected to require long-term care in Hessen in 2020: (28.4% x 43,660) + (42.2% x 72,750) = about 43,000 people in need of care. The total sum for Germany is obtained by adding up the Länder results. To calculate the long-term care rates in the base years, an adjusted number of those aged 90 years or over is used, as in the population projection. This is the reason why the results for this age group differ from those of current population statistics.

All in all, it becomes more and more difficult to predict the development of the major determining factors (and of the demographic structure) as the time from the base date increases. Therefore, the long-term calculation up to 2020 and 2030,

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[3] As regards this discussion, in particular on the need of long-term care, please refer to e.g., Dietz (2002), Deutsches Institut für Wirtschaftsforschung (2001) and Schnabel (2007) as well as Rothgang (2007).

in particular, is only a model of how the number of persons in need of care will develop if the underlying assumptions turn out to be correct.

The projected data do not distinguish between types of long-term care. This differentiation cannot be made because it is extremely difficult to incorporate in the simple model important factors, like the potential for family-based support, which have an impact on the relationship between residential and non-residential care. Neither are the people requiring care categorised according to care levels as it is hardly possible for the simple, age-related status-quo approach to describe even the current trend towards care level I.

Apart from that, people who require help at a level below or outside the range of benefits specified by Book XI of the German Social Code are, by definition, not included in the calculations. Sample surveys conducted by TNS Infratest (2003 and 2006) have revealed that there are some three million more people in private households who mainly require help with household duties, but do not receive any benefits from long-term care insurance funds. In addition, about 45,000 persons of what is referred to as care level 0 are accommodated in care homes.

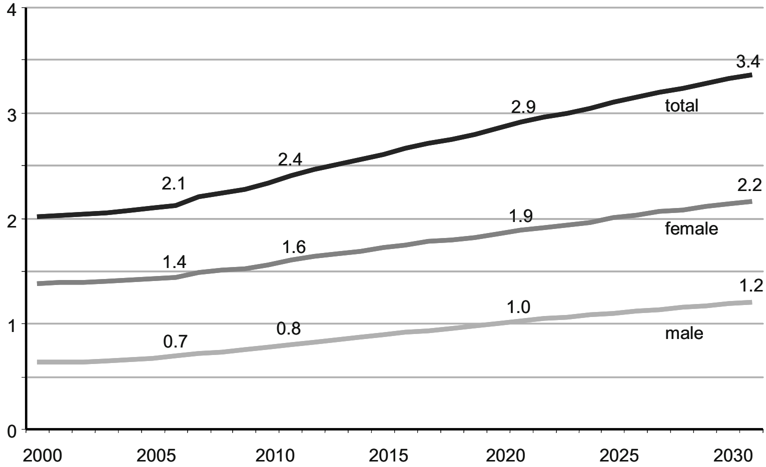
Furthermore, the projection is based on the existing definition of the need of long-term care. The model calculation takes no account of possible changes in the definition or in the corresponding legal bases.

Excursus: Declining Long-term Care Rates from 1999 to 2005?

The assessment of whether the long-term care rates, i.e., the risk of developing a need for care, declined in the individual age groups from 1999 to 2005 is made on the basis of an age-standardised number of persons in need of care in the relevant years. The age standardisation is carried out by transferring the care rates separately by age and sex to the demographic structure of 1987. This provides a standard of comparison to determine whether the need of long-term care – regardless of changes in the composition of the population – has expanded or not.

The results of long-term care statistics obtained so far revealed a slight decline in the age-standardised number of persons requiring care in Germany from 1999 to 2005. Overall, this was due to a slight decrease in the need for care in the individual age groups. In Germany, the age-standardised number of persons in need of care (calculated using single year-of-age groups of the 1987 demographic structure) was 1.61 million in 2005, 1.64 million in 2003 and 1.65 million in 2001. In 1999 it was 1.67 million. This was a decline of less than 4% between 1999 and 2005. (If the effect of the adjustment in Nordrhein-Westfalen in 2003 is also taken into account, the decrease even amounts to less 3%). Subsequent surveys will show whether the slight downward trend is continuing.

Figure 4: People in need of care in Germany from 1999 to 2030 (status-quo scenario), in millions



Source: Statistical Office of the Federation (2007).

In the next few years, it is likely that the ageing of the population will be accompanied by a rise in the number of people requiring care. According to the results of this projection, the number of people in need of care is likely to rise from 2.13 million in 2005 to 2.40 million in 2010. The total is expected to reach 2.91 million in 2020 and about 3.36 million in 2030. If the status-quo model is taken as the basis, the number of people in need of care can be expected to increase by more than a third (37%) between 2005 and 2020 and by 58% from 2005 to 2030. The increase up to 2030 will be higher for men (74%) than for women (50%). At the same time, the proportion of people requiring care in the total population will rise: from 2.6% today to 3.6% in 2020 and, finally, to 4.4% in 2030.

Marked shifts can be observed in the age-related structures: While about 33% of the people in need of care were 85 years old or older in 2005, the relevant age group will account for some 41% in 2020 and for about 48% in 2030. In contrast, those aged under 60 years will account for lower percentages: Their proportion in the total of persons requiring care will drop from 14% in 2005 to 10% in 2020 and to well over 7% in 2030.

4.2 Projections for the Länder

Table 1: Persons in need of care from 2005 to 2020 (status-quo scenario)

Land	Persons in need of care, at yearend						
	2005	2010	Change from 2005 to 2010	2015	Change from 2005 to 2015	2020	Change from 2005 to 2020
	1,000	1,000	%	1,000	%	1,000	%
Baden-Württemberg	225	260	15.6	291	29.1	320	42.2
Bayern	303	347	14.7	383	26.4	417	37.8
Berlin	96	102	6.3	114	18.6	128	32.9
Brandenburg	75	86	15.7	102	36.9	118	58.7
Bremen	20	22	6.5	23	14.2	24	20.5
Hamburg	41	45	9.3	49	17.6	52	24.5
Hessen	163	181	10.9	199	21.7	215	31.5
Mecklenburg-Vorpommern	51	60	17.3	70	36.9	80	55.5
Niedersachsen	228	252	10.4	276	21.2	300	31.7
Nordrhein-Westfalen	458	521	13.6	572	24.8	614	34.0
Rheinland-Pfalz	98	110	12.2	121	23.5	130	32.7
Saarland	28	32	13.6	35	23.8	37	31.0
Sachsen	120	138	14.8	155	28.9	170	41.4
Sachsen-Anhalt	76	86	14.0	97	28.0	106	40.3
Schleswig-Holstein	78	85	10.0	94	21.5	104	34.5
Thüringen	67	76	13.9	86	28.4	95	41.8
Germany	2,129	2,404	12.9	2,667	25.3	2,911	36.8

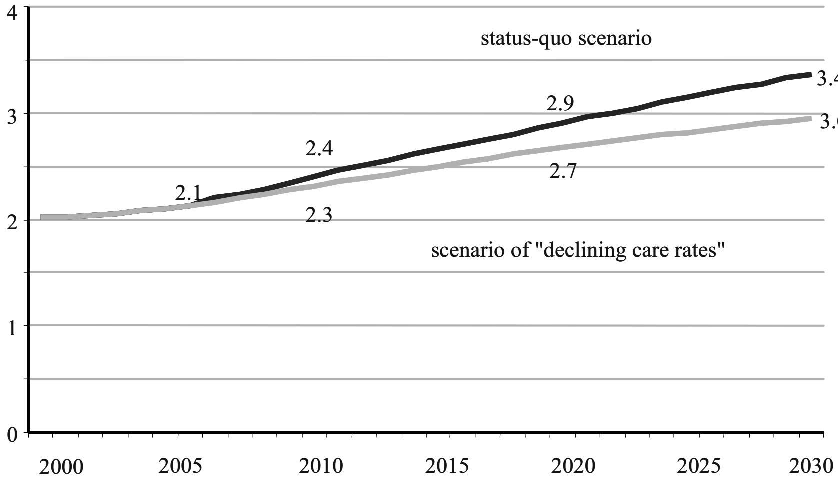
Source: Statistical Offices of the Federation and the Länder.

The biggest increases in the numbers of persons requiring care are likely to occur in Brandenburg (+59%) and Mecklenburg-Vorpommern (+55%). Substantially lower rates of growth are observed for the remaining Länder up to 2020. The city states of Bremen and Hamburg show the lowest rates of increase at 20% and 25%, respectively. The overall rate for Germany is 37% (see Table 1).

5. Persons in Need of Care in Germany in 2020 and 2030 - Scenario of "Declining Care Rates"

This more optimistic scenario is based on the assumption that medical-technical progress will reduce the risk of developing a need of long-term care across the age groups. The expected increases in life expectancy in the relevant ages serve as guideline values, which mean that the risk of developing a need of long-term care is postponed to later ages in accordance with the increase in life expectancy. To project the numbers of people requiring long-term care, the age-specific rates of care are transferred separately for the two genders to older age groups in accordance with the residual life expectancy.

Figure 5: Persons in need of care in Germany from 1999 to 2030 – Comparison between the status-quo scenario and the scenario of "declining care rates"



Source: Statistical Office of the Federation.

The scenario of "declining care rates" has a dampening effect; however, the total number of people requiring care rises in this scenario as well. A number of 2.68 million can be expected in 2020 according to the projection. In 2030 the number may reach circa 2.95 million. Consequently, there will be an increase of 26% until 2020 and of 39% until 2030.

The proportion of people in need of care in the total population will reach 3.4% in 2020 and 3.8% in 2030 and, thus, will be slightly lower than in the first scenario. Persons requiring care at the age of 85 or over will, however, account for a slightly higher proportion of the total of people in need of care than in the status-quo scenario (2020: 42%, 2030: 51%) (Figure 5).

6. References to other Projections

Over the past years, a number of forecasts of the number of persons in need of care have been published which differ in terms of methodological detail and data sources. Without any claim to completeness, we will briefly describe the following publications:

- A projection published by the DIW (Deutsches Institut für Wirtschaftsforschung 2001) as early as in 2001 used other basic data than those examined in this report.The information on persons in need of care was obtained from the statutory and private long-term care insurance institutions. Due, among other things, to differences in the survey methodology, the numbers of cases recorded by the insurance funds are somewhat lower than those reported by long-term care statistics.4) In addition, the calculations were based on the DIW's population forecast of 1999. In principle, the DIW projection also used a status-quo approach with 1999 as the base year. The calculations suggested a rise in the number of persons requiring care from 1.9 million in 1999 to 2.9 million in 2020. The projection also encompassed the types of long-term care (residential and non-residential) (Results of the DIW projection can be found in Schulz, Chapter 4 in this proceedings)
- In 2003, the Commission for Financial Sustainability in the Social Security Systems published a forecast of the number of people in need of care in the so called Rürup Report (Kommission zur Nachhaltigkeit in der Finanzierung der Sozialen Sicherungssysteme in Bundesministerium für Gesundheit und soziale Sicherung 2003. These calculations were only based on data relating to persons insured with statutory long-term care insurance funds, thereby excluding all those insured with private insurers. The development of the population was based on the assumptions made in that report. The basic model for determining the future number of persons requiring care also used constant rates of long-term care.
- This forecast predicted an increase in the number of persons in need of care from about 1.9 million in 2002 to 3.1 million in 2030. The calculations also included the financial situation of the statutory long-term care insurance funds and the types of care provided.
- In 2006, the Ifo Institute (Hofmann 2006) published calculations using the results of the 2003 long-term care statistics and the 10th coordinated

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4 At present, the number of people requiring care determined in this way is some 3% lower. As for the differences, please refer to Statistisches Bundesamt 2007c.

population projection of the statistical offices of the Federation and the Länder. These calculations indicated a rise in the number of persons requiring care from about 2.1 million in 2003 to 2.9 million in 2020. They were also based on constant rates of long-term care and additionally covered the types of care provided and possible employment effects.

- Projections on the number of persons requiring care with a focus on the development of the potential for family-based care were published by Blinkert and Klie (2004) as well as by Rothgang (2004).
- Furthermore, the attached list of references includes a number of previously published projections on long-term care by the statistical offices of the Länder, which were partly based on different model assumptions and population scenarios and, therefore, produced other results than this report. Some of the calculations take into consideration not only the Land level but also administrative districts[5].
- An example of a projection focussing on municipal planning for the elderly, outside the range of official statistics, has been published by Asam and Kneppe (2004).

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[5] Landesamt für Statistik und Datenverarbeitung Nordrhein-Westfalen (2006), Müller (2007), Statistisches Landesamt Baden-Württemberg (2007), Statistisches Landesamt Rheinland-Pfalz (2004).

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Care Need Projections for Germany until 2050

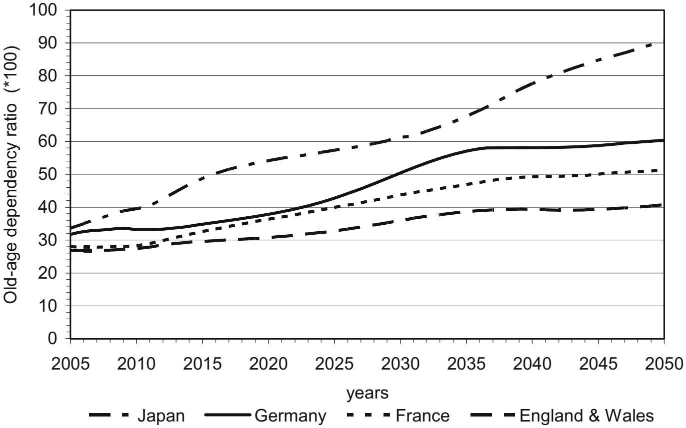
Eckart Bomsdorf, Bernhard Babel, Jens Kahlenberg

1. Introduction

Populations of many highly developed countries face the problem of an ageing society, i.e., the share of senior citizens in the total population increases. A common measure for quantifying this effect is the old-age dependency ratio (ODR) which gives the ratio of the number of people aged 65 and over to the number of people between ages 20 and 64.

For illustration purposes Figure 1 shows the development of the ODR exemplary for England & Wales, France, Germany and Japan. As can be seen, according to population projections (going to be explained later on) in these industrial nations the ODR is expected to increase significantly. While the development of the ODR is relatively moderate in England & Wales, the ODR more than doubles in the period from 2005 to 2050 in Japan.

Figure 1: Old-age dependency ratio in England & Wales, France, Germany, Japan 2005-2050 (medium variant)



The population's ageing development may have significant consequences. Among others, the results are of importance for the educational system, health care and social security (see e.g., Lee/Tuljapurkar 2000, Bongaarts 2004, Bomsdorf et al. 2008). In this paper we will consider the demand for long-term care and how it develops until 2050. We will show how to assess this future demand by means of population projection calculations using four different scenarios. Based on the projections the need of long-term care is derived by applying quotas for long-term care to the population results.

In the following we will focus on the German population development and its consequences for German Long-Term Care Insurance.

2. Deterministic Projection

2.1 Methodology and Assumptions

The projection of the need for long-term care requires assumptions concerning future population as well as the development of the risk of experiencing the need for long-term care. First, we will project the population development by deterministic calculations.

Based on the population given by age and sex at the end of 2005, we project different scenarios for future population by using a traditional cohort-component method (see e.g., Leslie 1945 or US Census Bureau 2000). First, the age- and sex-specific future death rates are modelled via the log-linear approach of Bomsdorf and Trimborn (1992).[1] In their model, projections of one-year death rates $m_x(t)$ depend log-linearly on the individual age x and observation year t as follows:

$$m_x(t) = m_x(t_0) \cdot e^{\beta_x \cdot (t-t_0)}$$

where $m_x(t_0)$ denotes the current death rate at time t_0. The insertion of the most recently available death rate $m_x(t_0)$, as initial value, guarantees that the short-term forecasts have a smooth transition from the most recent death rate and therefore, is common practice in life insurance. The expression e^{β_x} is interpreted as an age-

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[1] Lee and Carter (1992), Helberger and Rathjen (1998) and the German Institute of Actuaries (2004) came to the conclusion, that a log-linear approach is most suitable. Concerning the relationship and comparison of the approach of Bomsdorf and Trimborn (1992) to other mortality models, we refer to Babel et al. (2007a). A review of the literature on mortality models is given in Pitacco (2004) and Booth et al. (2005). Tuljapurkar et al. (2000) also provide projections for the considered countries based on the popular (log-linear) model of Lee and Carter (1992). Recently Janssen and Kunst (2007) projected old-age mortality in European countries with log-linear regression models.

specific growth factor (or reduction factor). The sex indexing is suppressed for notational convenience. More precisely, 100 $\left(e^{\beta_x}-1\right)$ shows the annual percentage change in death rates of x-year old persons: $\beta_x < 0$ indicates a decline of $m_x(t)$, whereas $\beta_x > 0$ implies an increase of $m_x(t)$.

The model is estimated from historical death rates from 1956 to 2003 for ages x=0 up to x=89 (see also Babel et al. 2007b, Babel et al. 2008). Due to the increasing trend of future life expectancy, we are interested in death rates up to the age of 115. We do not use the death rates from the Human Mortality Database for ages above 89 since these are based on small numbers of deaths only and, therefore, apply the Kannisto-model (Thatcher et al. 1998) in order to extrapolate the death rates given in year 2003 up to the age of 115.[2] In addition, we assume that the average annual mortality decline at the age of x=115 equals zero ($\beta_{115} = 0$). Between the ages 90 and 115 we interpolate β_x linearly. Life expectancies are then as usual derived from the forecasted $m_x(t)$ for a fixed year t, which is called the period perspective. Note that this period approach - due to the continuous decrease of death rates - causes a systematic underestimation of life expectancy. See Goldstein and Wachter (2006) and Bomsdorf (2004) for a detailed comparison between period and cohort perspective.

By contrast, age-specific fertility rates and migration flows have not shown clear trends. Therefore, we assume constant age distributions; for the absolute figures (total fertility and net migration), we choose the following reference assumptions:

- Total fertility rate (TFR): 1.35, which is approximately the level in the recent past and similar to the basic assumption of the projections of the German Federal Statistical Office (2006)
- Net migration: 150,000, which corresponds to the average of the last two decades

Table 1 provides an overview regarding the assumptions for the demographic components fertility, mortality and migration (Table 1) used in the considered scenarios.

Within the projections, we consider four different scenarios named “Low”, “Medium”, “High” and “Old”. The low variant represents a somewhat pessimistic view in terms of total fertility rate, life expectancy and migration, the high variant is optimistic. The medium variant is in between these two variants, the old variant - by

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[2] Thatcher, Kannisto and Vaupel (1998: 30) and the German Institute of Actuaries (2004: 79-83) analyse the goodness of fit of various extrapolation methods for ages beyond x=100. Both references conclude that the Kannisto-model fits well the empirical data. As well as Thatcher, Kannisto and Vaupel (1998), we base the estimation of the parameters in the Kannisto-model on the ages x=80 to 98.

assuming high life expectancy and low migration – leads to a population with the oldest age structure of all four considered scenarios.

Table 1: Assumptions for population scenarios, 2005 to 2050

Variant		**Low**	**Medium**	**High**	**Old**
Total fertility rate (TFR)		1.15	1.35	1.55	1.35
Life expectancy at birth	2005	76.6 / 82.1			
(male/female) in	2050	79.8 / 85.7	82.6 / 88.3	84.8 / 89.0	84.8 / 89.0
Net migration		50,000	150,000	250,000	50,000

2.2 Results

Figure 2 shows the results for the German population for the different scenarios. Only in the high variant, the population will remain nearly on the current level until 2050. The other scenarios show a declining population size until 2050. The medium variant leads to a decrease from 82 million in 2005 to 72 million in 2050. In the low variant the population in 2050 is even 30 % smaller than in the high variant and results in a size of 60 million.

Figure 2: Population in Germany 2005 to 2050

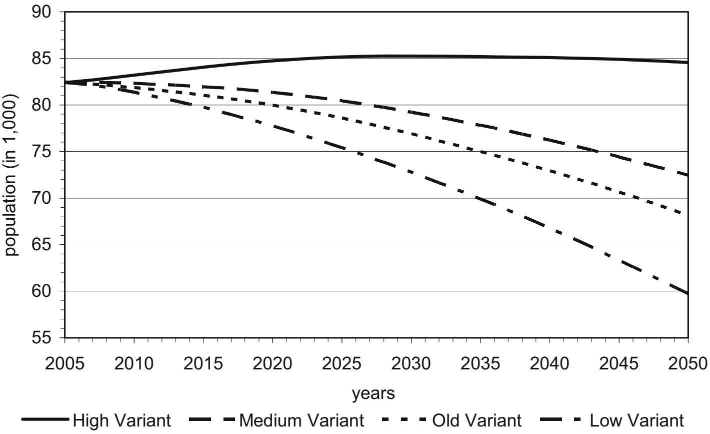


Figure 3 shows the corresponding results for the old-age dependency ratio. Here all variants lead to a strong increase in the ODR until 2050. In the old variant the ratio has more than doubled. Due to the optimistic fertility and migration assumptions the high variant results in the smallest increase. The low and medium variant are very similar, almost coincide, both leading to a doubling of the ODR in the time period from 2005 until 2050.

Figure 3: Old-age dependency ratio in Germany 2005 to 2050

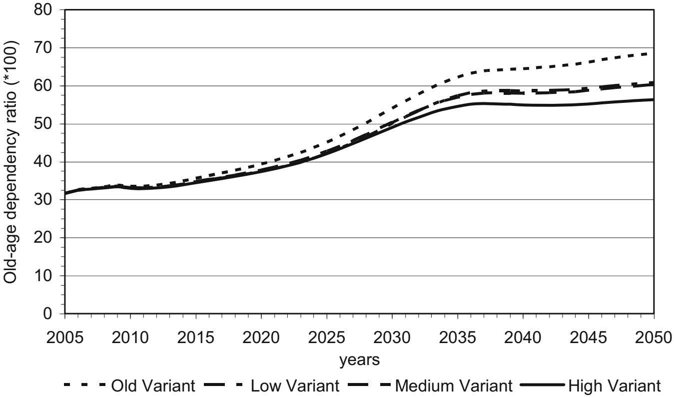
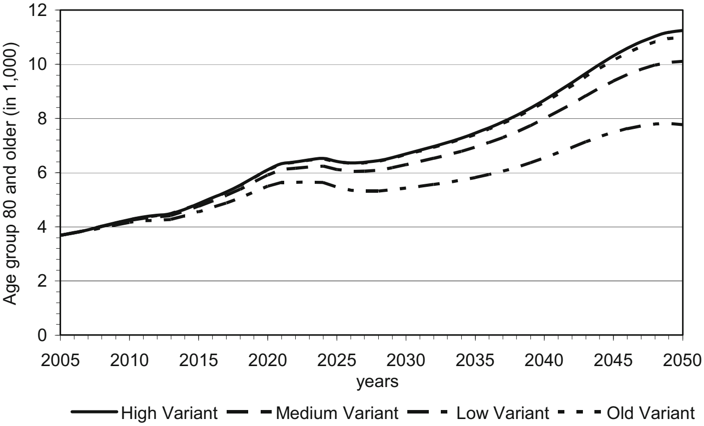


Figure 4: Age group 80 years and older in Germany 2005 to 2050.



Additionally, in Figure 4 we find the absolute number of individuals aged 80 and older. Again, we see that, according to the projections, this age group will grow considerably in the next 45 years. The low variant leads to a doubling of this age group's size. The medium variant results in an increase of 150% which is even exceeded by the old and high variants showing an increment from 4 million in 2005 to approximately 11 million individuals in 2050.

Table 2: Number of persons in need of long-term care and ratio of number of persons in need of long-term care to total population size 2005, 2020, 2035 and 2050

Year	Variant	Number of persons in need of care (in mio.)	Ratio to total population size (in %)
Variant A: no change in long-term care need ratios			
2005		2.12	2.57
2020	low	2.64	3.39
	medium	2.81	3.46
	high	2.89	3.41
	old	2.87	3.58
2035	low	2.93	4.19
	medium	3.43	4.41
	high	3.65	4.29
	old	3.57	4.77
2050	low	3.35	5.62
	medium	4.36	6.01
	high	4.83	5.71
	old	4.63	6.79
Variant B: slight decrease in long-term care need ratios			
2005		2.12	2.57
2020	low	2.43	3.13
	medium	2.6	3.19
	high	2.67	3.15
	old	2.65	3.31
2035	low	2.61	3.73
	medium	3.08	3.96
	high	3.29	3.86
	old	3.22	4.29
2050	low	3.05	5.12
	medium	4.05	5.59
	high	4.49	5.31
	old	4.31	6.33

Based on the population projections, Table 2 provides the resulting number of persons in need of care and the ratio relating the number of persons in need of long-term care to the total population size. For the risk of care need - based on data from the German Federal Statistical Office (age- and sex-specific ratios of persons in need of care relative to population) - two variants will be considered: Variant A equals the status quo, i.e., it is assumed that the current ratios persist in the future, whereas Variant B acts on the assumption that the ratios change or, to be more precisely, slightly decrease in the future (see Doblhammer/Ziegler, Chapter 3 in this proceedings).

In the high (population) variant the population size remained on a high level (see Figure 2) such that the number of persons in need of long-term care is highest here. In the low variant the increase is rather moderate whereas all other variants result in an almost doubling of the number of persons in need of long-term care in 2050. Regarding the corresponding ratios, the increase is higher than for the absolute figures and, in addition, the old variant leads to the highest increase.

Although the scenarios considered provide insights in future trends, the obtained results do not allow for answering the question of what happens between the different scenarios. Since no probabilities are available for the scenarios' occurrences and in order to see how fertility, mortality and migration affect the results sensitivity analysis is needed.

3. Sensitivity Analysis

Now, we will examine the impact of changes of fertility, mortality and migration on the number of persons in need of long-term care and its proportion of the total population (see also Bomsdorf/Babel 2005, Bomsdorf/Babel 2007).

First, we will carry out a graphical analysis. The reference case will be the medium scenario (see Table 1) for the population in connection with Variant B – a slightly decreasing proportion of the elderly in need of care - for the development of the risk of long-term care. The reference scenario's results are as follows:

Table 3: Medium results for population and number of persons in need of care in 2050

Population in 2050	72.4 million
Number of persons in need of care in 2050	4.05 million
Ratio of number of persons in need of care to population in 2050	5.59%

Figures 5, 6 and 7 illustrate the results of the sensitivity analyses. In Figure 5, an increase of the total fertility rate TFR from 1.35 to 1.55 comes along with 20,000 persons more in need of long-term care in 2050 than in the reference case; while in 2020 the effect is only 25% of the effect in 2050.

Figure 5: Changes in the number of persons in need of care dependent on changes in TFR (reference 1.35)

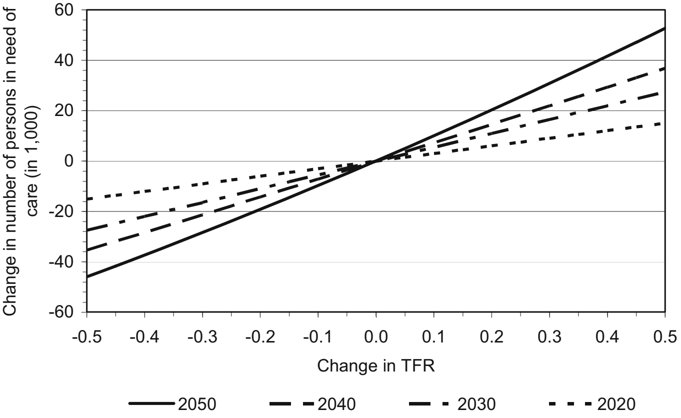
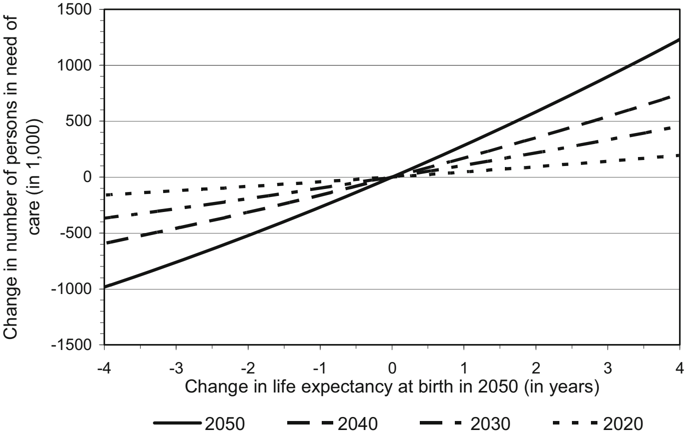


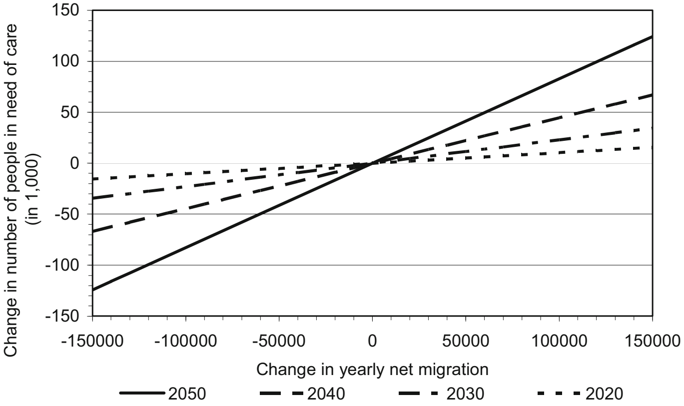
Figure 6: Changes in the number of persons in need of care dependent on changes in life expectancy at birth in 2050 (reference 85.5 years)



Compared to the reference case, a life expectancy diminished by two years (Figure 6) results in 500,000 persons less in need of long-term care in 2050, whereas a two years higher life expectancy leads to an increase of nearly 700,000 persons in need of long-term care in the same year.

A change in the yearly net migration by 50,000 leads to change in the number of persons in need of long-term care by around 10,000 in 2030 and approximately 40,000 in 2050 (Figure 7).

Figure 7: Changes in the number of persons in need of care dependent on changes in yearly net migration (reference 150,000)



The graphical analysis shows that the sensitivities are almost linear, i.e., that the dependence between the changes in the number of persons in need of long-term care and changes in fertility, mortality and migration, respectively, can be assumed to be linear. Hence, in the next step we will estimate a multiple regression model which allows a multiple analysis of isolated or simultaneous changes in the influencing factors. The endogenous variable will be the number of persons in need of long-term care in the year 2050, denoted by PNC2050, or the ratio of persons in need of long-term care to the total population in 2050, denoted by RPNC2050. In both models, the exogenous variables are the total fertility rate F, the life expectancy at birth L and the net migration N. The regression model is being estimated from a sample of 5,000 scenarios with (restricted to specified intervals) random assumptions for fertility, mortality and migration.

The estimation of the number of persons in need of long-term care in 2050 (PNC2050, Variant B for the development of the risk of long-term care) results in the following model equation:

$$\Delta PNC_{2050} = 0.01\cdot\Delta F + 0.26\cdot\Delta L + 0.04\cdot\Delta N$$

$$PNC_{2050} = 4.05 + 0.01\cdot\Delta F + 0\ 26\cdot\ \Delta L + 0.04\cdot\Delta N$$

whereas for the ratio RPNC2050 the model equation is:

$$\Delta RPNC_{2050} = -0.16\cdot\Delta F + 0.29\cdot\Delta L - 0.15\cdot\Delta N$$

$$RPNC_{2050} = 5.59 - 0.16\cdot\Delta F + 0.29\cdot\Delta L - 0.15\cdot\Delta N$$

where

PNC2050	Number of persons in need of long-term care in 2050, unit: 1 million
ΔPNC2050	Change in comparison to reference scenario (4.05 million), unit: 1 million
RPNC2050	Ratio of number of persons in need of long-term care to total population in 2050, unit: 1 percentage point
ΔRPNC2050	Change in comparison to reference scenario (5.59 %), unit: 1 percentage point
ΔF	Change in total fertility rate in comparison to reference assumption (1.35), unit: 0.1
ΔL	Change in life expectancy at birth in 2050 in comparison to reference assumption (85.5), unit: 1 year
ΔN	Change in yearly net migration in comparison to reference assumption (150,000), unit: 50,000

$\Delta F=2$ means an increase in the total fertility of 0.2 in comparison to the reference scenario (i.e., from 1.35 to 1.55), $\Delta L=2$ denotes an increase in life expectancy at birth in 2050 of two years in comparison to the reference scenario (i.e., from 85.5 years to 87.5 years) and $\Delta N=2$ represents an increase in the yearly net migration of 100,000 in comparison to the reference scenario (i.e., from 150,000 to 250,000).

The following interpretation of the coefficients for Germany is possible:

- An increase in the TFR of 0.1 leads to an increase in PNC in 2050 of 0.01 million.
- An increase in life expectancy at birth in 2050 of one year leads to an increase in PNC in 2050 of 0.26 million.
- An increase in the yearly net migration of 50,000 people leads to an increase in PNC in 2050 of 0.04 millions.

To summarise, the effects of the influencing factors are listed in Table 4.

Table 4: Effects of the exogenous variables of the regression models:

	PNC	RPNC
Fertility (TFR)	O	-
Life expectancy	+	+
Migration	(+)	-

+	Positive effect
(+)	Slight positive effect
O	Neglectable effect
(-)	Slight negative effect
-	Negative effect

4. Conclusion

In conclusion, the presented projections indicate that, independent from the chosen scenario, both the number of people in need of care as well as the ratio to total population will increase significantly. In addition, the multiple regression analyses show that the effect of life expectancy is very strong. By contrast, fertility and migration have only a small (positive) impact on the number of persons in need of care, whereas they have – due to their strong positive effect on total population size – a negative effect on the corresponding ratio to total population.

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Care Need Projections by Marital Status and Childlessness for Germany 2000-2030 based on the FELICIE Project

Gabriele Doblhammer, Uta Ziegler

1. Introduction

The elderly of the future may be expected to have different characteristics than older people today, largely due to changes in family, education and job biographies. In addition, the gender composition of the elderly will be more equal, with more men surviving to old age. For care need projections to go beyond the number of people in need of care, these differences must be accounted for.

Several demographic characteristics of the elderly are of particular importance when it comes to care need projections. Sex and age are the main determinants of health, while family status and the presence of children are indicators for potential care resources. Although women generally have a higher life expectancy than men, they more often suffer from health problems and have a higher probability of care need (Oksuzyan et al. 2008). Since in Germany, like in other European countries, a large share of the care responsibilities is taken over by the partner and by adult children, women in particular suffer from the absence of core family structures, which raises their risk of institutionalisation.

In general, the family status of people aged 60+ is fixed, unless they become widowed. The process of forming a family has long been finished, and the risks of childlessness and parenthood are only influenced by the mortality risk of the adult children. Since mortality at young ages is low, for the next 30 years the structure of the older population with regard to family status and the presence of children can be predicted relatively safely on the basis of demographic projection models. This chapter sets out to show that the future elderly will have considerably more favorable preconditions regarding family care resources than the elderly today do. While this is true for both sexes, elderly females in particular will profit from these changes.

As part of the fifth framework, the European Union funded the project "Future Elderly Living Conditions in Europe" (FELICIE). The central aim of the project was to estimate the number of elderly who will be in need of care, as well as their familial care resource levels, up to the year 2030 in the following nine European countries: Belgium, Czech Republic, Finland, France, Germany, Italy, Netherlands, Portugal and the United Kingdom. Results of the projections for all nine countries are described in Gaymu et al. (2008).

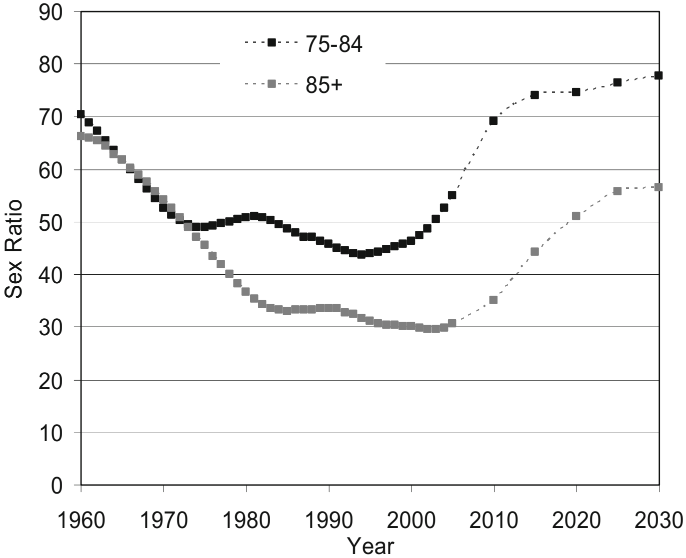
This chapter presents the main results of the care need projections for Germany based on family status and the availability of children. First, we discuss the current situation and future trends in Germany regarding gender proportions and the distribution of the elderly by marital status, as well as cohort trends in childlessness. In the second part, we present the method, assumption and disability definitions used in the FELICIE care need projections. Finally, we present the results of the projections, which are the number of people in need of care distinguished by possible family resources. We generate risk groups for institutional care with the help of the two indicators, family status and parenthood/childlessness, and forecast their proportional development up to the year 2030.

2. Gender Proportions

While over the long term 105 boys are born per 100 girls, the gender proportion changes with increasing age. In Germany in 2005, there were 74 men per 100 women between the age of 75 and 84. The older the population, the higher the share of women: in the age group 85+ there are only 30 men to 100 women (Federal Statistical Office, 2006a). Among centenarians, the difference is as high as 15 men to 100 women (http://www.mortality.org). The causes for this shift in the gender proportion in favor of older women are, on the one hand, the higher life expectancy of women and, on the other, recent German history. In particular, the Second World War led to enormous losses in the male population of the birth cohorts 1921 to 1927, which is reflected in the gender proportion of these cohorts in the decades following the war, and up until today.

Figure 1 illustrates the sex ratio for Germany from 1956 to 2005, and shows a projection of the ratio up to 2030 for the age groups 75-84 and 85+. The sex ratio gives the number of males per 100 females alive in a particular year. Over the various decades, there is an increasing imbalance in the sex ratio of the age group 75-84. Whereas in 1960, there were 70 men to 100 women, this number decreased to 44 men to 100 women in 1996. It was not until the end of the 1990s that younger cohorts no longer influenced by the Second World War first entered this age group. The proportion of males has since been increasing, and is edging towards the level seen in 1960. This growth will continue up to 2030, when the sex ratio will be 78 men per 100 women. For the age group 85+ this effect is further postponed by 10 years. In 1960, the ratio of males to females was 66 to 100. It then declined until 1997, when it reached 30 men to 100 females. Subsequently, the number of men started to approach that of females, but, at 56 men to 100 women in 2030, it will not reach its original level. This is a consequence of the higher mortality of males, which is expected to continue into the future, despite the larger improvements in male than in female life expectancy.

Figure 1: Proportion males to females (sex ratio) in Germany, 1956 to 2005, and projections up to 2030 by age groups (75-84, 85+)



Sources: Human Mortality Database and the 11th coordinated population projection for Germany (V1-W1), Federal Statistical Office (2006b).

In all industrialised countries, males have a higher mortality and thus a lower life expectancy than females. There are large regional differences within Germany: in Munich, the average life expectancy of women exceeds the life expectancy of men by only four years; whereas in Mecklenburg-Western Pomerania, the gender discrepancy is more than eight years (Luy 2004). With regard to age-specific mortality, males are disadvantaged in every age group, starting with infants and children, up to the highest ages.

Various explanations for the gender gap in life expectancy have been proposed. Biological factors, such as hormonal, autoimmune and genetic differences, are thought to be particularly important (Austad 2006). One factor often mentioned in this context is the positive impact of oestrogen on the risk of coronary hearth disease (CHD) through positive effects on serum lipids (Waldron 1995). The X-chromosome hypothesis identifies a genetic explanation for the increased male mortality. The lack of a second X-chromosome in males may be a reason for increased mortality, since two X cell lines have a higher potential of living longer (Austad 2006).

In addition to the biological reasons, there are behavioural factors that affect male and female mortality. The differences in health behaviours are seen as central in explaining disparities in life expectancy between the sexes. Generally, males more frequently display risk-taking behaviours than females, including cigarette smoking, alcohol consumption, the use of psychoactive substances and reckless driving, which results in a higher risk of heart disease, lung cancer, chronic obstructive pulmonary diseases, liver cirrhosis and accident fatalities (Waldron 1993). A further aspect of health behaviour is body weight. Specifically, obesity appears to develop differently in men and women. In Sweden between 1985 and 2002, the increase in abdominal obesity was higher in women, while the prevalence of obesity, as well as the increase in the body mass index, was higher in men (Berg et al. 2005). An explanation for this paradox lies in the differences in the health behaviours of the two sexes. While women consume a healthier diet – with, for example, more low-fat foods, less meat and more fruits and vegetables – than men (Prättälä et al. 2006), women engage less frequently in physical activity than men (Simpson et al. 2005).

The influence of lifestyle factors becomes particularly clear when the life expectancy of nuns and monks, who do not differ from each other in their way of life and occupational hazards, is compared to the life expectancy of all other males and females in general. Whereas nuns have the same life expectancy as females in the general population, the life expectancy of monks is five years higher than that of the general male population and only marginally lower than that of females (Luy 2003).

Another important factor is awareness of disease and health care utilisation. The sex differences in healthcare utilisation are visible in the significantly higher mean numbers of visits to primary care and diagnostic clinics among women than among men, but similar mean numbers of hospitalisations for both sexes (Redondo-Sendino et al. 2006). Galdas et al. (2005) conclude that there is tendency among men to delay seeking help until the later stages of disease. This is in line with results from a study by Doblhammer and Hoffmann (2009), which shows that gender differences in mortality are particularly large after deteriorating health trajectories. Once health deteriorates, males tend to die, while females continue to live, albeit with a worse health status.

3. Family Status among German Elderly and Future Developments

The characteristic that plays the biggest role in predicting the need for care resources is, without a doubt, marital status: it not only determines (or is rather the result of) the availability of a partner, it also influences health and mortality, and the extent of childlessness.

In 2003, women aged 75+ had an 87% lower risk of being married than men and were more than five times as likely to be widowed, almost three times as likely to be never-married and twice as likely to be divorced (Ziegler/Doblhammer 2007). As expected, the risk of being widowed is found to increase with age: for the age group 85+, it is three times higher than among 75-84-year-olds, but people aged 85+ are also less likely to be never married or divorced. The gender differences in marital status are the result of the lopsided sex ratio due to the higher life expectancies of females, as well as the high numbers of male deaths in the two world wars. With fewer males than females surviving the Second World War, marriage patterns differed between the two sexes, leaving a larger proportion of the females never-married.

The FELICIE care need projections are based on dynamic population projections by marital status, which model the transitions between the four marital status groups, never-married, married, widowed and divorced; and the respective mortality associated with each of these status groups (Murphy/Kalogirou 2004). Data and method will be described in greater detail later in this chapter.

Figure 2 shows the results of the marital status-specific population projections. The most important difference between 2000 and 2030 is the more balanced gender proportion in the latter years. As mentioned previously, the reasons for this shift include the fading out of the effect of World War II and the convergence of male and female life expectancy. The second most important difference is that the future marital status composition of the elderly will be dominated by the married. The proportional increase in the married population is particularly large for women. For males, the changes over time are smaller, as the great majority will be married, both today and in the future. Nonetheless, while traditional concepts of marriage and family keep the number of divorced low among these cohorts, rates of divorce are increasing.

Family status is indicated not only by the availability of a partner, but also by other characteristics, such as education, income and the household form. Family status is partly influenced by educational attainment, and both determine economic resources among the elderly. Finally, family status is linked to health.

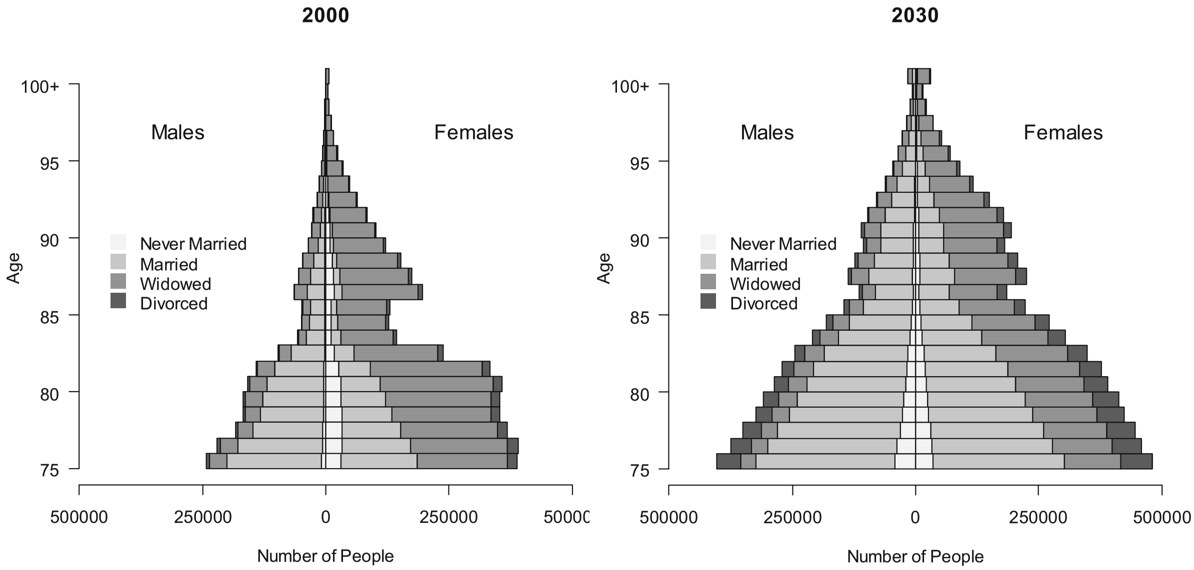
Based on the German microcensus of 2003, Ziegler and Doblhammer (2007) demonstrate the strong correlation between above-mentioned characteristics among the elderly. The lowest educational group has the highest risk of being widowed (+75% in comparison to the highest educational group) and the lowest risk of being married (-18 %), divorced (-40%) or unmarried (-57%). Education is often used as an indicator for the income and social status of a person (Huisman et al. 2005). Generally, the higher the level of education, the higher the income and level of social prestige. This has different consequences for men and women: in the highest educational group, men have a higher risk of being married (+34%), whereas highly educated women are more likely to be unmarried (+186%) or divorced (+91%) than women in the lowest educational group (calculations separated by gender, unpublished results from Ziegler/Doblhammer (2007)). A possible explanation for this discrepancy is that higher education (and, for this reason, a higher income) increases the chances of marriage and remarriage among males, while among women, education facilitates the choice to lead an independent life.

Household type and family status are mutually dependent. Married elderly live predominantly in private households. For example, whereas the risk of being married while living in an institution is 78% lower than when living in a private household, the risk of being unmarried is 166% higher. People in need of care have a 13% lower risk of being married than people without the need for care.

People in need of care are less frequently married and more often widowed than are people who do not need care. In all FELICIE countries, the non-married suffer from higher excess mortality (Festy/Rychtarikova 2008) and display higher prevalences of disability (Doblhammer et al. 2008). Differences in the health status in relation to family status have often been proved in the literature (e.g., Brockmann/Klein 2004, Goldmann et al. 1995, Joung et al. 1997). The health advantage of married people may be explained by the so-called protection hypothesis. This hypothesis states that married people are living healthier lives and are thus less exposed to health-threatening risks. On the other hand, there is the selection hypothesis which assumes that those people with relatively better health have better chances of (re-)marrying (Brockmann/Klein 2004).

Economic resources among the elderly depend largely on marital status. In the FELICIE countries, the personal income of women aged 75+ generally falls below that of males, which reflects the fact that, in the cohorts born before 1925, the economic activity of married women was generally limited (Festy/Rytcharikova 2008). This explains why the personal income of married elderly women is the lowest among all family status groups. However, when their income is combined with that of their partner, the couple's joint resources are the highest among all family status groups. After women become widowed, their personal resources increase when they combine their own pension with their husband's survivor pension. Nevertheless, this widow pension is considerably lower than the joint resources of the married couple. As Festy and Rytcharikova point out, widowhood has different effects on the economic resources of elderly men and women. While men are only marginally affected, women experience a significant reduction in income. Never-married women usually had full professional careers, and thus receive pensions comparable to those of widows. This is also true for the divorced. No differences in personal income are found between married, widowed and divorced males, but income is lower for the never-married.

Figure 2: Population of Germany by age, sex and marital status in the year 2000 and projections for 2030

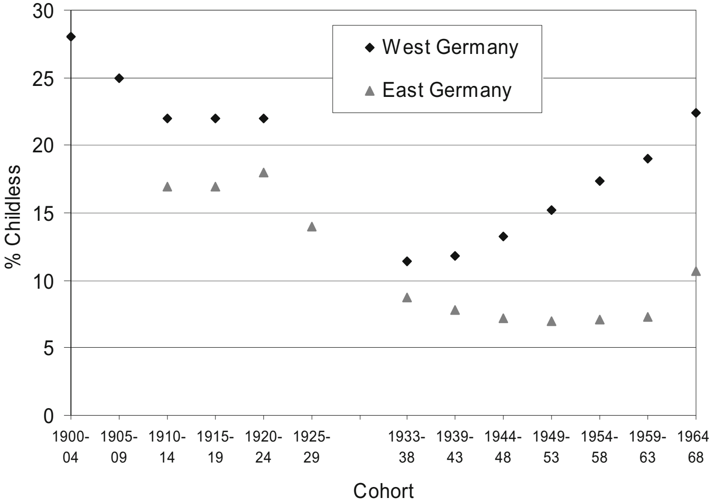


Source: Murphy and Kalogirou (2004).

4. Childlessness in Germany in the Female Birth Cohorts 1900 to 1968

In addition to family status, the availability of children and the extent of childlessness are important indicators of familial care resources. Given the importance of the presence of children, it is surprising that data sources on the fertility history of the elderly are limited, in Germany, as well as in Europe in general (Kreyenfeld/Konietzka 2007, Tomassini et al. 2008). In Germany, neither population statistics nor census data about childlessness have been available until recently. Some surveys and estimations are used instead, with sometimes diverging results (Kreyenfeld/Konietzka 2007). Only in the German microcensus of 2008 was a question about the number of children ever born included. In previous surveys, respondents were only asked to specify the number of children living in the household, which leads to inconclusive results for the elderly, whose children are grown up and have left parental home. If fertility histories are available, then the children are mainly linked to women, which means that hardly any information is available about the number of children fathered by men. In addition, there is considerable evidence that men underreport the number of children they have (Rendall et al. 1999).

Figure 3: Childlessness by birth cohort, 1900 -1968 (five-year cohorts) in West and East Germany



In 1964-68 the highest age for childless women is 40-44, 45+ otherwise.
Source: Data from 1900-1929 provided by Rowland 1998, Data from 1933-1968 are from the German Microcensus 2008 (Statistisches Bundesamt 2009).

Again, among the elderly, the presence of children is closely linked to the family status of the elderly. In 2000 in the European FELICIE countries, married men with at least one child comprised 60% of the total male population aged 75+. By contrast, among women, those married with at least one child only accounted for 20% (Tomassini et al. 2008). German cohort data reveal that, in West Germany, the lowest level of childlessness was reached in the birth cohorts born in the 1930s: only 11% are childless. Cohorts born before and after this decade both have higher levels of childlessness. It is interesting to note that only the birth cohorts 1964-68 reach a level of childlessness (22%) comparable to that of cohorts born before 1924.

The cohorts born in 1930 will reach age 80, the age of increased care need, from 2010 onwards. This implies that, in West Germany in the years 2010 to 2020, those cohorts with the lowest levels of childlessness will enter the age of increased care need. While childlessness will continuously increase among the elderly, high levels will, however, only be reached after 2030. The situation in East Germany is different: there is a similar decline in childlessness from the 1900 cohort onwards, but the lowest levels of childlessness, of under 8%, are reached over an extended period in the birth cohorts 1933 to 1963. This implies that childlessness will be much lower among East than West German elderly, and will only start to increase from 2040 onwards.

5. The Prevalence of Care Need and the FELICIE Care Need Projections

International comparisons of health profiles are clearly hampered by different definitions of health used in various national and international surveys. A publication of the European Commission (2003) gives an overview of the health questions asked in European health surveys, and assesses their comparability. According to the report, questions about self-perceived health are among those indicators with relatively high levels of comparisons which are commonly asked in national and international health interviews. Therefore, in the FELICIE project, care need projections are based on a health question about the ability to independently perform activities of daily living. The European Community Household Panel (ECHP) contains the question, “Are you hampered in daily activities by any physical or mental health problem, illness or disability?” The answer categories for this question are of “severely,” “to some extent” and “no.” Those who answered “severely” are considered in need of care.

Using the disability question from the ECHP in the years 1995 to 1999 for Germany, we find that those in need of care include not only the 1.38 million people aged 75+ who received support from the German long-term care insurance in the year 2003, but also those who report severe disabilities and are not covered by the care insurance.

Since the ECHP is restricted to private households only, it excludes the large number of elderly people living in institutions, which is related to health and marital status. Thus, results of the ECHP would lead to an underestimation of the prevalence of disability. This underestimation would be more serious for the unmarried than for the married. Since the sample sizes in the ECHP are generally small, particularly at older ages, the results of the survey do not provide reliable information about age-specific prevalences of disability for the unmarried population. Age-specific profiles of disability are therefore only calculated for the married. Using the proportion of married people living in institutions from national statistics, the age profile was then adjusted to reflect the prevalences in the total married population, rather than in the married population living in private households. In a third step, national health surveys are used to estimate odds ratios of disability for the widowed, single and divorced, compared to those of the married, and these odds ratios are applied to the age-specific prevalences of the married. For Germany, the odds ratios were estimated by logistic regression using the microcensus from the year 1999.

Figure 4 shows the prevalence of care need for Germany by age, sex and marital status. It is higher for females, and the increase after age 65 is much steeper among females than among males. Married males and females display the lowest prevalences. Widowed males do not differ from married males, while the prevalence is higher for the never-married and even higher for the divorced. Divorced females have the highest prevalence of care need, while the widowed and never-married are in between.

The FELICIE care need projections consist of two steps. In the first step, dynamic marital status projections by age and sex were developed using the LIPRO model (Murphy et al. 2004). The starting population for the German marital status projection is fixed at December 31, 1999 for ages 45 to 100. This age range was chosen because those aged 45 in 2000 will be aged 75 in 2030. Thus, the care need projections are restricted to all persons aged 75 and older.

The basic events used to calculate marital status transitions, as well as marital status-specific death rates, were collected from several publications of the German Statistical Office for the years 1990 to 2001. Since the information was only available for the age range one to 85, estimation procedures were applied to calculate the starting population, as well as the transition and death rates between ages 85 and 100+. Assumptions for future nuptiality rates take trends in past nuptiality rates into account. The assumptions are that the marriage rates of never-married males and females will increase slightly. While remarriage rates of divorced and widowed females will also increase slightly, they will decrease for males. Widowhood rates will decrease for females but increase for males and divorce rates will increase steadily for both sexes.

Mortality is marital status-specific, with lowest mortality seen among the married and the widowed. The annual improvement rates in mortality are slightly higher for married and divorced people. Remaining life expectancy at age 75 in 2030 will be 11.5 years (14.9 years) for married males (females), 7.9 years (11.2 years) for the divorced, 8.9 years (12.4 years) for the widowed and 8.2 years (12.0 years) for the never-married (Murphy/Kalogirou 2004).

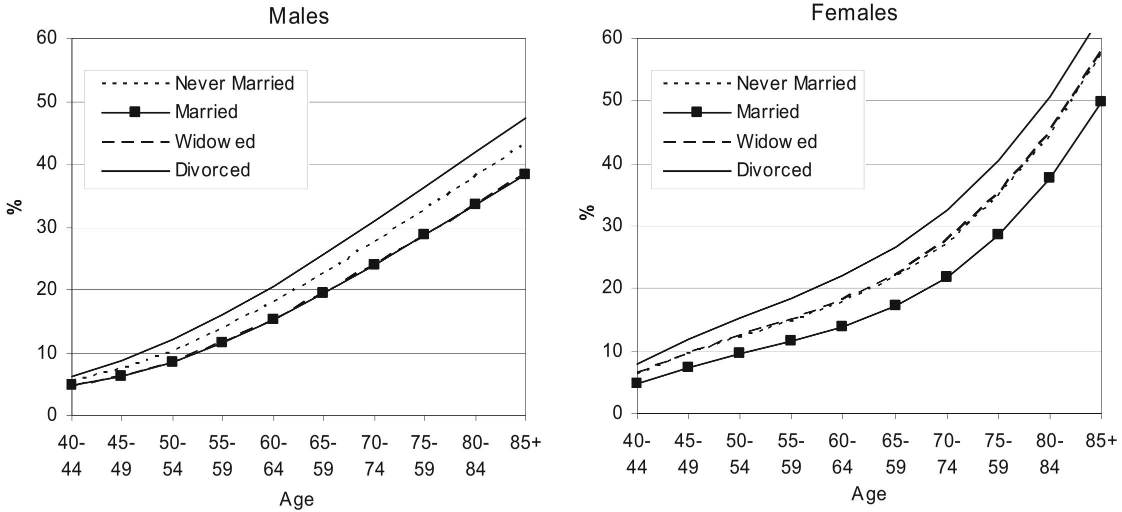
In a second step, the dynamic marital status projections were combined with the marital status-specific prevalences of disability using the two scenarios of health trends, namely the "Constant Disability Share Scenario" and the "Healthy Life Gain Scenario." The Constant Disability Share (CDS) Scenario assumes that the gain in life expectancy results in a proportional growth in the years in disability. Prevalences of disability will therefore remain constant. The Healthy Life Gain (HLG) Scenario assumes that all added years in life expectancy are healthy years. The years spent in disability will therefore stay constant (Ekamper et al., 2005). Until this step, health states and mortality are marital status-specific. In a third step, the sub-groups (sex, age, marital status, health) are divided into those with and without surviving children.

For a more detailed description of the methodological approach, the reader is referred to the reports by Murphy and Kalogirou (2004), Ekamper et al. (2005) and Ekamper (2006).

In absolute numbers, we estimate there were 2.71 million people in need of care in 2005, which corresponds to the figure given for private households by Schneekloth and Wahl (2005) and for institutions by Schneekloth (2006). From both reports, the number of people aged 75+ in need of care is estimated to be about 2.7 million.

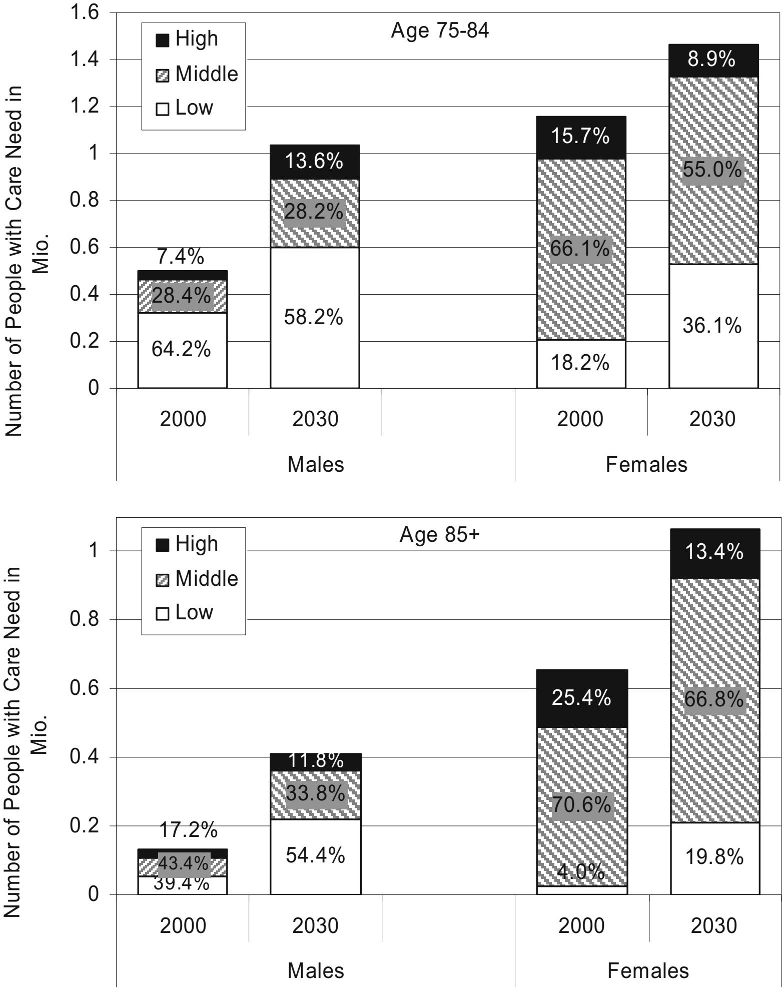
In both scenarios, for both males and females and for all countries in the FELICIE project, a marked increase in the number of severely disabled persons up to 2030 is projected. For Germany, the increase among the female population will be 39% according to the CDS and 20% according to the HLG scenario. In absolute figures, this is an increase from 1.8 million females in need of care in the year 2000, to 2.5 million (CDS) and 2.2 million (HLG) in 2030. The increase in the number of males in need of care will be 227% according to the CDS, indicating that the number of men in need of care will at least double if prevalences in disability remain constant. For the HLG, the increase is also relatively high, at 179%. In absolute figures, this amounts to an increase from 0.6 million males in need of care in 2000 to 1.4 million (CDS) and 1.1 million (HLG) in 2030. The important point shown by the two scenarios is that it is unlikely that improvements in health can fully counterbalance the ageing of the population.

Figure 4: Prevalence of care need based on severe disability for Germany by age, sex and marital status



Source: FELICIE care need projections for Germany for the period 2000 to 2030 by marital status and childlessness.

Figure 5: Number (in mio.) and percentage distribution of persons with need of care by risk of institutionalisation: males and females, ages 75-84 and 85+ in the year 2000 and projections for 2030.



With the help of the information about family status and children, three risk groups with regard to institutionalisation are formed. People who are childless and do not have a partner because they are widowed, never-married or divorced are especially endangered because neither a partner nor children can take over care responsibilities. Without other social networks or sufficient resources to finance formal home care, they have a high risk of entering an institution if their health should deteriorate. Married persons with at least one child can, should the need for care arise, rely on a larger network, which increases the probability that responsibility for their care will be taken over by the family. This group has the lowest risk of institutionalisation. All other groups, i.e., married persons without children and unmarried persons with children, belong to the middle-risk group, because there is at least one family relative who may provide care should health problems arise.

According to this classification, it becomes evident (Figure 5) that males currently have a much lower risk of institutionalisation than females: in the year 2000, 64% of men aged 75-84 were married with at least one child. Among males aged 75-84, 28% were at middle risk, but only 7% were at high risk, i.e., they were not married and had no children. Among women, only 18% of those aged 75-84 were married and had at least one child. Meanwhile, 16% of women in this age group had neither a partner nor a child they could rely on, and therefore had a high risk of institutionalisation. The largest proportion of females belonged to the middle-risk group (66%). For all persons aged 85+, the risk of living in a nursing home increased because both males and females were less frequently married and childlessness was higher among older cohorts. Nevertheless, in 2000 39% of the males aged 85+ belonged to the lowest risk group, compared to only 4% of the females. One in four women and 17% of men had no partner and no children. Forty-three percent of the males and 71% of the females belonged to the middle-risk group. These percentages will change considerably through 2030. The situation will worsen among males aged 75-84. While the proportion of those in the lowest risk group will by decrease by six percentage points, to 58%, it will almost double among the highest risk group (from 7% to 14%). On the other hand, females will profit from future changes in family structures: the lowest risk group will double to 36% and the highest risk group will be almost halved, to 9%. At ages 85+, both sexes will profit: among males, the lowest risk group will increase from 39% to 54%; and among females, from 4% to 20%. These developments will be accompanied by a reduction in the size of the highest risk group, from 17% to 12% for males and from 25% to 13% for females.

6. Summary and Discussion

The FELCIE projection shows that, despite the future assumptions about improvements in health, the number of people in need of care will increase due to the ageing of the population.

In addition to these increases, there will be a shift in the distribution of marital status and childlessness. In future, a larger proportion of the elderly will be married with at least one child than is the case now and than has ever been experienced in recent history. There are four reasons for this projected shift. First, cohorts unaffected by World War II will reach old age, which implies that more men will survive to higher ages and that more women could find a partner and marry at younger ages. Second, male and female life expectancy will converge, changing the sex ratio among the elderly, resulting in a larger number of couples. Third, divorces have not been very common among cohorts who will reach old age prior to 2030. Fourth, the share of persons with at least one child will increase. In the next 30 years, the parents of the baby boom cohorts (1940-49) will enter the age of care need in West Germany. This parent generation had the lowest childlessness rate in the last century. Not only the cohorts who were born after 1940-49, but also the cohorts born before this decade were more likely to be childless. In East Germany, elderly cohorts will have a low degree of childlessness well beyond 2030.

This shift in the family circumstances of the elderly will have large repercussions for the risk of entering an institution in case of deteriorating health. With the exception of males aged 75-84, family resources will increase over the coming decades and women in particular will profit from the increased availability of a partner and of children.

Our current welfare system is based on three pillars (Esping-Andersen 1990): markets, families and the state. In Germany, the main responsibility for care is assigned to the family: about two-thirds (68%) of people who need care are living at home, while the other third (32%) are living in institutions. Of those in need of care who live at home, 67.5% solely rely on the help of family members, while 32.5% get additional help from nursing services (Long-term care insurance 2005) (Federal Statistical Office 2007).

When assigning care responsibilities to the family in the future, the increase in female labor force participation may conflict with their traditional caring obligations. In Chapter 4, Erika Schulz provides an estimate of the familial care resources available, taking into account future employment patterns of women.

An alternative to family care is obtaining care resources from the market, i.e., through employment and the purchase of formal care. This is problematic, primarily because not all people have equal access to the same resources. For instance, differences in education or social status lead to unequal access to employment. In the face of high unemployment rates and unequal incomes, opportunities to take part in market activities are restricted for a great number of people. On the other hand, cohorts entering old age in the years to come will have profited from the prosperous economy of the post-war era and will have the financial means to purchase health care to a larger extent than previous cohorts. Since education can be seen as an indicator of past labour market opportunities, the FELICIE project has produced an estimate of the proportion of the elderly who will have low levels of education by marital status. Compared to the year 2000, the number of males and females with low levels of education will be decreasing in all marital status groups. Thus, in the year 2030, there will be more people with medium or high levels of education (Fernandes et al. 2008). In addition, these cohorts have profited from the economically prosperous years after World War II. This implies that these cohorts will have a higher income that can be used to pay for private health services (de Santis et al. 2008). At the same time, higher education is associated with a greater awareness of health issues and of appropriate health behavior. In addition, people in family situations considered to be most vulnerable (i.e., never married and divorced) are also more likely to have higher levels of education. This implies that they have more resources to pay for health services.

Concerning the market, the focus should be more on implementing and promoting private care insurance, as well as private nursing services. The elderly of the future will have the financial resources to co-finance their care needs. Another approach could be the introduction of new mortgage forms (e.g., Leibrente), as well as of new housing forms that allow the elderly to stay in their homes as long as possible.

The responsibilities of the state must include providing a legal framework that will pave the way for the formulation of new policies, and then putting these policies into practice. At the same time, the state should offer incentives to people to focus on private health care provisions and greater self-reliance. However, the state's primary task should be to provide institutional care for the most vulnerable groups. Finally, the state should invest in more research about care needs. For example, in Germany, as well as in most of the European countries, little is known about people living in institutions, because the data is not available. This is a gap that should be filled by additional research.

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Projection of Care Need and Family Resources in Germany

Erika Schulz

1. Introduction

In 2006, some 5.1 million people were in need of care in Germany. Of this number, 2.1 million were long-term care insurance (LTCI) beneficiaries.[1] The need for care is strongly related to age. Half of the beneficiaries were aged 80 and older. The prevalences of the need for care increase sharply from the age of 70 onwards (see Pfaff, Chapter 1 in this proceedings). Thus, it is expected that the ageing of the population, particularly the sharp increase in the number of the oldest old, will lead to a marked rise in the number of people in need of care in coming years.

The need for long-term care is affected by a number of factors, including health behaviour over the course of a person's lifetime, overall living conditions, an individual's genetic predispositions and medical-technological progress. It may be expected that, in particular, positive changes in health behaviour, increases in educational attainment and medical-technological progress will help to improve the health status of the elderly in future years. Thus, on average, older people will be healthier than previous generations. This may reduce the prevalences of the need for care and may therefore mitigate the demographic effect.

The intensity of care needed depends on the level of impairments in activities of daily living (ADL) and in instrumental activities of daily living (IADL)[2]. Additionally, the oldest old often suffer from mental health problems and therefore need special and intensive support in everyday life and with personal care. Only people with substantial impairments are eligible to receive LTCI benefits.[3] LTCI predomi-

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[1] Germany introduced a mandatory, universal social long-term care insurance system as a fifth pillar of the social security system in 1995. Benefits are available for all insured persons depending on the extent of the need of care, and irrespective of age, income or wealth.

[2] ADLs include, for example, bathing, dressing, and mobility. IADLs include, for example, cooking and cleaning.

[3] In legal terms, the "need for long-term care" refers to those people who have a physical, psychological or mental disease or handicap, and who require a significant or major amount of help to carry out the daily and recurring activities of everyday life over a prolonged period of time, most likely for a minimum period of six months. The entitlement to claim benefits is based on whether the individual needs

nantly provides assistance for domiciliary care (for informal care giving and for professional home care services), but may also be used to pay for institutional care if care giving at home is not possible. However, people in need of help with practical duties and personal care to a lesser degree may rely on informal care giving and assistance and/or pay for professional helpers themselves.

People in need of care want to live in their own homes and with their families for as long as possible. Around one million people receiving solely informal care, get cash benefits and some 0.5 million beneficiaries receive benefits for professional care giving at home. Together with the people in need of care who receive no LTCI benefits, around 4.4 million people in need of care received personal care and help with practical duties in the home in 2006. Hence, it follows that around 90% of all people in need of care and assistance rely on informal care giving (with and/or without help from professional home care services).

Care giving at home by family members is the preferred care giving arrangement. But the proportion of people receiving care at home depends on the availability of informal care givers within the family or the personal network, as well as on the level of impairments in daily living that are caused by physiological or mental illnesses. Informal care givers are mostly spouses, followed by daughters and daughters-in-law, other members of the family and friends or neighbours (Schneekloth/Leven 2003). People who are married or are living in a partnership have a higher chance of receiving care at home if the need for care arises, while people living alone have a higher probability of moving into a nursing home.[4] Therefore, the availability of informal care givers depends on the marital status or living arrangements of the people in need of care. Other fundamental factors that determine a possible informal care situation are the employment status and the living arrangements of potential informal care givers and the distance between the places of residence of people in need of care and potential care givers.

In the following sub-chapters, an estimation of the number of people in need of care (Sub-chapter 2), as well as of the potential number of informal care givers

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help in carrying out at least two basic activities of daily living (ADL), and one additional instrumental activity of daily living (IADL). Three levels of dependency are distinguished (care levels I to III) depending on how often assistance is needed and how long it takes a non-professional care giver to help the dependent person. The minimum requirements are 45 minutes personal care, and in total 90 minutes care and help a day.

[4] Considerable differences exist concerning the marital status of males and females receiving long-term care at home. Most of the male beneficiaries are married (55%), while one-fourth are never married and 17% are widowed. Among the female beneficiaries (like among female population), widowhood is common; 58% are widowed, and only 23% are married (Table A.1 in appendix). Persons who were never married or widowed have a higher probability of being institutionalised than married people. Around two out of three men and 90% of women living in nursing homes are widowed or have never been married (Table A.2 in appendix).

(Sub-chapter 3), is made. The aim is to pinpoint the pressure on care due to population ageing and the reduction in the number of potential care giving children, taking living arrangements into account. Additionally, in Sub-chapter 4 the influence of improvements in health on the number of people in need of care is shown. Sub-chapter 5 concludes.

2. Population Development and the Need for Care

2.1 Population Projection by the DIW - Assumptions

The projected number of people who will need care in the future will be determined by changes in the population and in the health and impairment status of the elderly. While the low fertility rate influences mainly the size of the future generations, the expected changes in life expectancy primarily have an impact on the numbers of old and oldest old people. In 2007, the DIW updated their population forecast (Schulz/Hannemann 2007). The change in the population was estimated using different assumptions concerning migration flows and life expectancy. For fertility, it was assumed that the cohort fertility rate will be nearly constant over the projection period, or at around 1,400 children per 1,000 women, but that the mean age at childbirth will further increase marginally. Past experience shows that it is very difficult to project migration flows. Therefore, three scenarios with different sizes of net migration flows were calculated, using 100,000, 200,000 and 300,000 net numbers of migrants arriving per year. Concerning the life expectancy, a further increase was expected: in the first variant, alleviated negative growth rates of the age- and sex-specific mortality rates were assumed and in the second variant, constant negative growth rates[5] were applied. In the second variant, life expectancy was found to increase for men from 76.6 years in 2004/06 to 85.9 years in 2050 and for women from 82.1 years to 88.7 years over the same period. This variant is used for the care need projections in the following.

2.2 Decline in Population, but Marked Increase in the Share of the Elderly until 2050

The increase in life expectancy is only a row indicator for an ageing population. More essential is the question of in which age groups reductions in mortality can be realised in the future. In the past, the highest reduction was realised in infant mor-

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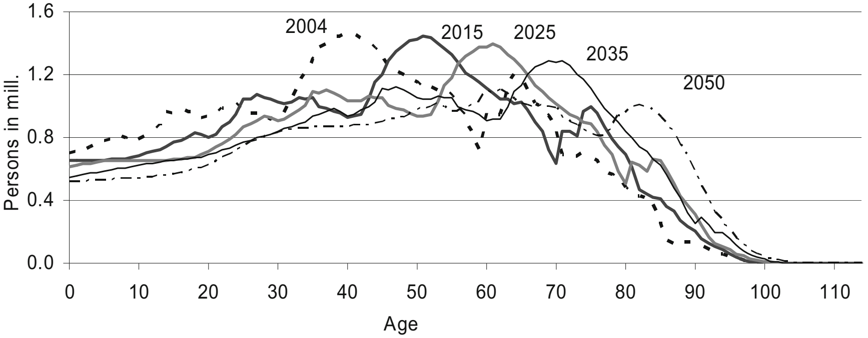
[5] In the first variant the life expectancy will rise up to 84.3 years for men and 86.9 years for women. For more details see Schulz et al. (2007).

tality as well as in the young and middle age groups. According to the life table of 2004/06, only 10% of a female (male) cohort had died before the age of 67 (56) and 30% before the age of 80 (71). As the mortality rates in the young and middle age groups are still low, a further reduction in mortality will be realised, particularly in the older age groups. It is assumed that the highest reduction can be obtained between the ages of 65 and 90 for women (55 and 90 for men). Thus, in 2050 90% of a female (male) cohort will survive until the age of 77 (79) and 70% until the age of 87 (83). The decline in mortality in the higher age groups will lead to a marked increase in the number of surviving elderly.

While the total population will decline from 82.5 million in 2006 to 76.6 million in 2050 in Germany[6], the number of people aged 70 and older will increase by some 10 million (Table A.3 in the appendix)[7]. The change in age structure of the German population is best illustrated by focusing on the so-called baby boomer generation, or persons born between 1959 and 1968. In 2004, the baby boomer cohorts made up the population aged 35 to 45. During the forecast period up to 2050, the baby boomers' peaks shift to the right, corresponding to their increasing ages (Figure 1). In 2050, the baby boomers determine the age group from 78 to 87 and they will still be a large group of around 8.5 million people.

Figure 1: Population development by age in Germany 2004 to 2050



Source: DIW population projection.

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[6] DIW-population projection, Variant 2b (200,000 net migration per year, life expectancy 82.5 men and 88.7 women); see Schulz et al. (2007).

[7] The number of people aged 70 to 79 will increase by 1.9 million (from seven to 8.9 million), the number of people aged 80 to 89 by 5.8 million (from 3.2 to nine million) and the number of people aged 90 and older will increase by 2.2 million (from 0.6 million in 2006 to 2.8 million in 2050).

2.3 Sharp Increase in the Number of People in Need of Care

To get an overview of the pure demographic effect on the number of people in need of care, the population forecast was combined with the age-, gender- and care-level-specific prevalences of the need for care. The prevalences were calculated as the average of the three years 2004, 2005 and 2006. Unlike other projections of care need, the number of beneficiaries of long-term care insurance (people with care levels I to III), as well as the number of people who need help with both practical duties and personal care, but to a lesser degree than the LTCI eligibility criteria requires (care level 0), are integrated in our calculation.

Table 1: People in need of care (care levels 0 to III) in 2006 and 2050 in Germany

People in need of care with care level 0 and beneficiaries form the LTC insurance funds with care levels I to III								
Age groups	I	II	III	I-III	I-III at home	0	total	total at home
in 1,000								
2006								
under 15	35	22	11	68	65	50	118	114
15 to 39	60	38	27	124	97	232	356	329
40 to 59	99	53	24	175	124	492	667	616
60 to 64	38	22	8	68	52	191	260	243
65 to 69	73	45	15	133	101	303	435	403
70 to 75	97	61	20	178	134	515	692	649
75 to 79	149	93	30	272	196	478	750	675
80 to 84	216	136	45	397	260	450	846	709
85 to 89	189	130	44	362	214	188	551	403
90+	136	136	54	326	161	133	459	295
Total	1,092	736	275	2,103	1,403	3,032	5,135	4,435
2050								
under 15	24	15	8	47	45	34	81	78
15 to 39	42	28	19	88	69	164	252	233
40 to 59	79	43	19	140	100	392	532	492
60 to 64	47	28	10	85	64	199	284	263
65 to 69	68	42	14	124	94	327	451	421
70 to 75	113	73	23	209	159	554	762	713
75 to 79	201	130	41	372	272	668	1,039	939
80 to 84	468	306	99	873	588	942	1,815	1,530
85 to 89	673	482	153	1,308	809	956	2,263	1,764
90+	610	601	222	1,433	759	662	2,094	1,420
Total	2,324	1,747	606	4,678	2,958	4,896	9,574	7,854

Source: Schneekloth/Leven 2003, estimation by DIW Berlin.

As a result, the change in the number of people in need of care at home can be shown, irrespective of the level of care needed. That will be used as an indicator for the demand for care.

The number of people in need of care will increase from 5.1 million (all care levels together) in 2006 to 9.6 million in 2050. This represents an increase of 86% (Table 1). Around half of them, or 4.9 million in 2050, are people with care level 0 who will be cared for by family members, mostly without help from professional care givers. The number of long-term care insurance beneficiaries (care levels I - III) is expected to rise up to 4.7 million in 2050, of whom around three million will receive care at home (Schulz 2008a). Therefore, the number of people in need of care at home will rise from 4.4 million in 2006 to 7.9 million in 2050.

Due to population ageing, the increase in the number of people in need of care is higher in the oldest age groups than in the younger age groups. In 2006, one out of three persons in need of care was older than 80 years; this share will double by 2050. Because mental illnesses occur more frequently among the oldest old, the number of people with mental illnesses is expected to increase considerably[8]. In 2002, the number of people with mental illness amounted to 1.2 million in Germany (Hallauer and Kurz 2002). By 2050, an increase of up to around 2.8 million is estimated.[9]

3. Changes in Care Giving Potential

These projections of the numbers of people in need of care only show the influence of demographic change. However, this information can be used as a point of reference in discussing other factors which could also have an impact on the demand for care. The determinants influencing the need for care are manifold. We want to focus on three factors. *First*, the living arrangements of the elderly, which determine the possibility for care giving at home, should be considered. Expected changes in living arrangements have an influence on the split between care giving at home and in institutions. *Second*, the increasing labour force participation of women in the middle and older age groups will be analysed in detail. As daughters and daughters-in-law are the second largest informal care giving group after spouses, the expected further increase in labour force participation of women may have a negative effect

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8 The share of people suffering from mental illnesses rises sharply with age. Around 13% of the people aged 80 to 84 years, 24% of people aged 85 to 89 years and 35% of people aged 90 and older suffer from mental illnesses (Bickel 2008 and Bickel 2002). For more details on mental illnesses of the elderly see Ziegler/Doblhammer, Chapter 6 in this proceedings.

9 See Ziegler/Doblhammer, Chapter 6 in this proceedings.

on the potential for care giving. *Third*, the effects of improvements in health status, which may reduce the need for care, are explored (see Sub-chapter 4).

3.1 Impact of Changing Living Arrangements of the Elderly

The availability of informal care givers is essential if people are to stay in their homes when the need for care arises. Partners are the preferred care givers and people living in partnerships have a greater chance of staying at home than single people. According to the micro-census, around one-third of persons aged 80 to 85, one-fifth of people aged 85 to 90 and 12% of people aged 90 and older lived as couples in 2003[10]. Based on (i) the DIW population forecast (ii), information on the living arrangements of persons by age groups and gender and (iii) past developments, the DIW carried out an estimation of persons living in private households by household type and age groups, as well as an estimation of the number of households based on the same characteristics (Schulz 2008b).

The number of people living in private households and the structure of households is mainly determined by the development of the population. The low fertility rate will lead to a decreasing proportion of households with three and more children and the growth in life expectancy will lead to an appreciable increase in the number of households headed by oldest old persons. Additionally, it is assumed that the trend towards single households in the younger and middle age groups will continue, as more people live alone and the number of divorces or separations continues to rise.

In total, the average household size will decrease further, but not among older age groups. The increase in life expectancy will lead to a higher share of couples growing old together at older ages. In particular, widowhood among women will decrease, as the life expectancy of men is expected to increase to a greater degree than the life expectancy of women. As a result, by 2050 the share of people living in partnerships will rise to nearly 50% among those aged 80 to 85, to 37% in the age group 85 to 90 and to one-fourth for the elderly aged 90 and older (Table 2). Considering this development, it can be assumed that the potential number of informal care givers will increase among the oldest old. And, even if we focus on the young old aged 65 to 79, a small increase in the share of people living in partnerships can be expected, from 60% to 64%. This suggests that there may be a small gain in the number of potential care givers for young old people as well. The increase in the potential number of informal care givers among the oldest old may reduce the need

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[10] Data base is the scientific use file of the micro-census provided by the Federal Statistical Office of Germany. For the calculation only the people living in private households are taken into account. For more details see Schulz (2008b).

to move to a nursing home when people fall in need of severe care. But care giving is a physically and psychologically straining task. The oldest old care givers will need additional assistance from other family members or professional home care services to a higher degree than today.

Table 2: Persons living in private households by household type in 2003 and 2050 in Germany in %

Age groups	Single	Single parent	Couple without children	Couple with children	Other house-holds	Total
			in %			
			2003			
0 to 17	0.1	12.3	0.0	72.1	15.5	100.0
18 to 34	19.9	2.6	16.9	24.1	36.5	100.0
35 to 49	14.5	4.0	15.9	39.6	26.0	100.0
50 to 64	15.8	0.4	52.4	4.4	27.0	100.0
65 to 79	29.2	0.0	59.5	0.2	11.1	100.0
80 to 84	55.7	0.0	34.0	0.0	10.4	100.0
85 to 89	63.6	0.0	21.1	0.0	15.3	100.0
90+	67.9	0.0	11.5	0.0	20.5	100.0
Total	17.0	3.8	27.1	28.4	23.7	100.0
			2050			
0 to 17	0.1	14.0	0.0	71.0	14.9	100.0
18 to 34	25.2	1.7	17.3	15.2	40.6	100.0
35 to 49	19.2	5.2	16.0	38.4	21.2	100.0
50 to 64	18.0	0.2	50.0	5.5	26.3	100.0
65 to 79	25.2	0.0	63.6	0.2	11.0	100.0
80 to 84	41.4	0.0	48.9	0.0	9.7	100.0
85 to 89	49.6	0.0	36.6	0.0	13.8	100.0
90+	56.9	0.0	25.0	0.0	18.1	100.0
Total	22.5	3.1	33.0	19.8	21.7	100.0

Sources: Federal Statistical Office of Germany; forecast by DIW Berlin.

3.2 The Influence of Female Labour Force Participation

Whilst an increase in the number of potential care givers among the oldest old can be expected, the reverse situation is expected for the potential number of care givers in the middle age groups. First, the low fertility rate leads to a decline in the ratio of children to parents. Second, the ability to provide assistance to family members in the form of help with housekeeping and personal care is higher among non-active people than among employed people.

Table 3: Women aged 18 and over in private households by household type and employment status in 2003 and 2050

Age groups of women	Single		Couple without children		Couple with children		Other* households		Total	
	in 1,000	Share of employed	in 1,000	Share of employed	in 1,000	Share of employed	in 1,000	Share of employed	in 1,000	Share of employed
					2003					
18 to 35	1,369	78	1,528	82	2,372	56	2,860	54	8,129	64
35 to 50	936	80	1,610	80	3,617	68	3,172	71	9,335	73
50 to 65	1,437	44	4,469	39	193	56	2,085	53	8,184	44
65 to 75	1,628	3	3,172	2	5	0	543	5	5,348	3
75 to 85	1,946	0	871	1	0	0	344	2	3,161	1
85 +	599	0	46	0	0	0	159	0	804	0
Total	7,915	32	11,696	37	6,187	63	9,163	54	34,961	45
					2050					
18 to 35	1,461	87	1,470	91	1,598	61	2,540	63	7,069	73
35 to 50	927	89	1,368	88	2,969	75	2,363	80	7,627	81
50 to 65	1,447	68	5,038	55	267	67	2,192	68	8,944	61
65 to 75	1,455	5	3,284	4	6	0	617	7	5,362	4
75 to 85	1,811	0	1,376	0	0	0	390	1	3,577	0
85 +	1,322	0	151	0	0	0	357	0	1,830	0
Total	8,422	37	12,689	43	4,839	70	8,459	59	34,409	49

Sources: Federal Statistical Office of Germany; forecast by DIW Berlin.

*) Single parents included.

More than half of the informal care givers are aged 40 to 64. Around 60% of informal care providers who care for long-term care insurance beneficiaries and 50% of people providing informal care to people with care level 0, are not employed (Schneekloth/Leven 2003).

To get an idea of the development of the potential number of female care givers in this age group, the DIW estimated the projected number of active people (Schulz et al. 2008). Based on long-time series of female labour force participation by age groups and the expected changes in regular retirement age (and, therefore, retirement behaviour) the future labour force participation rates were calculated and combined with the results of the population forecast. It is assumed that the labour force participation rates of women will rise further, particularly among the young and older working age groups and in the middle age groups of women with children. According to the DIW population forecast, the number of women aged 35 to 64 will decrease by 950,000, but the share of employed women will increase by 10 percentage points (from 60% to 70%) by 2050 (Table 3).

The capacity to become an informal care giver also depends on marital status. People in the middle age group (aged 45 to 59) are more likely to become care givers if they are separated, divorced, widowed or never married; while people in older ages are more likely to become care givers if they are married[11]. Care giving behaviour subdivided by household types could not be explored because of missing data. While is possible that the increasing share of singles and couples without children will lead to a rise in the number of care givers, the trend towards individualisation may have the opposite effect. Nevertheless, the decline in the number of females and the increase in female labour force participation will mainly influence the potential number of informal care givers in the middle age groups and in total. In general, a decline can be expected.

3.3 Estimation of Care Giving Potential by 2050

The calculation of the potential number of informal care givers requires several steps. In a first step, persons living in institutions have to be excluded, as only people living in private households can be considered as potential care givers. In a second step, all people who are themselves in need of personal care and help with domestic tasks (including people in need of care with care level 0) must be removed.

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[11] Results from the ECHP. In the EU15 (without Luxembourg and Sweden) the share of females looking after old people was highest in the middle age group 45 to 59, (12.1%). Of this group, the highest rates of care giving were among never married people (12.8%), followed by separated people (10.1%). Five percent of all people aged 80 and older were looking after another person, but 9% of married older persons were care givers. See Schulz (2004) and Schulz (2005).

This is especially relevant for people aged 65 and older. In a third step, the living arrangements of people, particularly the share of people living in partnerships, has to be taken into consideration. Schneekloth and Leven (2003) show that elderly informal care givers provide care primarily to their partners. Furthermore, for people in the middle age groups, the activity status has to be taken into account, particularly for women.

Table 4: Potential care givers in 2006 and 2050 in Germany

Potential care givers	2006	2050	2050/2006
	in million		Changes in million
Women aged 20 to 40			
Active	17.5	13.7	-3,9
Non-active	3.5	2.2	-1,3
Total	21.0	15.8	-5,1
Men aged 40 to 65			
Active	12.4	11.1	-1,3
Non-active	2.2	1.5	-0,7
Total	14.6	12.6	-2,0
Women aged 40 to 65			
Active	9.9	8.7	-1,2
Non-active	4.4	3.0	-1,4
Total	14.3	11.7	-2,6
Women aged 65 to 80			
living as a couple	3.2	4.3	1,2
and not in need of care*	2.7	3.6	0,9
Men aged 65 to 80			
living as a couple	3.9	4.3	0,5
and not in need of care*	3.3	3.7	0,4
Women aged 80 years and older			
living as a couple	0.3	1.7	1,4
and not in need of care*	0.1	0.8	0,7
Men aged 80 years and older			
living as a couple	0.6	2.4	1,9
and not in need of care*	0.3	1.5	1,1
Total potential and not in need of care*	56,4	49.8	-6.6

*) Including people in need of help with housework, not receiving benefits from LTC insurance.
Source: Estimation of DIW Berlin.

Table 4 shows the development of the number of potential care givers by age groups. It is assumed that, among people under age 40, only women are potential care givers. The number of women aged 20 to 40 is expected to decline by around five million. In the other age groups, women as well as men are potential care givers, although the share of care givers among women is much higher. The number of men and women aged 40 to 65 is expected to decline noticeably by 4.5 million in total.

Considering the labour market status of women, the results show that the number of active females is expected to fall by only 12% between 2006 and 2050, while the number of non-active women is expected to decline by more than 30%.

While the care giving potential in the younger and middle age groups is expected to decline, the potential number of care givers aged 65 and older is expected to grow substantially. The increasing life expectancy, the fact that more couples are growing old together and the ageing of the baby boomers will lead to an increase in the number of people aged 65 to 80 years through 2030, and thereafter to a growing number of people aged 80 and older. The number of women (excluding females who are themselves in need of care or help) aged 65 to 80 years living in partnerships will increase by one million by 2050, or by 35%. The number of men (excluding males who are themselves in need of care or help) aged 65 to 80 years living in partnerships will increase by 12%. The increase is even higher among the oldest old. The number of females living in partnerships is expected to increase by nearly 500% and the number of males living in partnerships by more than 300%.

3.4 Ratio of People in Need of Care to Potential Care Givers

In 2006, the proportion of care givers among all women aged 20 to 40 was 0.7%.[12] It was around 2.3% among active females aged 40 to 65 and around 7% among non-active women aged 40 to 65 (Table 5). The care giving rate among men aged 40 to 65 was 1.1% for active men and 3.8% for non-active men. As informal care givers among the elderly mainly live in partnerships, the care giving rates are calculated for people (excluding those people who are themselves in need of care or help) living with a partner.

In 2006, around 10% of women aged 65 to 80 living in partnerships were care givers and 58% of women aged 80 and older cared for somebody. The care giving rate of men aged 65 to 80 was 3.8% and was 4% for men aged 80 and older. These care giving ratios are calculated for persons who are the so-called "main" care givers or the persons who provide personal care or the greatest share of personal care and

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[12] Estimation by DIW based on information from Schneekloth et al. 2003.

help with practical duties. Schneekloth and Leven (2003) noted that, generally, more than one person provides help to people in need of care, but they only collected information about the characteristics of the main care giver. Therefore, the total number of care givers is higher than the number of main care givers, but it is not possible to quantify this part of the care giving potential.

Table 5: Ratio of people in need of care (care levels I-III) to potential care givers in 2006 and 2050

Potential care givers	2006	2050	2050/2006
	in %		Changes in %-points
Women aged 20 to 40			
Active	0.6	1.1	0.4
Non-active	1.2	2.1	0.8
Total	0.7	1.2	0.5
Men aged 40 to 65			
Active	1.1	1.9	0.8
Non-active	3.8	6.4	2.6
Total	1.5	2.5	0.9
Women aged 40 to 65			
Active	2.3	3.8	1.6
Non-active	7.0	11.9	4.8
Total	3.7	5.9	2.2
Women aged 65 to 80 living as a couple and not in need of care*	10.0	16.8	6.8
Men aged 65 to 80 living as a couple and not in need of care*	3.8	6.4	2.6
Women aged 80 years and older living as a couple and not in need of care*	58.2	98.3	40.0
Men aged 80 years and older living as a couple and not in need of care*	4.0	6.8	2.8
Total potential and not in need of care*	2.5	5.9	3.4

*) Including people in need of help with housework, not receiving benefits from LTC-insurance.
Source: Estimation of DIW Berlin.

Table 6: Ratio of people in need of care including care level 0 to potential care givers in 2006 and 2050

Potential care givers	2006	2050	2050/2006 Changes in %-points
	in %		
Women aged 20 to 40			
Active	2.5	3.9	1.4
Non-active	3.9	6.0	2.2
Total	2.8	4.2	1.5
Men aged 40 to 65			
Active	4.3	6.7	2.4
Non-active	9.3	14.7	5.4
Total	5.1	7.7	2.6
Women aged 40 to 65			
Active	9.3	14.4	5.1
Non-active	16.0	25.3	9.3
Total	11.3	17.2	5.8
Women aged 65 to 80 living as a couple and not in need of care*	30.3	47.4	17.1
Men aged 65 to 80 living as a couple and not in need of care*	14.7	22.8	8.1
Women aged 80 years and older living as a couple and not in need of care*	100.2	161.3	61.1
Men aged 80 years and older living as a couple and not in need of care*	12.7	19.8	7.1
Total potential and not in need of care*	7.9	15.8	7.9

*) Including people in need of help with housework, not receiving benefits from LTC-insurance.
Source: Estimation of DIW Berlin.

If the share of care givers in the population is subdivided by age groups and employment status and living arrangements are held constant, only 57% of people in need of care who live in their own home can be expected to receive informal care in 2050. This indicates that an increase in the share of informal care givers in each age group is required to provide care to all people in need of care at home. It is anticipated that the number of people with substantial dependency who will be cared for at home (care levels I to III) will be around three million in 2050. To meet this need, the share of care givers will have to double in all age groups, including among the elderly and oldest old living in partnerships. One extreme value estimates that the proportion of hypothetical care givers among women aged 80 and older living in partnerships will be as high as 98% (Table 5). That implies that almost every woman living with a partner who is not in need of care or help herself would have to provide care to her partner in 2050. While they may be able to provide some kind of care to their partners, these women will presumably need additional help from other family members or professional home care services.

The results in Table 5 show only the care required for people with substantial dependency or with care levels I to III. But to get a complete picture, the people in need of care with a lower degree of dependency (care level 0) also have to be taken into account. The proportion of informal care givers has to rise significantly to meet the required amount of care for all people in need of care at all four care levels. Around one-fourth of non-active women aged 40 to 65 and nearly half of the women aged 65 to 80 living in partnerships would have to provide care. Among the oldest old women who live with a partner this proportion will rise to 160% by 2050 (Table 6). The latter is calculated based on the assumption that care givers among the oldest old provide care to their partners. If the substantial growth in the number of men at the oldest old ages and the underlying constant prevalences of need for care is taken into account, the ratio of care giving female spouses shows a marked increase. This demonstrates that the ageing of people in need of care, along with the ageing of potential care givers, will entail the need for additional assistance from other persons, particularly professional home care services. Otherwise, the proportion of institutionalised people will rise.

4. Influence of Changing Health Status

The substantial pressure on informal care giving could be relieved if the health status of the population further improves. Studies from the US and Canada show that, in addition to other determinants, health status is related to educational attainment. People with higher educational levels are, on average, healthier and display healthier behaviours than people with low educational levels (Cutler/Lleras-Muney 2007). For Germany, a further increase in the proportion of people with tertiary education is expected (Schulz et al. 2008) and this could lead to a decrease in the share of people with care level 0. Life style is also an essential factor that influences health. A reduction in risk factors - by, for example, encouraging overweight people to adopt healthy diets and physical exercise, helping smokers to quit and bringing sports activities into everyday life - will positively affect the proportion of healthy elderly.

Medical-technological progress can have a powerful impact on the health status of the population and thus on the share of people in need of care. The main diagnoses resulting in the need for long-term care are diseases of the circulatory system, mental and behavioural disorders, diseases of the musculoskeletal system and connective tissue and neoplasm. Expected further developments in medicine and of new drugs, particularly treatments designed to prevent or postpone mental disorders, will likely lead to an increase in the proportion of healthy people. However, Bickel (1999) has asserted that the mental disorders of the elderly cannot be treated in the near future.

Table 7: Severely hampered persons in Germany and EU 15 in 2050

Health status	Germany	EU 1)
	in 1,000	
Living longer		
Good	203	2,968
Fair	1,385	11,182
Bad	9,112	25,760
Total	10,700	39,910
Cut down 2)	6,162	22,860
Living longer and in better health		
Good	243	3,209
Fair	1,528	11,644
Bad	6,818	19,352
Total	8,589	34,205
Cut down 2)	4,969	19,675

1) EU (15) without Luxembourg and Sweden; people aged 15+.-
2) Severely hampered persons who have to cut down on normal activities.
Sources: ECHP; projections by DIW Berlin.

In the study Ageing, Health and Retirement in Europe, which was conducted on behalf of the European Commission, the DIW analysed the connection between the health status of the population and the demand for health care and long-term care services by age groups in the original member states of the European Union (Schulz 2004). The demand for health care services and for long-term care giving was sub-divided by the health status of the population into single age groups. Based on ECHP (European Community Household Panel) data, the current situation was described and predictions about the health status of various populations by the year 2050 in four different scenarios were made (Schulz 2005). The scenarios differ in the assumption of the further increase in life expectancy (a more or less dynamic increase in life expectancy) and the development of the share of people in good, fair or bad/very bad health. Based on the population projection in the four scenarios, the demand for long-term care was calculated under constant health-specific prevalences of the "need for care" (severely hampered persons). In the baseline scenario, in which life expectancy increases but the health status of the population remains constant, the number of severely hampered persons rises by 60%. However, is a higher share of people in good health assumed, a much more moderate increase results. In the 'living longer and in better health scenario', the number of hampered persons increases 30% by 2050 in Germany. Thus, improvements in health could have a significant effect on the number of people in need of care.

Table 8: Ratio of people in need of care to potential care givers - assuming a 20% reduction in people in need of care due to improvements in health status

Potential care givers	2006	2050	2050/2006 Changes in %-points
	in %		
Women aged 20 to 40			
Active	2.5	3.0	0,5
Non-active	3.9	4.6	0,7
Total	2.8	3.2	0,5
Men aged 40 to 65			
Active	4.3	5.1	0,8
Non-active	9.3	11.2	1,8
Total	5.1	5.8	0,8
Women aged 40 to 65			
Active	9.3	11.0	1,7
Non-active	16.0	19.2	3,2
Total	11.3	13.1	1,7
Women aged 65 to 80			
living as a couple and not in need for care*	30.3	36.0	5,7
Men aged 65 to 80			
living as a couple and not in need for care*	14.7	17.4	2,7
Women aged 80 years and older			
living as a couple and not in need for care*	100.2	121.7	21,5
Men aged 80 years and older			
living as a couple and not in need of care*	12.7	15.1	2,4
Total potential and not in need of care*	7.9	12.5	4.6

*) Including people in need of help with housework, not receiving benefits from the LTC-insurance
Source: Estimation of DIW Berlin.

In addition, the analysis took into account the number of activities severely impaired persons were unable to perform due to their impairments. The effect of improvements in the health status of the population on this group of impaired persons was also impressive. The calculated reduction due to better health in the number of severely impaired persons accounted for 20% in Germany and 14% in the EU15 without Luxembourg and Sweden, compared to the baseline scenario (Table 7).

If we convey these results to our calculation, the development through 2050 will be less dramatic, but continues to represent a heavy burden for German society (Table 8). In total, around 12.5% of the relevant population would have to provide care in 2050.

5. Conclusion

The estimation shows that the number of people in need of care living at home will rise markedly through 2050, even if improvements in the health status of various populations can be realised. Among the people in need of care, the proportion of the oldest old will increase. The elderly will, in many cases, also suffer from mental illnesses. The oldest old will be in need of care to a greater degree than people at younger ages. Thus, the intensity of care giving will rise more sharply than the number of care recipients.

While the need for care will increase, the potential number of care givers under the age of 65 will decline. Low fertility rates and growing numbers of childless couples, as well as the rise in female labour force participation, will lead to a decline in the number of potential care givers in the middle age groups.

Although the potential number of care givers among the elderly is expected to rise, the amount of care that must be provided at home will grow faster than the potential number of elderly care givers. Care giving at home is a heavy burden for informal care givers, particularly for the elderly. In light of these anticipated developments, an expansion in assistance by professional care givers will be required. Informal care givers and people in need of care will have to become better informed about the availability of supportive technologies and services. They will need advice and guidance in some cases. Assistive technologies will play a larger role in the near future. But new technologies, such as tele care, have to be as simple and as user-friendly as possible. Care giving at home also means that homes may have to be adapted to meet the requirements of the elderly. Houses will have to become barrier-free and kitchens and bathrooms will have to be modified. Health and long-term care policies have to take into account the housing situations of the elderly, combining the need for both appropriate housing and care. Care giving packages, including assistive technologies and the expansion of provided care, will have to be considered by policy makers in the coming decades.

Appendix

Table A.1: Long-term care recipients at home by family status in 2003

			Family Status			
Age groups	Total		Never married	Married	Widowed	Divorced
	in 1000			in %		
			Men			
under 25	57	100	100.0	0.0	0.0	0.0
25 to 60	91	100	55.3	34.2	1.1	9.4
60 to 70	85	100	9.7	78.9	5.6	-
70 to 75	64	100	-	79.7	11.5	-
75 to 80	68	100	-	74.3	18.4	-
80 to 85	61	100	-	71.4	25.1	-
85 to 90	52	100	-	48.9	45.4	-
90 and older	34	100	-	38.1	60.6	-
Total	513	100	24.7	55.0	16.6	3.6
						Women
under 25	46	100	100.0	0,0	0,0	0,0
25 to 60	80	100	44.9	42.0	3.7	9.4
60 to 70	80	100	12.5	54.9	24.0	-
70 to 75	76	100	-	43.2	40.7	-
75 to 80	137	100	7.5	32.9	55.5	-
80 to 85	168	100	4.6	20.7	70.2	4.5
85 to 90	188	100	5.0	9.1	82.6	-
90 and older	147	100	-	5.0	87.4	-
Total	922	100	14.2	23.3	57.6	4.9

Sources: Micro-census 2003; calculations by DIW Berlin.

Table A.2: Long-term care recipients in institutions by family status in 2003

			Family Status			
Age groups	Total		Never married	Married	Widowed	Divorced
	in 1000		in %			
			Men			
under 25	-	100	-	0.0	0.0	0.0
25 to 60	15	100	81.2	-	-	-
60 to 70	24	100	41.3	-	-	30.8
70 to 80	32	100	26.4	29.3	36.1	-
80 to 90	37	100	-	31.5	54.1	-
90 and older	17	100	-	-	62.0	0.0
Total	126	100	28.9	22.1	37.8	11.2
			Women			
under 25	-	100	-	0.0	0.0	0.0
25 to 60	11	100	-	-	-	-
60 to 70	22	100	38.5	-	38.8	-
70 to 80	86	100	19.0	11.3	63.5	-
80 to 90	219	100	13.1	4.1	78.9	4.0
90 and older	130	100	12.4	-	82.1	-
Total	469	100	16.2	5.1	73.1	5.4

Sources: Micro-census 2003; calculations by DIW Berlin.

Table A.3: Population development by age groups

	Population in million					
	2006			2050		
Age groups	Total	Men	Women	Total	Men	Women
0 to 59	61.76	31.44	30.32	45.70	23.53	22.16
60 to 69	9.78	4.74	5.04	10.42	5.31	5.11
70 to 79	7.05	3.09	3.96	8.78	4.31	4.47
80 to 89	3.26	0.98	2.28	8.98	4.16	4.82
90 a.o.	0.55	0.12	0.43	2.77	1.18	1.59
Total	82.40	40.37	42.03	76.64	38.49	38.15

Source: Schulz et al. 2007, Variant 2b.

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Cohort Trends in Disability and Future Care Need in Germany

Rainer Unger

1. Introduction

There is ample evidence that the increase in total life expectancy does not necessarily lead to an increase in expected years of healthy life (e.g., see Hoffmann/Nachtmann, Chapter 9 in this proceedings). However, there is general agreement that the prevalence of severe disability has been decreasing, with a shift towards moderate disability (for a review see Christensen et al. 2009). Nevertheless, projections of future care need often neglect health improvements and apply constant prevalences of disability to demonstrate the effect of population ageing, or assume a hypothetical decrease that is not based on empirical evidence (Doblhammer/Ziegler. 2006, Rothgang/Vogler 1997, Rothgang 2002, Schulz et al. 2001).

The aim of this study is to project the future care need up to the year 2020 using cohort trends in the transition rates between health and disability, while incorporating empirical trends in disability into the projections. The study is based on the German Socio-Economic Panel (GSOEP), and seeks to provide answers to two questions. First, to what extent does the changing age distribution influence the future demand for care? Second, to what extent can improvements in disability levels compensate for the growing number of elderly reaching the age at which the need for care typically increases? The need for care is defined in terms of disability measured by severe functional limitations in the activities of daily living (ADL). First, increment-decrement life tables of disability are constructed for different cohorts. Second, age-specific prevalences of disability are calculated for each cohort based on the life tables. Finally, the cohort prevalences are transformed into period prevalences, which are applied to the future development of the population.

2. Data and Methods

This analysis is based on the GSOEP, an annual longitudinal household survey of the non-institutionalised population (for a detailed description of the GSOEP, see Doblhammer/Ziegler, Chapter 10 in this proceedings). This analysis is based on

Samples A to F, which generally cover a time span that is long enough to allow us to distinguish between age and cohort effects. Data on mortality were obtained from the deaths of the respondents between the waves. The deaths have been available as a generated variable since 1997. Fifty-five deaths were identified in 1992 in an additional study and in 2002 the vital status of all those who dropped out of contact between 1984 and 1998 (n=8048) were verified (Infratest 2002). Health status in the GSOEP used in this study is defined using information on the ability to perform activities of daily living (ADL). The exact wording of the question is as follows: “Apart from minor illnesses, does your health prevent you from completing everyday tasks, such as work around the house, employed work, studies, etc.? To what extent?” Respondents can rate the degree of their limitation as “not at all,” “a little” or “very much so.” This item was included in the survey from 1984 to 1987, in 1992 and from 1995 to 2001. To better analyse levels of severe disability, the categories “not at all” and “a little” were combined into the category “independent,” while the category “very much so” was classified as “dependent.”

Panel data permit longitudinal analysis of healthy life expectancy, while cross-sectional data are limited to the prevalence approach of the Sullivan (1971) model. The increment-decrement or multistate model incorporates transitions from the “independent” to the “dependent” state, and vice versa. Thus the increment-decrement life table allows for a more precise analysis of the disability process, facilitating, for example, the exploration of the question of whether a compression of morbidity is due to a decrease in the onset of illness or to faster recovery from illness. In contrast to the prevalence model, it also includes mortality rates by health status. The calculations in this study are based on the increment-decrement or multistate life table, which is well documented (Land et al. 1994, Rogers 1995, Schoen 1975) and which is commonly applied to synthetic cohorts obtained from two waves of panel data (Crimmins et al. 1994, 1996, Guralnik et al. 1993, Land et al. 1994, Liu et al. 1995, Manton et al. 1993, Rogers et al. 1989, Tsuji et al. 1995). Estimating the mortality rates and the incidence and recovery rates is the first step in this analysis. Multivariate hazard models with an exponential baseline hazard are used to obtain the one-year transition rates, which are in turn used to calculate the multistate life tables.[1] The hazard models are estimated using the maximum likelihood method. The estimations were restricted to women and to ages of 40 and above because the numbers of deaths at younger ages in the GSOEP are too small for meaningful analysis.[2] The model is based on age and year of birth in single years:

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[1] The multistate life tables are estimated by first transforming the transition rates into a matrix of transition probabilities from which all other life table functions are derived.

[2] Unlike the female population, parts of the male population were “negatively” selected by the two World Wars (Unger 2006).

$$r_{ij}(age) = a_{ij}\ \exp(\beta_{ij} age)\exp(\gamma_{1ij} cohort + \gamma_{2ij} cohort^2)$$

where r_{ij} is the transition rate from state i (e.g., dependent or independent) to state j (e.g., dependent, independent or death). To model future trends in disability, for the younger cohorts these rates are extrapolated up to the age they will reach in the year 2020. For the older cohorts, the rates are extrapolated backwards to age 60. For example, the 1900 cohort is covered by the GSOEP (1984 to 2001) between ages 84 and 101 and will be extinct in 2020. The transition rates are extrapolated backwards to the age range 60 to 83. The 1920 cohort is covered between ages 64 and 81 and will reach age 100 in 2020. Transition rates are extrapolated to ages 82 to 90 and to ages 60 to 63. The 1940 cohort is observed between ages 44 and 61 and will reach age 80 in 2020; thus the rates are extrapolated to the age range 62 to 90. The second step is the construction of the increment-decrement life tables by applying the age-specific transition rates to the cohorts of 1900 to 1960. This results in age-specific prevalences for the years 2000 to 2020. In a last step, age-specific cohort prevalences are transformed into period prevalences, which then are applied to population projections.

3. Results

Table 1 shows the antilogs of the estimated regression coefficients for the effect of age β and birth cohort γ. The effect of age indicates that one additional year of age increases the relative likelihood of death by 10.9% for the independent population and by 7.7% for the dependent population. The corresponding antilog coefficient for the birth cohorts indicates a reduction in the likelihood of death of 9.4% for the independent population. In addition, there is a curvi-linear effect, with the greatest reduction occurring among older cohorts and lower reductions taking place among younger cohorts. The rate of transition from the independent to the dependent state increases by 0.9 % with one additional year of age. The rates also decline by 3.1% among younger cohorts. While rates of recovery from limitations in the activities of daily living decline with increasing age and are lower for the younger cohorts, the differences are small and the effects on the multistate life tables are marginal, as has been already noted by Crimmins et al. (1994).

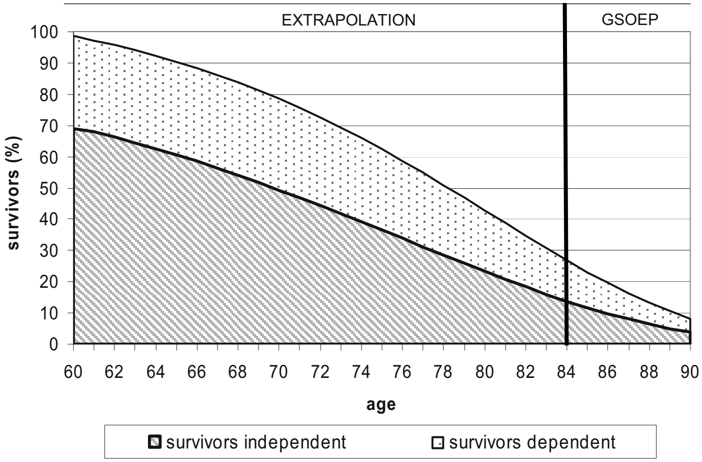
The second step in the analysis is to construct increment-decrement life tables for the cohorts born between 1900 and 1960 by applying the age- and cohort-specific transition probabilities. The survivor functions of the life table population in each of the two health states are shown in 10-year intervals in Figures 1a to 1f. Overall, the picture supports the view that elderly women are not only living longer, they are also remaining independent for longer periods: almost 62% of the 1900 cohort are estimated to have no severe disability above age 60, but this proportion rises to 68% of the 1910 cohort, 74% of the 1920 cohort and 78% of the 1930 cohort.

Table 1: Antilogs of estimated regression coefficients for females aged 40+ based on the GSOEP 1984 to 2001

	Mortality risk of the dependent population	Mortality risk of the independent population	Transition from independent to dependent state	Transition from dependent to independent state
Exp(Constant)	-9.593***	-8.024***	-1.386***	0.903**
Age	1.109***	1.077***	1.009**	0.975***
Cohort	0.906***	0.997	0.969***	0.992**
Cohort2	1.001***			
Person-years	32,760	5,866	25,968	4,835
Events	203	330	1,935	1,672
Log-likelihood	-1,050.765	-1,151.994	-6,822.403	-3,401.988

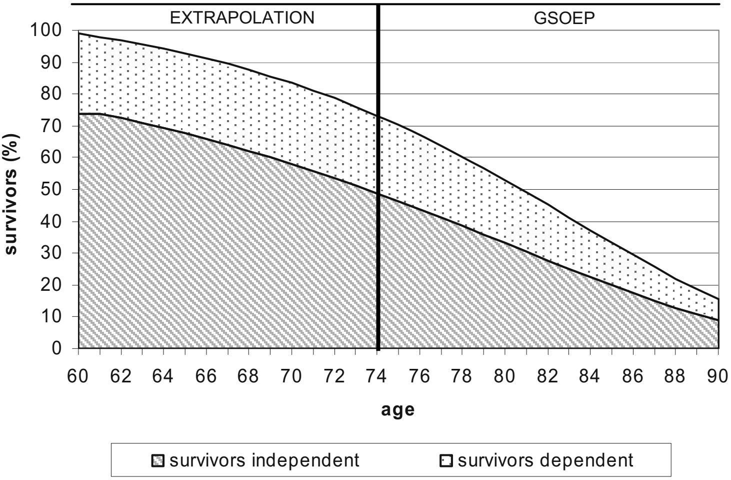
Source: GSOEP (1984 to 2001).
***P < 0.1%, ** P < 1%, *P < 5%.

Figure 1a: Survivors of the cohort 1900



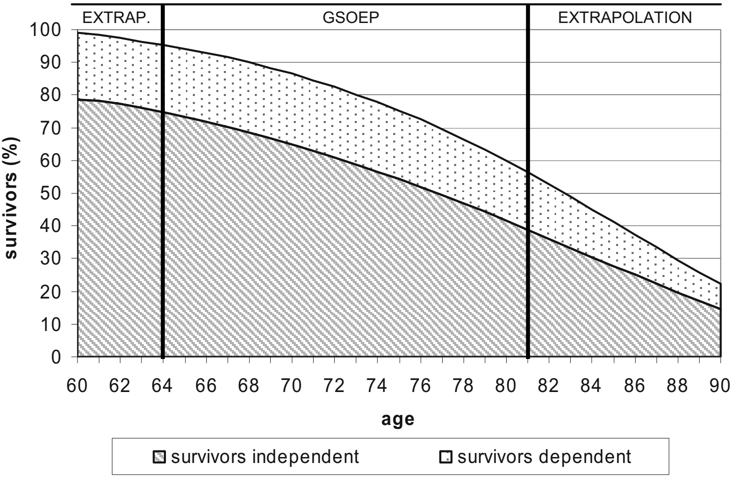
Source: GSOEP (1984 to 2001), own calculations.

Figure 1b: Survivors of the cohort 1910



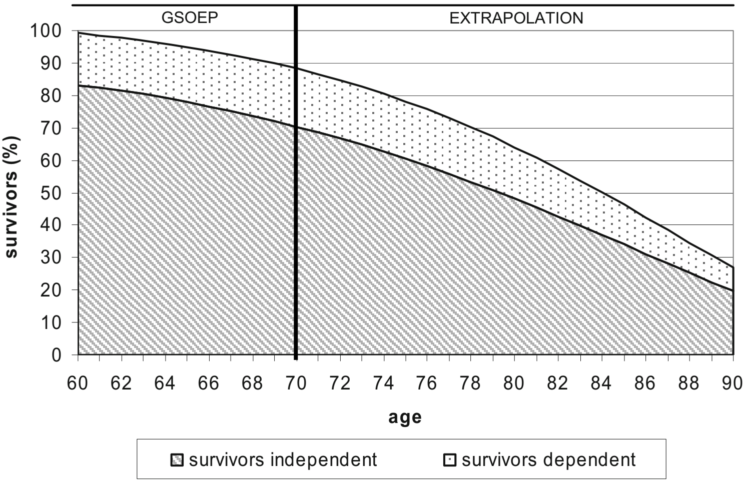
Source: GSOEP (1984 to 2001).

Figure 1c: Survivors of the cohort 1920



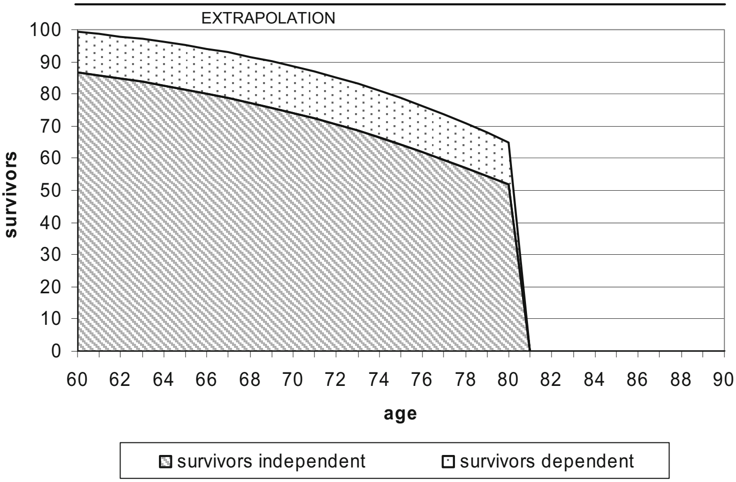
Source: GSOEP (1984 to 2001).

Figure 1d: Survivors of the cohort 1930



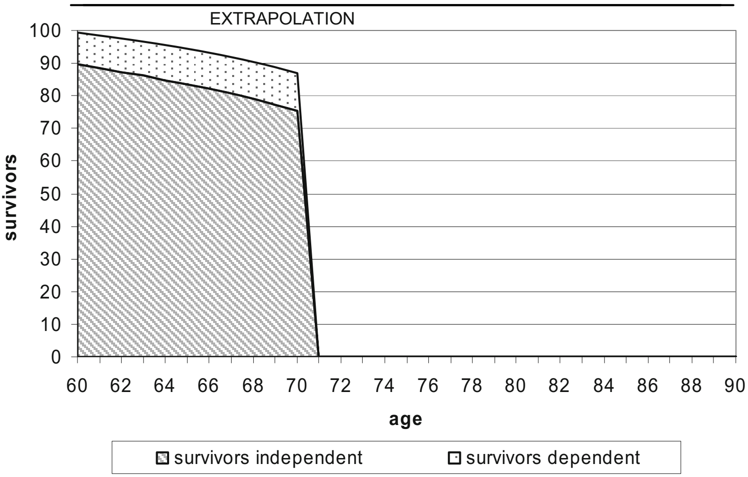
Source: GSOEP (1984 to 2001).

Figure 1e: Survivors of the cohort 1940



Source: GSOEP (1984 to 2001).

Figure 1f: Survivors of the cohort 1950

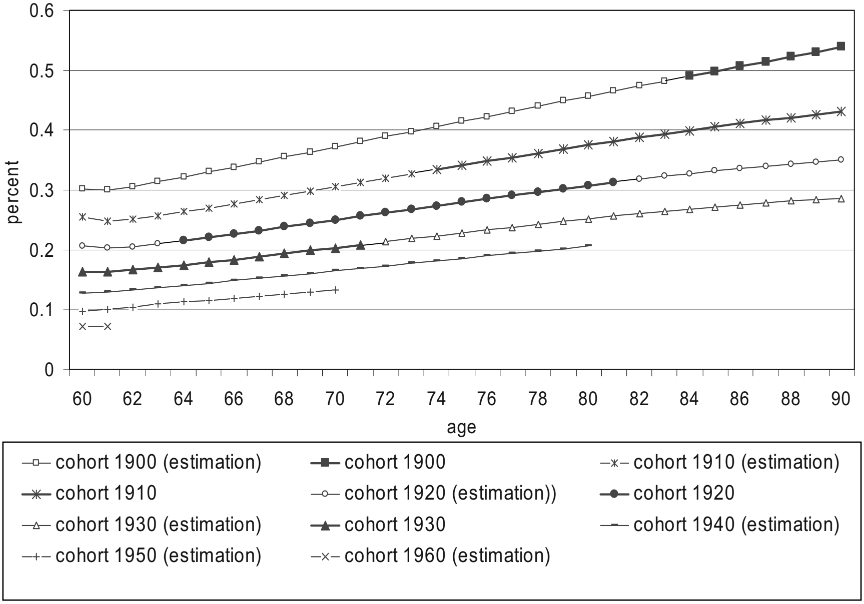


Source: GSOEP (1984 to 2001).

In Figures 1e and 1f, the survivors are calculated up to the age of 80 and 70 because the extrapolation is limited up to the year 2020. The figures show that these health improvements are accompanied by an increase in life expectancy (the survivor functions are shifting towards the right corner of the figures) and an increase in disability-free life expectancy (the survivor functions of the independent population are shifting faster towards the right corners). These results tend to confirm the "compression of morbidity" hypothesis, which states that the recent declines in mortality have been associated with improvements in severe disability.

Figure 2 shows the age-specific prevalences of disability for the different cohorts derived from the increment-decrement life tables and again illustrates the decreasing prevalences for the cohorts of 1900 to 1960. Since the aim of the study is to model the future care need for the years up to 2020, the cohort prevalences are transformed into period prevalences. For example, the prevalence of the 1910 cohort at age 90, the prevalence of the 1920 cohort at age 80, etc., give the period prevalences of the specific ages in the year 2000. Due to the extrapolation, period prevalences can be calculated up to the year 2020 (the grey unmarked line).

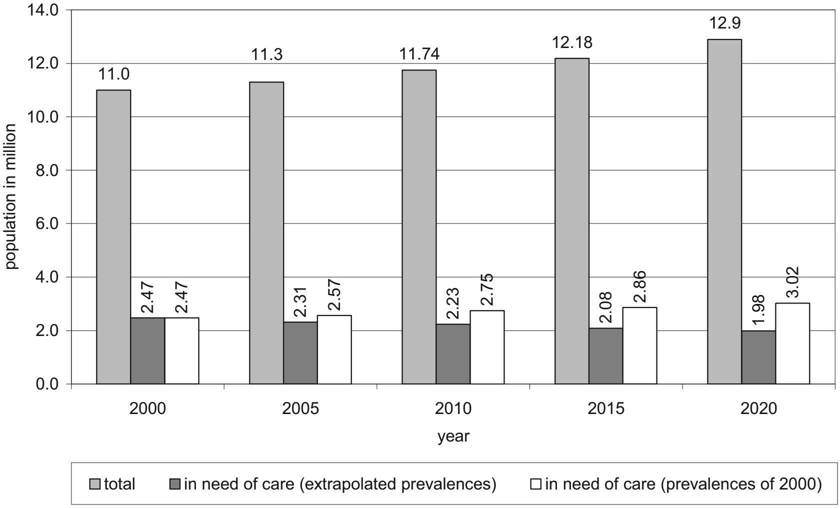
Figure 2: Prevalences of disability for the cohorts of 1900 to 1960 and the periods 2000 and 2020



Source: GSOEP (1984 to 2001), own calculations.

In a last step, the period prevalences are applied to the development of the population (Figure 3) using the variant 1-W1 of the 11th coordinated population projection of the Federal Statistical Office (Federal Statistical Office 2006). Overall, the female population between the ages of 60 and 90 rises from 11 million in 2000 to 12.9 million in 2020. To explore the effect of the ageing of the population on the future care need, the age-specific period prevalences of the year 2000 are used. This results in an increase in the number of women in need of care from 2.47 million in 2000 to 3.02 million in 2020. This increase of 22% is solely due to the changing age structure. In contrast, applying the extrapolated prevalences between 2000 and 2020 to the population development results in a decrease in the need for care from 2.47 million in 2000 to 1.98 million in 2020.

Figure 3: Number of females in need of care aged 60 to 90 using constant disability prevalences of the year 2000 and extrapolated cohort prevalences



5. Discussion

The aim of the study is to answer the following questions: to what extent is the increase in the need for care due to the changing age distribution up to the year 2020 and to what extent can health improvements at older ages compensate for the increasing number of elderly women? The answer to the second question is surprising: if past trends in the transition rates between the independent and dependent state are extrapolated on a cohort basis, then a decrease in the number of women in need of care may be anticipated.

Since the finding that the number of elderly in need of care will decrease in the future is contrary to all other projections presented in this book, several points need to be considered.

The time frame of this projection is up to the year 2020. In this period, only a moderate increase in the number of people aged 60 and above will occur, from 20.5 million in 2005 to 24.5 million in 2020 (Federal Statistical Office 2006, variant 1-W1). The bulk of the increase in the number of elderly will be after 2020, as the baby boomers age. Thus, the effect of population ageing on the number of people in need of care will increase considerably after 2020 and health improvements may compensate less for the changing age distribution than in this analysis.

This study is based on the estimation of age-specific transition rates between the dependent and the independent state in a proportional hazard framework, in which the baseline hazard is shifted upwards or downwards for specific cohorts. However, a proportional hazard framework may prove to be inadequate. For example, mortality over the course of the 20th century did not decrease at the same rate among all age groups. At the beginning of the 20th century, mortality declined primarily at younger ages, while at the end of the century, improvements occurred primarily at older ages. The proportionality assumption may thus distort the estimation of the trend. It is also important to note that the cohorts are observed over different age ranges and that none of the cohorts is observed over the full age range. These gaps and inconsistencies could also introduce a bias in the estimation of the trend. To compensate for these problems at least in part, squared effects of the birth year are introduced into the model (when found) to account for the decrease in the health improvements among the younger cohorts.

In the present study, care need is defined using a subjective measure of severe disability. Generally, studies using similar measures show a positive trend in disability (Crimmins et al. 1997, Unger 2003, 2006, Cambois/Robine 1996, Robine et al. 2003). However, a study by Ziegler and Doblhammer (2008) found a lower risk of transition into care need between 1986 and 2005 for each successive cohort when severe and moderate care need are considered and that no change occurred when only severe care need is measured. Moreover, studies based on data from the German long-term care insurance did not find an improvement between 1999 and 2005 (Rothgang et al. 2008, Hoffmann/Nachtmann, Chapter 9 in this proceedings).

A limitation of this study is that only private households are included in the GSOEP. People who have been institutionalised are solely covered by the follow-up concept, which means that residential mobility is included irrespective of whether an individual is moving into an existing or new household, or is institutionalised. The institutionalised population, who are usually in worse health, are thereby undersampled. For this reason, the calculated health improvements may be overestimated.

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Projections of the Number of People with Dementia in Germany 2002 Through 2047

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1. Introduction

Mental and behavioral disorders represent four of the 10 leading causes of disability worldwide, and are estimated to account for 12% of the global burden of disease (World Health Organization, 2001). European and Northern American studies show that about one-quarter of the population over age 65 suffer from a mental health problem. About 6% to 10% of these illnesses involve severe dementia and severe functional psychoses (Bickel 2003, Hendrie 1998). The number of dementia sufferers at the beginning of the 21st century is estimated to be about 25 million people worldwide, with 46% of them living in Asia, 30% in Europe and 12% in North America (Wimo et al. 2003). A lower number is provided by Eurostat (2003), which estimates that 4,624 million Europeans (EU25) between the ages of 30 and 99 suffered from different types of dementia (12.3 per 1000 inhabitants) in 2000. Due to their higher mean age, more women are affected: 2.9 million women, but only 1.7 million men suffer from dementia. By 2006, the number of dementia sufferers provided by the group known as European Community Concerted Action on the Epidemiology and Prevention of Dementia (EURODEM) (Alzheimer Europe 2006) had risen to 5.37 million people. In industrialized countries, dementia is the fourth most common cause of death after heart diseases, malignant growth and cerebrovascular diseases (Bickel 2003).

It is very difficult to quantify dementia because different definitions and measurement methodologies lead to diverging results. The first problem is that the term dementia is used to describe different kinds of diseases. The most frequent form today is Alzheimer's disease (AD), a neurodegenerative disorder which slowly and progressively destroys brain cells. The disease accounts for about 50%-75% of all dementias (Bickel 2005, Breteler et al. 1992, European Community 2005, Eurostat 2003, Weyerer 2005). Vascular dementia (VaD) is the second most common form of dementia, and accounts for about one-quarter of all cases (European Community 2005, Weyerer 2005, Skoog 2004). Second, it is difficult to differentiate the disease in its early stages from the normal cognitive changes that occur at older ages (Fratiglioni/Rocca 2001, Schaie 2004). Over time, a growing awareness might have influenced the number of affected cases because the disease is diagnosed earlier and more often. Cross-cultural differences and within-culture changes over time also make it more difficult to achieve a consistent understanding of the disease. Recently, more attention has been paid to the subject of dementia, as can be seen in the increasing number of journals, programs and initiatives dealing with the topic; as well as in the growing number of studies analyzing the epidemiology of dementia, the prevalence and incidence of dementing illnesses and the risk factors of the disease (Fratiglioni et al. 1999, Larson et al. 1992). Definitions from the Diagnostic & Statistical Manual of the American Psychiatric Association (DSM) and the International Classification of Diseases and Related Health Problems (ICD) are among the most widely accepted formal definitions of dementia today (American Psychiatric Association 1987, 1994, World Health Organization 2006). While definitions vary, they all describe dementia as a change in the brain which leads to memory impairment and a change in personality. The disease hampers the daily living of the sufferer. This indicator also differentiates dementia from normal aging: age-related decline does not usually cause significant impairment of function, it is slower and it can be compensated for by the elderly person (Larson et al. 1992). By contrast, dementia usually worsens quickly. The affected persons may, for example, exhibit changes in cognitive perception, emotional control, social behavior and personality; and they may also suffer from depression, sleep disorders, anxiety, hallucinations, aggressive impulses and constraints on daily living. The gradually deteriorating health of the sufferer leads to complete dependence and the initial need for occasional help turns into a need for full-time care. People with dementia have a higher institutionalization rate and are at higher risk of having other health problems, such as hip fracture, urinary incontinence and high blood pressure (Skoog 2004). Dementia is also associated with a higher mortality rate (Bickel 2005, Dewey/Saz 2001, Kliegel et al. 2004, Kokmen et al. 1996, Wilson et al. 2003). The average amount of time sufferers live with the disease from the onset until death is an estimated 4.7 to 8.1 years for AD and about one year less for VaD (Weyerer 2005).

As the population ages, concerns about a dramatic increase in the number of people suffering from dementia are also growing. The development of morbidity against the background of rising mortality has been discussed in the 'expansion' (Gruenberg 1977, Olshansky 1991) and 'compression of morbidity' theories (Fries 1980). Manton (1982) proposed a third, intermediary 'dynamic equilibrium' scenario. He assumes that the increase in life expectancy will be associated with a parallel increase in the proportion of healthy and unhealthy years. However, there will be a shift from severe to moderate disability. So far, no consistent pattern for the development of the need for care and of disability has been demonstrated, either across countries or over time. A recent review of trends in diseases and disability rates show mixed results, which, however, generally support the theory of 'dynamic equilibrium' (Christensen et al. 2009). Despite the finding that the prevalence of some chronic diseases has increased over time, it seems that people under age 85 experience a postponement of limitations and disabilities. For people above age 85, there are fewer studies with contradictory results, but there is evidence of a leveling off in disability levels for the oldest old on a cohort basis. An increase in the use of assistive living technologies and a changing social perception of disability might support a more positive view of self-rated health.

In this article, we use prevalences of dementia for Germany for the year 2002 using data from the German sickness funds (Ziegler/Doblhammer 2009). We use the information to forecast the number of people who will be suffering from dementia through the year 2047. This is done in two steps. First, the total population is projected through 2047 with different scenarios. In a second step, the resulting numbers are multiplied by constant and dynamic prevalences. The 'dynamic equilibrium scenario' is taken as an underlying assumption for the dynamic prevalences. Comparing the life expectancy with and without dementia in 2002 and 2047, we seek to demonstrate how the prevalence had to decrease in order to maintain a dynamic equilibrium of dementia-free life expectancy in 2047.

2. Dementia in Germany Today

2.1 Prevalence of Dementia

The prevalence of dementia shows the proportion of affected people within the total population. Age is the most important factor for the prevalence of dementia. Before age 65, dementia is a negligible problem, and only a few individuals have this pre-senile form of dementia. After age 60 or 65 most studies report a rapid increase in the number of affected people. Many studies find, irrespective of the methodology, that the prevalence of dementia doubles every five to six years after age 60 (Jorm et al. 1987, Jorm/Jolley 1998).

However, large studies of dementia prevalence throughout the total population are rare and the results of individual studies vary. There is, however, one German study that calculated prevalences for the total country based on a large representative sample from the German sickness funds (Ziegler/Doblhammer 2009). Meta-analyses overcome the problem of small study populations and erratic rates and pool data from several studies. In the oldest review, Jorm et al. (1987) pool data from 27 of the earliest prevalence studies and average the results using an exponential model. The individual studies still vary greatly in their methods and approaches to sampling. Later meta-studies often specify a consistent scale as an inclusion factor. For example, Hofman et al. (1991) pool data from 12 European studies conducted between 1980 and 1990, which included the institutionalized population and used DSM-III or equivalent criteria. Other meta-analyses were conducted by Ritchie et al. (1992) (pooled data on 13 studies since 1980), Ritchie/Kildea (1995) (nine papers in which community and institutionalized population are included and only DSM-III diagnostic criteria are used are included), Fratiglioni et al. (1999) (35 prevalence studies), Lopes/Bottino (2002) (38 studies between 1994 and 2000) and Lobo et al. (2000) (pooled data from 11 European studies). A meta-meta-analysis was done by Bickel (2000, 2002). He pooled the data from the meta-analyses and calculated the average prevalence. In addition, two regional results from Germany were included in the 2002 article (Bickel 2002) by Bickel (1996) and Riedel-Heller et al. (2001). The results for all studies with pooled prevalences have been quite similar. The prevalence has been found to rise steeply with age, from about 1% for people aged 60-64 to about 35% to 55% for people over age 95.

Recently, many studies have examined the question of whether a compression or an expansion of cognitive problems and life with dementia has occurred. Most studies have not found changes in the prevalence or incidence of dementia (Jagger et al. 2007, Lafortune et al. 2007), Manton et al. (2005) reported a decline in dementia prevalence for the U.S., while Lafortune et al. (2007) found increases in Japan and Sweden. Studies of cognitive problems have also produced varying results: no change (Engberg et al. 2008), a compression (Langa et al 2008, Freedman et al. 2002), or an increase in cognitive impairment (Meinow et al. 2006). Although some studies have shown a positive trend after taking all results into account, there is no clear evidence of a consistent trend. However, because of the large amount of research on dementia that is being conducted, studies often end with an optimistic outlook on the chances of reducing dementia prevalence. Further medical advances could help to delay the onset of the disease (Lafortune et al. 2007), as could as improvements in the treatment of cerebrovascular risk factors (Jagger et al. 2007) and of hypertension (Forette et al. 1998) and increased educational levels among younger cohorts (Manton et al. 2005).

2.2 Projections of Numbers of People with Dementia in Germany

Projections of the number of people likely to develop dementia are rare in Germany. Table 1 shows the existing studies conducted from 2000 onwards. Bickel (2001) estimated that the number of people with dementia will increase from about 0.93 million in 1996 to 2.05 million people in 2050. He used population projections from the ninth coordinated population projection from the Statistical Office (Statistisches Bundesamt 2000), and assumed constant prevalences. They are a mean of age-specific prevalences of several studies (Bickel 2000). Bickel (2006) used his prevalences from 2000 (Bickel 2000) and the population projection from the 10th coordinated population projection from the German Statistical Office (Statistisches Bundesamt 2003) with the medium increase in the life expectancy variant. Bickel

(2008) used prevalences from 2000 (Bickel 2000) and population projections from the 11th coordinated projection from the German Statistical Office, a variant (V1, W2) with 'basic' life expectancy and high migration assumptions. This is surprising because life expectancy is always corrected to higher values in subsequent population projections, as has been shown above, and because migration has been rather low in Germany in recent years. Hallauer and Kurz (2002) used the mean prevalences of several studies by Bickel (2002) that included two more studies than were used in calculating the 2000 mean prevalence (Bickel 2000), which in turn led to only very slight differences. Two different population projections were applied: the ninth projection from the German Statistical Office and projections from Birg and Flöthmann (2000) with a higher increase in life expectancy. Although Hallauer and Kurz (2002) and Bickel (2001) both used nearly the same prevalence and the ninth population projection, Hallauer and Kurz (2002) projected much higher numbers of people with dementia. He used variant 2a, in which higher life expectancy and levels of migration are assumed than in the medium variant used by Bickel (2001). In a second projection, Hallauer and Kurz (2002) used population projections from Birg and Flöthmann (2000), who assumed an even higher life expectancy than the high variant of the Statistical Office, and therefore found that the number of people who will suffer from dementia in 2050 increases when constant dementia prevalences are applied. Priester (2004) used constant mean prevalences from several studies by Bickel (1999) and the 10th population projection from the Statistical Office. They predicted a rise in the number of people with dementia from 0.99 million in 2002 to about 2.36 million in 2050. However, since the prevalences projected by Bickel (1999) only measure moderate and severe dementia, Priester (2004) estimated that the total number of dementia sufferers, including those with early dementia, could reach five million by 2050. An older projection was made by Kern and Beske (2000). They projected constant prevalences from the fourth family report from the Ministry of Family, Senior Citizens, Women and Youth using the eighth population projection from the Statistical Office. Nonetheless, the projected numbers were quite high, rising from 1.3 million in 1997 to 2.2 million in 2030. While the population projection underestimated the aging effect, the numbers from the fourth family report from 1986, which were taken as dementia prevalences, actually included 'psychiatric illnesses' in general and thus overestimated the prevalence.

Even though all of these studies were based on prevalences and assumed no change over time, and most of the studies were based on prevalences calculated by Bickel (2000, 2002), they reported quite different results. This demonstrates that the outcome of dementia projections depends largely on the underlying population projections.

Table 1: Dementia projections for Germany

	2000	2020	2030	2040	2050
Kern/Beske 2000	1.3**	1.98	2.21		
Bickel 2001	0.93*	1.39	1.56	1.81	2.05
Bickel 2006	0.94	1.41	1.69	1.92	2.29
Bickel 2008	0.94	1.55	1.82	2.20	2.62
Hallauer/Kurz 2002[1]	1.13		1.95		2.8
Hallauer Kurz 2002[2]	1.13			3.0	3.5
Priester 2004	0.99***	1.5	1.74	2.03	2.36

*1996, **1997, ***2002.

1 Prevalence from Bickel (2002), Population from 9th Projection, Statistical Office.

2 Prevalence from Bickel (2002), Population from Birg/Flöthmann (2000).

3. Data and Projection Method

A detailed description of the data (Lugert 2007) used in the analysis of dementia prevalence can be found in Ziegler and Doblhammer (2009). Diagnoses in the data were encoded according to the International Classification of Diseases and Related Health Problems (ICD), 10th Revision (World Health Organization 2006). Dementia was measured when one of the following diagnoses was made:

- F00 Dementia in Alzheimer's disease
- F01 Vascular dementia
- F02 Dementia in other diseases classified elsewhere
- F03 Unspecified dementia
- G30 Alzheimer's disease

The projection was done in two steps. First, the total population was projected using the Population-Development-Environment (PDE) program, which was developed at the International Institute for Applied Systems Analysis IIASA in Laxenburg, Austria (Dippolt et al. 1998). The population was projected using five-year age groups up to age 94; the last age group is 95+. Base-year is 2002. Different scenarios with different life expectancies in 2050 were calculated. Scenario 1 was done with constant mortality rates and constant dementia prevalences to show the pure age-structure effect. Scenario 2 projected an increase in life expectancy to 82.61 years for males and 87.51 for females. Scenario 3 projected increases of 84.30 years for men and 89.08 for women. In scenario 4, life expectancy was projected to be 87.90 for men and 92.52 for women. Scenarios 2 and 3 were roughly the same as the increases in life expectancy of the 'basic' and 'high' variants from the 11th coordinated population projection of the German Statistical Office (Statistisches Bundesamt 2006), while scenario 4 had higher life expectancy assumptions.

In a second step, the population projection results were multiplied with the dementia prevalence. Each scenario was multiplied using two prevalences: constant prevalence and prevalence, which resemble the dynamic equilibrium in life expectancy with and without dementia. Thus, seven different scenarios were obtained:

1. Scenario 1 constant mortality and constant prevalence
2. Scenario 2.1 low increase in life expectancy and constant prevalence
3. Scenario 2.2 low increase in life expectancy and dynamic prevalence
4. Scenario 3.1 medium increase in life expectancy and constant prevalence
5. Scenario 3.2 medium increase in life expectancy and dynamic prevalence
6. Scenario 4.1 high increase in life expectancy and constant prevalence
7. Scenario 4.2 high increase in life expectancy and dynamic prevalence

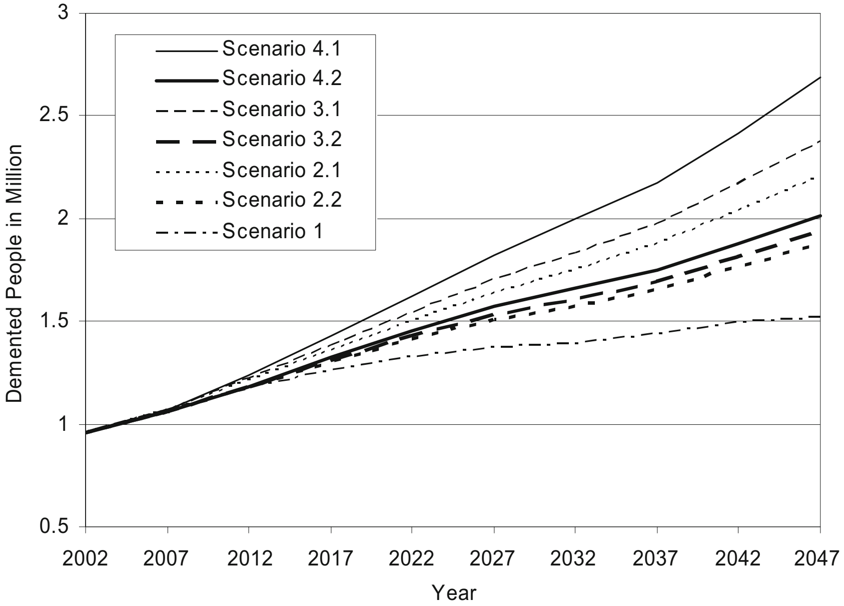
Dementia-free life expectancy was calculated using the Sullivan-Method (Sullivan 1971), in which age-specific prevalences are combined with a life table. For each scenario 2, 3 and 4, two types of assumptions were made. First, constant prevalences were applied to see how the number of people with dementia would increase without changes in the prevalence of dementia (scenarios 2.1, 3.1 and 4.1). Second, for each scenario 2.2, 3.2 and 4.2, we calculated how the prevalence had to decline in order to gain a dynamic equilibrium in healthy-life years (Manton 1982) at ages 80-84, which means that, as in 2002, an equal proportion of years are spent with and without dementia. To obtain a dynamic equilibrium in the different scenarios, the age-specific prevalences need to change at different rates depending on the assumed increase in life expectancy. Ages 80-84 were chosen here to demonstrate the effect of the dynamic equilibrium, because most people with dementia are aged 80+, and prevalences rise steeply beyond those ages. Generally can be said, the younger the age for the dynamic equilibrium that was chosen, the more the prevalence at each age above had to decrease. For example, the prevalence at age 80 had to decrease to a much greater extent to obtain an equilibrium at age 60 than at age 80.

4. Results

4.1 Projection of the Number of People with Dementia

When constant dementia prevalences are assumed, only the projected total number of elderly people influences the change in the number of people with dementia. Even with constant mortality, the number of demented people above age 60 would increase from 0.96 million people in 2002 to 1.52 million simply because of the changing age structure (see Figure 1, scenario 1). With higher life expectancy, the increase is much greater: constant dementia prevalence and increases in life expectancy to 87.9 years for males and 92.5 years for females would lead to 2.7 million demented people in 2047. If a dynamic equilibrium in dementia-free life expectancy could be achieved at ages 80-84, the increase in the number of demented people would be less steep, but would still roughly double (scenario 4.2). The results are displayed in Figure 1 and Table 2.

Figure 1: Projected number of people with dementia according to different scenarios, Germany 2002 to 2047



Assumptions about life expectancy in 2047:
Scenario 1: Males 75.9, Females 81.5.
Scenario 2: Males 82.6, Females 87.5.
Scenario 3: Males 84.3, Females 89.1.
Scenario 4: Males 87.9, Females 92.5.

Table 2: Total number of people above age 60 and number of people with dementia in 2002 and 2047, according to different life expectancy and dementia prevalence assumptions (in Mio.)

	2002		2047					
			Low LE		Medium LE		High LE	
e_o in 2002*	75.9	81.5	82.6	87.5	84.3	89.1	87.9	92.5
				Total Poulation				
Age	Males	Females	Males	Females	Males	Females	Males	Females
60-64	2.848	2.958	2.149	2.148	2.170	2.159	2.206	2.176
65-69	2.073	2.305	2.066	2.164	2.098	2.180	2.152	2.208
70-74	1.584	2.021	1.894	2.056	1.940	2.081	2.021	2.123
75-79	0.983	1.855	2.234	2.544	2.320	2.596	2.475	2.686
80-84	0.499	1.190	2.010	2.472	2.134	2.560	2.364	2.717
85-89	0.228	0.696	1.221	1.699	1.347	1.812	1.592	2.020
90-94	0.083	0.329	0.552	0.906	0.650	1.018	0.857	1.240
95+	0.013	0.070	0.152	0.258	0.176	0.287	0.229	0.346
60+	8.310	11.424	12.278	14.248	12.835	14.692	13.896	15.518
Total 60+	19.73		26.53		27.53		29.41	
				Demented Population - Constant Dementia Rates				
60-64	0.024	0.019	0.018	0.014	0.018	0.014	0.019	0.014
65-69	0.032	0.030	0.032	0.029	0.032	0.029	0.033	0.029
70-74	0.050	0.062	0.060	0.063	0.061	0.064	0.064	0.065
75-79	0.055	0.127	0.125	0.174	0.130	0.178	0.138	0.184
80-84	0.052	0.152	0.208	0.315	0.221	0.327	0.245	0.347
85-89	0.041	0.161	0.219	0.392	0.241	0.418	0.285	0.466
90-94	0.020	0.103	0.134	0.284	0.157	0.319	0.207	0.389
95+	0.004	0.027	0.045	0.099	0.052	0.111	0.068	0.133
60+	0.277	0.681	0.840	1.370	0.913	1.458	1.059	1.627
Total 60+	0.96		2.21		2.37		2.69	
				Demented Population - Dynamic Equilibrium				
60-64			0.015	0.012	0.015	0.011	0.014	0.011
65-69			0.027	0.024	0.026	0.023	0.025	0.022
70-74			0.051	0.053	0.050	0.052	0.048	0.049
75-79			0.106	0.148	0.106	0.145	0.104	0.138
80-84			0.176	0.268	0.180	0.266	0.183	0.260
85-89			0.185	0.333	0.196	0.340	0.214	0.350
90-94			0.113	0.241	0.128	0.260	0.156	0.291
95+			0.038	0.084	0.043	0.090	0.051	0.100
60+			0.713	1.163	0.743	1.187	0.794	1.220
Total 60+			1.88		1.93		2.01	

* e_0: life expectancy at birth in 2047 (in years).

Table 3: Remaining life expectancy with and without dementia for males and females at ages 80-84 in 2002 and in 2047 according to the different life expectancy and dementia prevalence assumptions

		2002		2047					
				Low LE (Scenario 2)		Medium LE (Scenario 3)		High LE (Scenario 4)	
		LE	CI (95%)	LE	CI (95%)	LE	CI (95%)	LE	CI (95%)
				Males					
Constant	LE (Total)	7.03		10.65		11.70		14.18	
Dementia	LE(Not Dem.)	6.01	[5.95-6.07]	8.82	[8.76-8.88]	9.61	[9.55-9.67]	11.44	[11.38-11.50]
Rates	LE(Demented)	1.02	[0.96-1.08]	1.83	[1.77-1.89]	2.09	[2.03-2.15]	2.74	[2.68-2.80]
	Ratio (in %)	14.5	[14.37-14.61]	17.2	[17.09-17.28]	17.9	[17.78-17.97]	19.3	[19.22-19.38]
Dynamic	LE (Total)	7.03		10.65		11.70		14.18	
Equilibrium	LE(Not Dem.)	6.01	[5.95-6.07]	9.09	[9.03-9.15]	9.99	[9.93-10.05]	12.13	[12.07-12.19]
	LE(Demented)	1.02	[0.96-1.08]	1.55	[1.49-1.61]	1.70	[1.64-1.76]	2.05	[1.99-2.11]
	Ratio (in %)	14.5	[14.37-14.61]	14.6	[14.50-14.66]	14.6	[14.48-14.63]	14.5	[14.41-14.53]
				Females					
Constant	LE (Total)	8.48		12.42		13.57		16.30	
Dementia	LE(Not Dem.)	6.83	[6.79-6.87]	9.54	[9.50-9.58]	10.30	[10.26-10.34]	12.08	[12.04-12.11]
Rates	LE(Demented)	1.66	[1.62-1.70]	2.88	[2.84-2.92]	3.27	[3.23-3.31]	4.22	[4.18-4.26]
	Ratio (in %)	19.5	[19.45-19.63]	23.2	[23.12-23.26]	24.1	[24.01-24.15]	25.9	[25.84-25.96]
Dynamic	LE (Total)	8.48		12.42		13.57		16.30	
Equilibrium	LE(Not Dem.)	6.83	[6.79-6.87]	9.97	[9.94-10.01]	10.91	[10.87-10.95]	13.13	[13.09-13.17]
	LE(Demented)	1.66	[1.62-1.70]	2.44	[2.40-2.48]	2.66	[2.62-2.70]	3.16	[3.13-3.20]
	Ratio (in %)	19.5	[19.45-19.63]	19.7	[19.61-19.74]	19.6	[19.55-19.66]	19.4	[19.37-19.46]

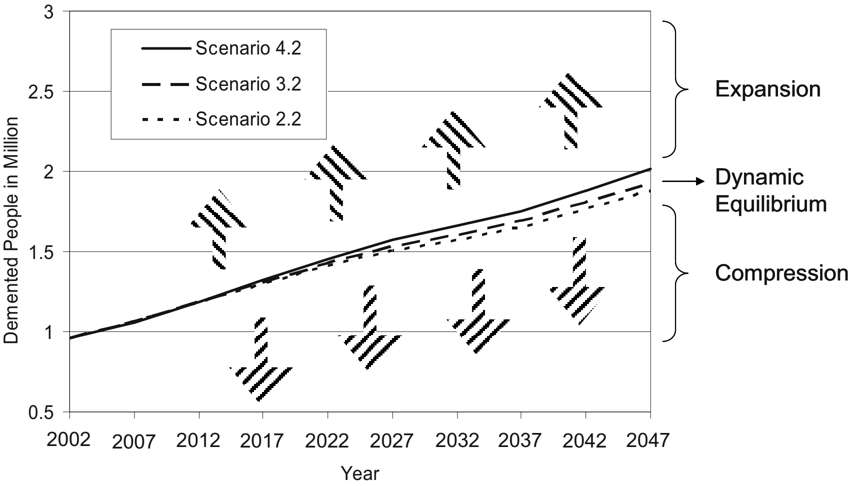
Assumptions about life expectancy in 2047:
Scenario 1: Males 75.9, Females 81.5.
Scenario 2: Males 82.6, Females 87.5.
Scenario 3: Males 84.3, Females 89.1.
Scenario 4: Males 87.9, Females 92.5.

4.2 Dementia-Free Life Expectancy at Ages 80-84 in Germany in 2002

When the age-specific prevalences are combined with the life table from the year 2002, age-specific life expectancies with and without dementia can be calculated. Table 3 shows the results for the year 2002 in the third column for people aged 80-84. Males at ages 80-84 have a total further life expectancy of 7.03 years, of which 6.01 (85.5%) are free of dementia and 1.02 (14.5%) are with dementia. Females at the same ages have a further life expectancy of 8.48 years, 6.83 (80.5%) years without and 1.66 (19.6%) years with dementia.

4.3 Dementia-Free Life Expectancy at Ages 80-84 in Germany in 2047

Figure 2: Projected number of people with dementia above age 60 with the dynamic equilibrium development at ages 80-84 and the areas of a compression/expansion of life expectancy with dementia



Assumptions about life expectancy increase until 2047:
Scenario 2.2: Males 82.6, Females 87.5; dynamic equilibrium scenario, see table 3.
Scenario 3.2: Males 84.3, Females 89.1; dynamic equilibrium scenario, see table 3.
Scenario 4.2: Males 87.9, Females 92.5; dynamic equilibrium scenario, see table 3.

When life expectancy is increasing, the number of years with and without dementia have to increase in the same proportion to gain a dynamic equilibrium. Table 3 shows total life expectancies at ages 80-84 for males and females for 2002 and 2047 according to all variants and life expectancies with and without dementia, as well as the ratios. At ages 80-84 males spent about 14.5% and females 19.5% of their remaining life expectancy with dementia. With constant dementia prevalences this ratio increases to 19.3% for males in the highest life expectancy scenario and to 25.9% for females. Thus, for the dynamic equilibrium the age-specific dementia prevalence had to decrease. For example, the prevalence for males at ages 80-84 declines by 0.4% per year, from 10.4% in 2002 to 8.8% in 2047 for the low LE variant; and by 0.7% per year to 7.8% for the high LE variant. For females, prevalences decrease from 12.8% to 10.8% for the low LE variant and to 9.6% for the high LE variant.

Figure 2 shows the increase in the number of people above age 60 with dementia according to the three life expectancy scenarios, combined with the dynamic equilibrium development of dementia at ages 80-84. The area above the trajectories shows an expansion of life expectancy with dementia: when the trajectory is higher than the dynamic equilibrium trajectory, people live longer, but they also spend a bigger proportion of life with dementia. The area below marks the compression area; a lower trajectory would mean that a smaller proportion of life is spent with dementia.

5. Discussion

Our results show that, in scenario 4.1, with high life expectancy and constant prevalence, the number of demented people will rise from 0.96 million in 2002 to 2.69 million in 2047. This large increase in life expectancy is quite likely because it is based on the assumption that life expectancy is improving at a speed similar to the one seen in recent decades. A constant prevalence could occur if no medical advances in dementia research are achieved.

If, however, the increase in life expectancy is combined with improvements in the onset and severity of dementia to such an extent that the proportion of years lived without dementia at age 80 remain the same as in the year 2002 (dynamic equilibrium scenario), then the number will increase to 2.01 million in 2047.

The dynamic equilibrium scenario is the „watershed” between the compression and the expansion of years lived with dementia. Any projection that shows a lower number of demented people (for the given life expectancy) implies that a compression of dementia will take place in the future, while any projection that shows a larger number of dementia cases implies an expansion of dementia.

Scenarios 2 and 3 of our dementia projections are based on population projections that are comparable to the ‘basic’ and ‘high’ variants from the 11th coordinated population projection from the German Statistical Office (Statistisches Bundesamt 2006). The scenarios of our population projections that are based on the low and medium increases in life expectancy show increases in the total elderly population to 26.5 and 27.5 million people over age 60 in 2047, respectively. Results are slightly lower than predicted by the Statistical Office (2006). Until 2050 they calculate an increase for the basic variant to 27.8 million and for the high life expectancy variant to 29.7 million people. This could be mainly due to migration assumptions: we do not take migration into account, and the Statistical Office assumes in its variants a net migration of +100,000 (variants W1 (also variants with 200,000 immigrants (W2) are calculated)). Our assumptions for the increase in life expectancy are slightly higher than the ones used from the German Statistical Office for the 11th coordinated population projection. For the basic variant, there is an increase to 83.5 years for males and 88.0 years for females; and, for the high increase variant, to 85.4 and 89.8 years (Statistisches Bundesamt, 2006). However, these assumptions could be seen as conservative, as the assumptions have been increased in each successive projection (compare, for example, Schnabel et al. (2005)). Thus, we use a third model with higher life expectancies.

The age-specific prevalences are based on data from the German sickness funds (Ziegler/Doblhammer 2009), which appear to accurately reflect the dementia prevalence (for a discussion of the obtained prevalence and age as the main risk factor, see the study by Ziegler and Doblhammer (2009)). The split of the analyses by gender shows a higher prevalence for females than for males, which increases at higher ages. A higher risk for women is often found, but is not always confirmed in the literature (for an overview of gender as a risk factor for dementia, see, for example, Muth et al. (2007).

Multiplication of the prevalence with the total population results in a figure of about one million people with dementia in Germany in 2002, a finding which is consistent with other estimates for Germany (see Table 1). However, it is difficult to estimate the true number of demented people. The result may still be an underestimate: while there has been a rising awareness of the disease, which may have led to earlier diagnoses, the meta-studies (Jorm et al 1987, Lobo et al 2000, Ritchie et al. 1992, Ritchie/Kildea 1995, Fratiglioni et al. 1999, Lopes/Bottino 2002) usually include only moderate and severe cases. Priester (2004) estimated that the actual number of demented people in Germany, including mild cases, was about 1.2 to 2.0 million in 2002. When the first symptoms appear, it is often difficult to differentiate between normal cognitive aging and beginning dementia. Many general practitioners may be unable to diagnose the illness correctly in its early stages and may not refer patients to neurologists, thus resulting in an underestimation of true cases.

Projections of the number of demented people with constant prevalences show increases from 1.0 million to 2.2 for the low life expectancy scenario (2.1), or to 2.7 million people for the high life expectancy scenario (4.1) (see Table 2). Results for the same increase in life expectancy, but with dynamic equilibrium prevalences in scenarios 2.2 and 4.2 show increases to 1.9 and 2.0 million people. The difference between scenarios 2.1 and 2.2 is about 300,000, while for scenarios 4.1 and 4.2, it is about 700,000 people. However, the increase over time is much higher, which shows that the assumption about life expectancy is the driving factor for the future number of demented people. Only if extreme changes in the prevalences occur will the number of future dementia cases be influenced to a larger extent by the change in prevalences than in life expectancy.

But how likely is a compression/expansion of morbidity, or a dynamic equilibrium development? The review by Christensen et al. (2009) shows that, while the prevalence of chronic diseases is expected to increase, the levels of disability arising from these diseases will be less severe and disabling. A compression of morbidity thus seems less likely, but a dynamic equilibrium is feasible. Medical advances, assistive living technologies and a changing social perception of disability might lessen the impact of chronic diseases and give hope for a postponement of dementia into higher ages.

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Part II: Health Factors and Care Determinants

The Effect of Sex, Obesity and Smoking on Health Transitions: A Statistical Meta-analysis

Gabriele Doblhammer, Rasmus Hoffmann, Elena Muth, Wilma Nusselder

1. Introduction

There are several pathways to death: someone may die healthy or the trajectory may go from good health to disability, include recovery and finally lead to death. Sex, obesity and smoking are important risk factors for these health transitions (Armenian et al. 1998, Hardy/Gill 2005, LaCroix et al. 1993). Sex, next to age, is the most important predictor of mortality (Luy 2003). Obesity and smoking are the two most important modifiable, behavioural factors that have a large impact on public health and are a core issue of public health policy. Both factors affect present and future mortality and disability levels and gender and social disparities. Disability largely affects the quality of life and the need for long-term health and social care (Waidmann/Liu 2000).

Sex, smoking and obesity may have different effects on the various health transitions; for example, the effect of obesity on the mortality risk of healthy people may be not as large as for disabled persons. Insight into these effects is needed for understanding the associations between risk factors and prevalence of disability. As transitions are closer to interventions than prevalence, they are even more relevant for reducing the future burden of disability. A systematic overview of the effects of sex, smoking and obesity on health transitions, however, is still lacking.

This meta-analysis fills in this gap by summarising the existing evidence of the effect of sex, obesity and smoking on four health transitions from (1) non-disabled to disabled, (2) non-disabled to death, (3) disabled to non-disabled, recovery and (4) disabled to death. These transitions determine the prevalence of disability and the lifetime spent without and with disability. A secondary aim is to assess which risk factors have been studied most and for which transitions. This is important as the reliability of research findings depends on the number of high quality studies.

2. Methods

2.1 Study Selection

We used electronic databases, recommendations of experts and references in existing articles. The electronic search is based on Medline, PsycINFO and SOCA (Sociological Abstracts). The search was performed from September 2005 to February 2006 and includes studies published in the years 1985-2005. The systematic search logic contains the following terms: disability, impairment, limitation, decline, function, activities of daily living and/or mobility. We restricted the search to cohort and longitudinal studies. For the term study, we also used the term trial, for "longitudinal study" we also applied the term follow-up. To further restrict the search to our risk factors, we looked for the terms life-style, obesity, overweight and Body Mass Index and smoking (including cigarettes or tobacco). We included the term transition as well as demographic characteristics (comprising age, sex or gender). We excluded children and cross-sectional studies, however. The search was performed in titles, keywords and abstracts.

Application of the search strategy to the electronic databases produced 7,729 potential results. We considered 287 additional sources. Of these, 78 stem from a literature review by Stuck et al. (1999). 49 are expert recommendations and 160 articles are taken from references of the articles. In total 8,016 articles served as the basis for our literature review. All abstracts of these articles were read by three persons independently (AK, EM, CW)[1].

We excluded studies in non-industrialised countries, in entirely non-white populations, in persons younger than 25 years of age and in hospitalised populations. We only considered studies that clearly distinguish the disability status at baseline: studies that look at mixed populations at baseline, i.e., disabled and non-disabled people together in one examination unit are excluded from our analysis as well as studies where the length of follow-up is less than one year. We further excluded studies that focus on disability caused by injuries or specific chronic conditions or surgeries.

This selection yielded 561 articles to read in length. We further selected studies that included at least one of the four transitions shown in Figure 1, presented information on the association with sex, obesity or smoking and were written in German, French or English. Studies not containing odds ratios (OR), rate ratios, relative risks (RR) or incidence rates were also excluded. A total of 55 articles met the inclusion criteria.

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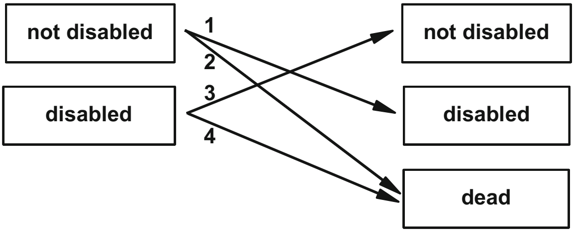
1 AK Anne Kruse (PhD. Student at the Rostcck Center), EM Elena Muth (PhD. Student at the Rostcck Center), CW Christina Westphal (PhD. Student at the Rostcck Center).

All data were abstracted through the use of a standard extraction form in Excel. The following information is available for each article in the original published article (Dobhammer et al. 2007): author, year of publication, country, study name, share of women, baseline year, length of follow-up, baseline age, analytic sample size, studied transitions, type of disability, definition of disability, studied risk factors, method and control variables.

Figure 1: Transitions



2.2 Measures of Outcome

Disability is either established through self-reported data or objective measurements. A multitude of disability measures is used in the selected studies. To take into account this heterogeneity, we generated four categories of disability measures representing the most frequently used concepts of disability. The first category is based on Katz' *Activities of Daily Living (ADL)* (Katz/Akpom 1976) and the second on the concept of *Instrumental Activities of Daily Living (IADL)* according to Lawton and Brody (1969). The third, measuring functional limitations, was constructed by Nagi (1976) and Rosow and Breslau (1966) and is called *Combined Mobility/Physical Performance Category (M/PP)*. The fourth refers to a mixture of the previous categories and is called *Combined Disability Measure (CDM)*. Information on all measured items in each study is also provided in the original published article (Doblhammer et al. 2007). All tables and figures as well as all the statistical analyses are based on all measures of disability.

Possible outcome measures are rate ratios, relative risks, odds ratios and incidence rates. We transformed incidence rates into rate ratios and, where possible, odds ratios into rate ratios. For criteria and the method used, see Zhang and Yu (1998). In the following text, we use the term rate ratios also for those odds ratios that have not been transformed.

2.3 Measures of Risk Factors

For sex, we considered men as reference group. For obesity, people with a Body Mass Index (BMI) below 18.5 kg/m^2 are regarded as underweight, those with a BMI between 18.5 and 25 kg/m^2 as normal weight. Persons with a BMI between 25 and 29.9 kg/m^2 and above 30 kg/m$_2$ are considered as overweight and obese, respectively. Where applicable, we recalculated the groups into standardised groups with a normal weight BMI as the reference group.

The variable smoking has different categories. Mostly never smokers are compared with current and former smokers. In some studies, however, smoking is coded as smokers versus never-smokers. Where applicable, never smokers are considered as reference group.

2.4 Statistical Analysis

We present outcomes for three levels of analysis: (1) single effect size of each study, (2) average effect size resulting from meta-analyses and (3) results from a meta-regression.

In the meta-analyses, we estimated fixed and random effect models using weighted least squares. The weights were defined as the inverse of the variance of the effect sizes of the individual studies. The Cochrane Statistic Q (Cochran 1954) was used to assess heterogeneity. If a between study variance could be identified, the random effect model yields more reliable results which are used in our result sub-chapter. If there is no such variance both models give the same results and we only give results from to the fixed effects model.

Publication bias was identified by visual examination of funnel plots and the Egger weighted regression method (Egger et al. 1997) and Begg rank correlation method (Begg/Mazumdar 1994). Sensitivity analyses were performed to test the influence of a single study on the pooled meta-analysis estimate. Only studies including standard errors of the effect sizes or providing information to permit their calculation (confidence intervals, p-values) were included in the meta-analysis. When a study reports several models with different covariates, the most extensive model was included. Separate models were estimated (a) when more than two categories of the risk factor were reported (e.g., current and former smoker versus never smoker), (b) when the effect size takes the form of a continuous measure and (c) when effect sizes are provided for different transitions. We present the most important meta-analyses by a figure, which includes the single effect sizes of each study and the average effect size from the meta-analyses (Figures 2 to 6). Table 1A and 1B displays the average effect size from each meta-analysis of sex, obesity and smoking on the four transitions, if available, completed by the statistical tests for heterogeneity and publication bias.

We performed a meta-regression to assess whether the average effect size systematically depends on the characteristics of the selected studies. We only performed meta-regressions for transitions and risk factors that have a sufficient number of effect sizes: i.e., all transitions for sex and the transition from non-disabled to disabled for smoking and obesity. The different models contain different numbers of study characteristics to avoid over-parameterisation of the models. Since the number of studies is limited, we only included the most relevant study characteristics, that is the age range of the study population, sex of the study population (both sexes, males, females), the metric of the outcome measure (relative risk versus odds ratio), the category of disability and household type (private, institutions, both). We could not control for other variables than the variable of interest because of the limited numbers of effect sizes. The results of the meta-regression will not be presented here in detail. More material can be found in the appendix.

3. Results

3.1 Search Results

The inclusion criteria were met by 55 articles[2]. From these, 48 articles include information on the transition from non-disabled to disabled, 11 on the transition from non-disabled to death, 17 on recovery and 14 on the transition from disabled to death (Tables 1A and 1B). Further, 46 studies provided information on the effect of sex, 20 on the effect of obesity and 16 on the effect of smoking. We included multiple effect sizes provided by the same article, for instance when different disability measures, study populations, age ranges or sexes were included. An explanation of the multiple effect sizes provided by the same author is available from the authors on request.

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[2] Agüero-Torres et al. 1998, Armenian et al. 1998, Avlund et al. 2002, Avlund et al. 2003, Beckett et al. 1996, Béland/Zunzunegui 1999, Boult et al. 1994, Boult et al. 1991, Branch 1985, Brill et al. 2000, Clark et al. 1998, Clark;et al. 1998, Crimmins et al. 1996, Cronin-Stubbs et al. 2000, Dunlop et al. 2002, Elgar et al. 2002, Ferrucci et al. 1996, Ferrucci et al. 1999, Flacker/Kiely 1998, 2003, Gill/Kurland 2003, Grundy/Glaser 2000, Haga et al. 1991, Hardy/Gill 2005, Huang et al. 1998, Ishizaki et al. 2002, Ishizaki et al. 2000, Jagger et al. 1993, Kivelä/Pahkala 2001, LaCroix et al. 1993, Lamarca et al. 2003, Launer et al. 1994, Leveille et al. 2000, Liu et al. 1995, Maddox et al. 1994, Manton 1988, Matthews et al. 2005, McCurry et al. 2002, Mendes de Leon et al. 1997, Mor et al. 1989, Nusselder et al. 2000, Oman et al. 1999, Penninx et al. 2003, Penninx et al. 1999, Péres et al. 2005, Porock et al. 2005, Reynolds/Silverstein 2003, Romoren/Blekeseaune 2003, Sauvel et al. 1994, Seeman et al. 1996, Strawbridge et al. 1992, van Dijk et al. 2005, Wannamethee et al. 2005, Wolff et al. 2005, Zimmer/House 2003.

In the meta-analyses, we excluded studies[3] which provided no confidence intervals or no information to compute these intervals.

3.2 Sex

Being female was associated with a higher risk of changing from non-disabled to disabled (RR 1.35, 95% CI 1.28-1.43, Table 1A, Figure 2). All 29 effect sizes point into this direction; although 13 were not significant.

Women faced a lower chance of recovery (RR 0.71, 95% CI: 0.63-0.81) compared to men (Figure 3). All but one effect size point into this direction and the majority of effect sizes is significant. There are two outliers; one is the age group 90 to 95 in the study by Leveille et al. (2000), suggesting that at very advanced ages women have much lower chances to recover than men. However, a gradient over the whole age range of his study (65 to 95) is not significant since the confidence intervals overlap. The second outlier (Mendes de Leon et al. (1997), studying North Carolina) suggests that there are no sex differences. Note that the confidence intervals of most studies largely overlap. Even if two specific studies (out of 10 or 20) are significantly different, this does not necessarily imply or require an explanation.

The risk of dying for non-disabled women is lower as compared to non-disabled men (RR 0.41, CI: 0.37-0.45, Table 1A). The risk of dying for disabled women is also lower as compared to disabled men (RR 0.58, CI: 0.57-0.60, Table 1A).

3.3 Obesity

Obesity as compared to normal weight significantly increases the risk to become disabled (RR 1.49, 95% CI: 1.33-1.66, Figure 4). However, both Begg's and Egger's test suggest the presence of a publication bias. Taking into account that studies with significant results are more likely to be published, the risk might be lower.

Comparing the effect of obese with normal/overweight people also shows that among the non-disabled, the risk to become disabled is significantly increased for obese persons (RR 1.30, CI: 1.19-1.41, Figure 5). When the BMI is measured as a continuous variable, there is no significant effect on the risk of becoming disabled (see Table 1A).

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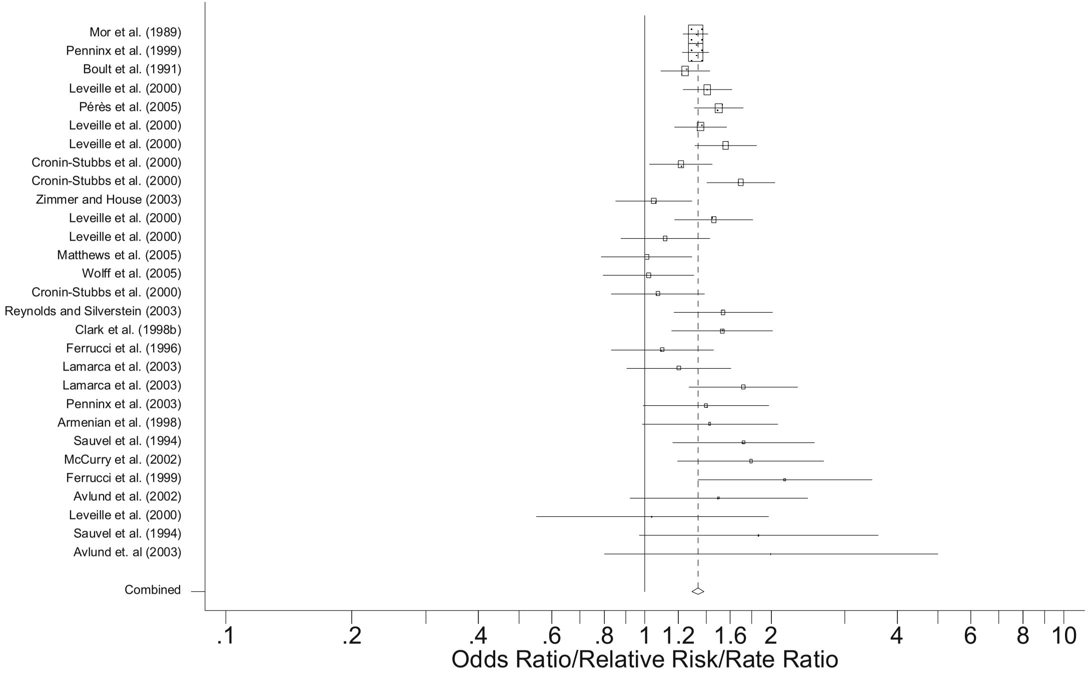
[3] Beckett et al. 1996, Béland and Zunzunegui 1999, Clark et al. 1998, Crimmins et al. 1996, Dunlop et al. 2002, Hardy and Gill 2005, Jagger et al. 1993, Liu et al. 1995, Maddox et al. 1994, Manton 1988, Mendes de Leon et al. 1997.

Figure 2: Risk factor sex (females vs. males), Transition 1, from non-disabled to disabled*



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* Figures 2 to 6 read as follows: the left-hand side of the figures contains the name and year of the study. The "datapoints" in the figure itself are shown as squares. The size of the square indicates the precision (inverse of the variance) of the effect size. A horizontal line shows the width of the confidence interval of each effect size. The result of the meta-analysis is shown as a dashed vertical line. A trapezoid at the bottom of this line represents the 95% confidence interval for the result of the meta-analysis. The log-scaled x-axis reveals the relative risk for the group in question.

Figure 3: Risk factor sex (females vs. males), Transition 3, recovery

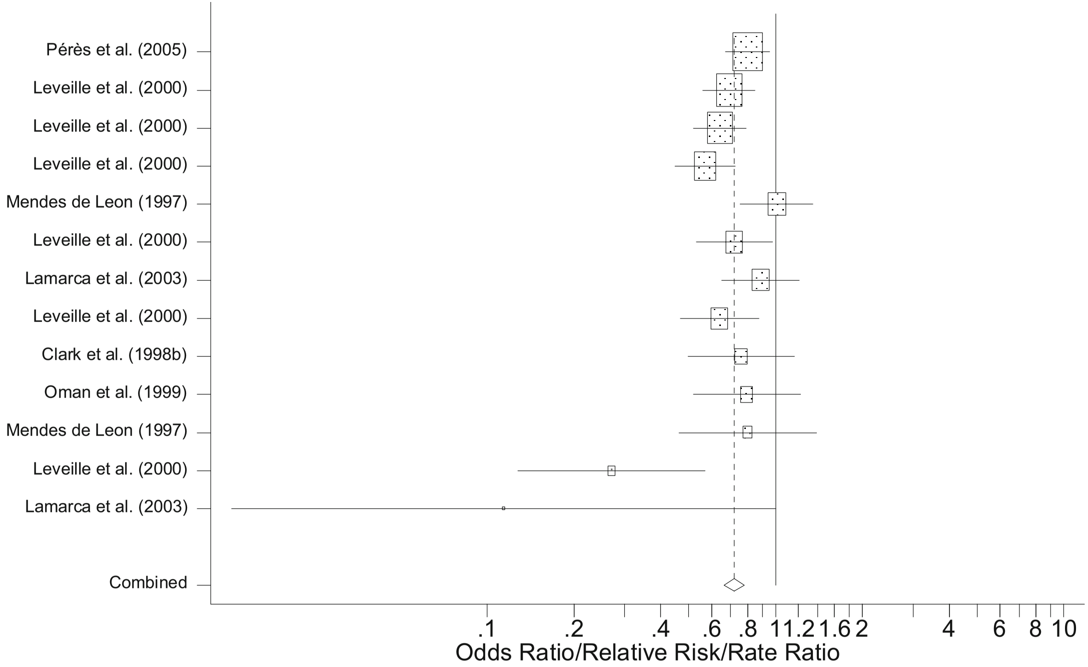


Figure 4: Risk factor obesity (obese versus normal), Transition 1 from non-disabled to disabled, Transition 3 recovery, Transition 4 from disabled to death

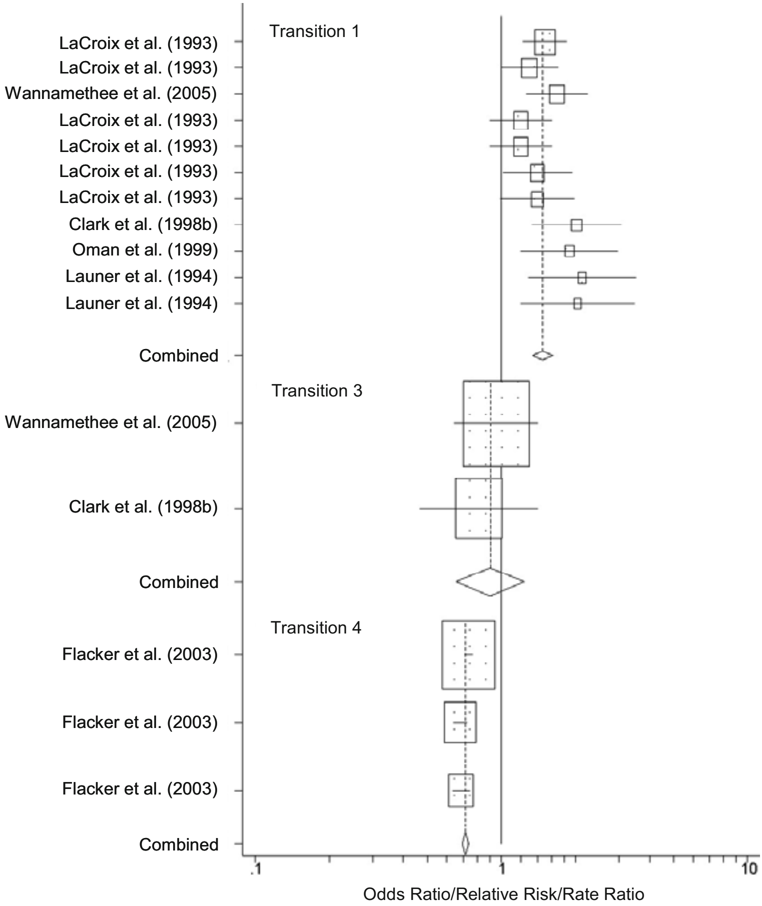


Figure 5: Risk factor obesity (obese versus normal/overweight), Transition 1 from non-disabled to disabled; Transition 2 from non-disabled to death, Transition 3 recovery, Transition 4 from disabled to death

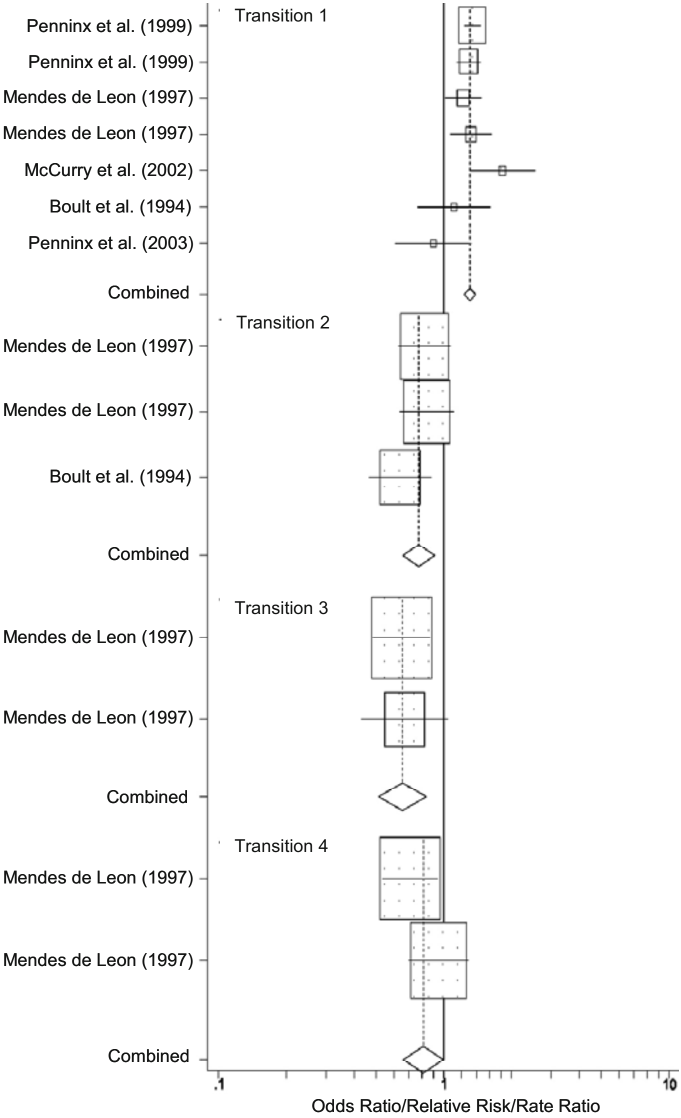
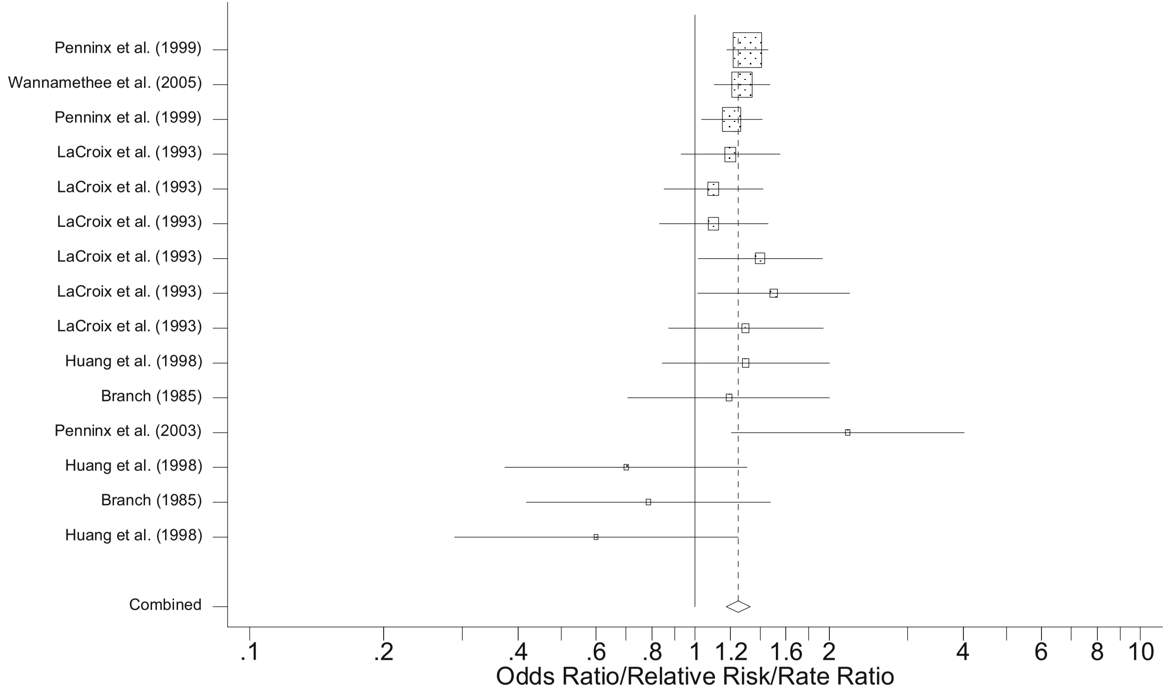


Figure 6: Risk factor smoking (current vs. never), Transition 1 from non-disabled to disabled



The chance of recovery was slightly lower among obese as compared to normal weight persons (RR 0.90, 95% CI, 0.66-1.24). However, this effect is based on two studies with two effect sizes and is not significant (Figure 4). For obese persons compared to persons with a normal weight or overweight (Figure 5), the study by Mendes de Leon et al. (1997) provides evidence that the chances of recovery stand at 0.66 (95% CI: 0.51-0.84).

For the risk of dying of non-disabled persons, none of the included studies provided effects sizes for the effect of obesity as compared to normal weight. Obesity as compared to a reference group, comprising both normal weight and overweight persons, shows a reduced risk of mortality among non-disabled persons (Figure 5). The average effect size of 0.78 (CI: 0.66-0.91) from the meta-analysis is based on a study by Boult et al. (1994) and two different populations in the study by Mendes de Leon et al. (1997) whose results are as such not significant.

For the transition of disabled to death, one study with three effect sizes indicates a protective effect of obesity as compared to normal weight (RR 0.70, 95% CI: 0.67-0.75, Figure 4). All three effect sizes in the study by Flacker and Kiely (2003), which are based on different cohorts, i.e., different samples, indicate a lower risk of dying for disabled obese persons compared to disabled persons of normal-weight. Statistical tests indicate heterogeneity but reject any publication bias (see Table 1B).

The two populations in New Haven and North Carolina (Mendes de Leon et al. 1997) comparing obese with normal-weight or overweight persons (Figure 5) also show that on average, disabled obese persons have a lower mortality risk of 0.82 (95% CI: 0.61-1.09). Of the two populations, one yields a significant result. However, in the meta-analysis the borderline significance of the fixed effects model (RR 0.81, 95% CI: 0.66-1.00) is lost in the random effects model (RR 0.82, 95% CI: 0.61-1.09, see Table 1A).

3.4 Smoking

Current smokers compared to never smokers have an increased risk of becoming disabled (RR 1.24, 95% CI: 1.14-1.33, Figure 6). All confidence intervals of the included studies overlap and only one effect size is significantly lower than the average risk in the meta-analysis. Current smokers as compared to never or former smokers also have a higher risk of becoming disabled (RR 1.02, 95% CI: 1.01-1.03), with their rate ratio being much lower than in the comparison to never smokers only.

Table 1A: Results of the statistical meta-analysis of the effect of sex, obesity and smoking by type of transition: fixed effect model and random effects model

Risk factor	Transition	Number of Included Effect Sizes	Number of Excluded Effect Sizes	Number of Studies	Fixed Effects Model Confidence Interval			Random Effects Model Confidence Interval		
					Mean	Lower	Upper	Mean	Lower	Upper
Sex females vs. males	**1**	29	0	20	**1.34**	**1.30**	**1.38**	**1.35**	**1.28**	**1.43**
	2	13	0	7	**0.41**	**0.37**	**0.45**	*	*	*
	3	13	2	7	**0.72**	**0.66**	**0.78**	**0.71**	**0.63**	**0.81**
	4	18	2	9	**0.58**	**0.57**	**0.60**	**0.56**	**0.51**	**0.62**
Weight										
Overweight vs normal	1	2	0	2	1.13	0.93	1.38	*	*	*
	3	2	0	2	0.82	0.61	1.11	0.81	0.74	1.22
Obese vs normal & overweight	**1**	7	0	5	**1.31**	**1.23**	**1.39**	**1.30**	**1.19**	**1.41**
	2	3	0	2	**0.78**	**0.66**	**0.91**	*	*	*
	3	2	0	1	**0.66**	**0.51**	**0.84**	*	*	*
	4	2	0	1	0.81	0.66	1.00	0.82	0.61	1.09
Obese vs normal	**1**	11	0	5	**1.47**	**1.34**	**1.62**	**1.49**	**1.33**	**1.66**
	3	2	0	2	0.90	0.66	1.24	*	*	*
	4	3	1	1	**0.72**	**0.69**	**0.74**	**0.70**	**0.67**	**0.75**
Weight continuous	1	9	0	4	1.01	0.99	1.03	*	*	*
Smoking										
Current vs never smoked	**1**	15	0	5	**1.25**	**1.17**	**1.33**	**1.24**	**1.14**	**1.33**
	3	2	0	2	0.76	0.61	0.94	0.79	0.58	1.08
Current vs former/non-smoker	**1**	10	0	8	**1.02**	**1.01**	**1.03**	**1.15**	**1.08**	**1.22**
Former vs never smoked	**1**	12	0	4	**1.08**	**1.02**	**1.14**	*	*	*
Former vs never/non-smoker	3	2	0	1	1.05	0.79	1.39	*	*	*

Table 1B: Results of the statistical meta-analysis of the effect of sex, obesity and smoking by type of transition: heterogeneity and publication bias

Risk factor	Transition	Number of Included Effect Sizes	Number of Excluded Effect Sizes	Number of Studies	Heterogeneity Q-Test	Heterogeneity Between Study	Publication Bias Begg's Test	Publication Bias Egger's Test	
					P-Value	Variance τ2	P-Value	Bias	P-Value
Sex females vs. males	**1**	29	0	20	0.01	0.01	0.30	0.34	0.44
	2	13	0	7		*	0.58	-0.24	0.78
	3	13	2	7	0.02	0.02	0.50	-1.08	0.27
	4	18	2	9	0.00	0.03	0.94	-0.57	0.54
Weight									
Overweight vs. normal	1	2	0	2	*	*	n.a	n.a.	n.a.
	3	2	0	2	0.19	0.04	n.a.	n.a.	n.a.
Obese vs. normal & overweight	**1**	7	0	5	0.17	0.00	0.23	-0.63	0.53
	2	3	0	2	0.39	*	n.a.	-9.69	0.19
	3	2	0	1	0.91	*	n.a.	n.a.	n.a.
	4	2	0	1	0.17	0.02	n.a.	n.a.	n.a.
Obese vs normal	**1**	11	0	5	0.24	0.01	**0.07**	**2.34**	**0.05**
	3	2	0	2	0.64	*	n.a.	n.a.	n.a.
	4	3	1	1	0.06	0.00	0.71	4.18	0.22
Weight continuous	1	9	0	4	0.50	0.00	0.53	0.76	0.43
Smoking									
Current vs. never smoked	**1**	15	0	5	0.26	0.01	0.15	-0.67	0.21
	3	2	0	2	0.19	0.02	n.a.	n.a.	n.a.
Current vs. former/non-smoker	**1**	10	0	8	0.00	0.00	**0.1**	**1.71**	**0.03**
Former vs. never smoked	**1**	12	0	4	0.33	*	0.45	0.06	0.92
Former vs. never/non-smoker	3	2	0	1	*	*	n.a.	n.a.	n.a.

*: moment, restricted Maximum-Likelihood and Maximum-Likelihood estimates of the between study variance are zero; significant effects are indicated in bold; n.a. not applicable.

Statistical tests, however, suggest the presence of a publication bias. Additionally, former smokers have a higher risk than never-smokers (RR 1.08, 95% CI: 1.02-1.14). Statistical tests do neither suggest the presence of a publication bias nor of outliers affecting the overall result.
For recovery, the effect of smoking is non-significant and depends on the reference group (Table 1A).

Neither for the transition from non-disabled to death nor for the transition from disabled to death effects sizes for smoking are available.

3.5 Effect of Study Characteristics

The meta-regression of the effect of the type of disability showed that for the transition from not disabled to disabled, CDM and PPM measures tend to result in larger sex differences than do ADL and IADL measures. The effect of obesity on the risk of becoming disabled is larger among the young- and middle-aged than among the elderly. Studies based on only one sex report smaller effect sizes than studies based on both sexes.

The use of odds ratios compared to relative risks usually does not have an impact on the results, with the exception of smoking. In studies reporting odds ratios for the transition from non-disabled to disabled a detrimental effect of smoking exists for CDM and PPM measures but not for ADL and IADL measures. This might be caused by the small numbers of studies (N=4) that report ADL and IADL measures. Studies based on relative risks find significant differences between smokers and never-smokers also for ADL and IADL measures.

4. Discussion

4.1 Summary of Main Findings

This meta-analysis shows that the effects of sex, obesity and smoking on the health transitions between non-disabled, disabled and death are studied to a very different degree. Most studies focused on the transition from non-disabled to disabled. Being female, obesity and smoking significantly increase the risk of this transition. Protective and detrimental factors for recovery are less well documented. Being female, smoking and obesity were found to reduce the chances of recovery. The transitions from non-disabled to death and from disabled to death are seriously understudied. Existing evidence shows that women have lower mortality risks than men, disregarding of whether they have a healthy or unhealthy status. Obesity seems to be associated with lower mortality both for healthy and unhealthy persons. For the impact of smoking on the transitions from non-disabled to death and from disabled to death the small number of studies did not even permit a meta-analysis. For all transitions, more studies report on the effect of sex than on the effect of smoking or obesity. Partly this might reflect publication bias, which seems to be present for smoking and obesity, but not for sex. The latter is often included as a control variable, with no effect on the likelihood of getting published.

The sensitivity analysis of the effect sizes of sex led to the exclusion of the study by Ishizaki et al. (2000) and the effect sizes reported for the "newly admitted" group of persons in the study by Flacker and Kiely (2003). In the analysis of obesity the effect sizes of the "newly admitted" persons in the "development cohort" are excluded (Flacker/Kiely 2003).

Our meta-analysis of sex shows that women face higher risks of incidence of disability (RR 1.35) and lower chances of recovery once they are disabled (RR 0.71). In contrast, women have lower chances to die, both when they are non-disabled and disabled (RR 0.41 and 0.58, respectively). For obesity, we show that obesity as compared to normal weight or overweight increases the risk of becoming disabled (RR 1.30) and reduces the chances of recovery (RR 0.66), but is associated with lower mortality, both in the non-disabled and disabled state (RR 0.78 and 0.81). Our meta-analysis of smoking shows that current smokers experience an increased risk of incidence of disability (RR 1.25) and lower chances of recovery (RR 0.78) compared to never smokers. For former smokers, the effect on recovery is attenuated, indicating that it pays off to quit smoking.

4.2 Strengths and Limitations of this Study

Most studies included in the meta-analyses are non-experimental, observational studies, which are prone to a greater degree of bias than randomised control trials. We therefore placed a very strong emphasis on sensitivity analyses, publication bias and a careful analysis of the original studies concerning their methodological and statistical properties. We used this detailed information for a description of the results and for the purpose of interpretation, but we refrained from quality scoring of individual studies (see e.g., Tas et al. 2007) as in the selection of studies to be included we already set high standards for the quality of the study, including the standard of a longitudinal perspective.

The finding that obesity and not just overweight decreases mortality is striking. Overweight and obesity seem to increase the risk of becoming disabled and to reduce the chances of recovery, but obesity is associated with lower mortality both among non-disabled and disabled persons. This finding is based on a small number of studies and more studies are needed to confirm this result and to rule out that the protective effect is simply the result of weight loss due to morbidity prior to death. Clinical studies show that e.g., patients with cancer, dementia or Alzheimer's disease loose weight, which may explain why a higher BMI is associated with lower mortality, at least for disabled persons (Holm/Söderhamn 2003, Prasher et al. 2004, Yen 2005). However, in the three studies included in our analysis of the association between obesity and mortality the authors either control for cancer, poor cognitive function, amount of uneaten food or weight loss, which means that the problem of selection (weight loss because of morbidity) is already addressed in the selected studies. It is possible that these control variables are not sufficient to completely account for selection and a simultaneous longitudinal measurement of weight changes and the development of morbidity would be necessary. In this regard, our focus on BMI as an indicator for obesity and not for weight change is not optimal.

Selection is a possible explanation that cannot be completely ruled our here, the finding that the association of obesity with lower mortality also holds for healthy persons is even more surprising and must remain unexplained until further research. In the review by Tas et al. (2007) only limited evidence was found for BMI as a prognostic factor for the course of disability, as well as some evidence for no association for sex and smoking. The reverse effect of obesity on mortality is supported by a recent study, reporting that not a high Body Mass Index but an elevated waist hip ratio is associated with a greater risk of death (Price et al. 2006).

On the other hand, while we show that obese persons have lower mortality in healthy and unhealthy people, we also demonstrated a detrimental effect of obesity on the onset of disability and recovery. Therefore high BMI might still result in higher mortality for obese persons, as obesity increases the risk of becoming disabled, which, combined with the higher mortality risks among disabled persons may result in overall higher mortality risks as compared to normal weight people. For a complete assessment of a risk factor it is important to look at its impact on different transitions combined.

4.3 Implications for Future Research

We conclude that the effects of smoking and obesity should be verified in future studies as the meta-analysis could only be based on a limited number of studies, with many of the results being not significant. The existence of a large number of ways to measure disability complicates all attempts to unify research findings and makes the existing findings less easy to use and to interpret In our meta-analyses, we generated four categories of disability measures representing the most frequently used concepts of disability to handle this heterogeneity in existing studies. This enabled us to summarise what is known and to assess the robustness of this evidence and to identify areas where more research is needed. While future research certainly should concentrate more on the harmonisation of the different concepts of disability (Tas et al. 2007), the meta-regression showed that our main outcomes were not dependent upon the choice of the disability measure. The same was found for the use of odds ratios versus relative risks and the age range considered. While sometimes differences in these study characteristics attenuate or intensify the effect, it rarely changes its direction with the exception of smoking.

This meta-analysis summarises the variety of research findings on the effects of sex, smoking and obesity on health transitions and identifies areas where more research is needed. It shows that more studies of risk factors on health transitions are warranted, particularly on transitions other than from non-disabled to disability. Although this transition may seem the most challenging to public policy makers in terms of prevention, recovery and the transition from disabled to death determine how long persons will live with disability, once they are disabled. Public health measures which successfully decrease the time spent with disability are extremely important in ageing populations and may need to go beyond delaying the onset of disability. In general, more thought should be given to the state-space that exists in disability and mortality studies. Many studies, particularly in the area of mortality, were not eligible for this review, because they were based on populations where at baseline no distinction between disabled and non-disabled was made. For achieving healthy ageing, insight into the effects of modifiable factors, such as smoking and obesity, on health transitions between non-disabled, disabled and death is crucial.

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Appendix

Meta-regression Results

Additionally to our meta-analysis of the numerous effect sizes of different studies, we perform a meta-regression to find out whether the average effect size systematically depends on characteristics of the selected studies. We only perform meta-regressions for transitions and risk factors with sufficient numbers of effect sizes: i.e., all transitions for sex and the transition from not disabled to disabled for smoking and obesity. One model is estimated for each of the above mentioned transitions and risk factors. The different models contain different numbers of study characteristics in order not to over-parameterise the models. Since the number of studies is limited, we restricted the explaining variables to the most relevant ones such as the age range of the study, whether the outcome is measured as relative risk or odds ratio, the four types of disability, the sex of the respondents (both sexes, males, females) and the household type (private, institutions, both). The age range of the studies was the most difficult to categorise and we finally used the four groups: (1) all ages: age 18 and above; (2) young and middle ages: ages 30-44 to 60-74; (3) old age: ages 55-85 to 75-85; (4) old & oldest old: ages 55+ to ages 75+; oldest old: ages 79+ to ages 90+. Results are displayed in Tables A1 to A3.

Table A 1: Effect sizes estimated by meta-regression using the study characteristics: sex, age range of the study, outcome metric, disability measure and household type

Transition	Risk factor	N	Reference group	N	Effect size	p-value
Non-disabled to disabled	Females	29	Males		1.17	0.12
	Age range of the study					
	Old+oldest old	18	All ages; old age	2;6	1.24	0.45
	Oldest old	3	All ages; old age	2;6	0.76	0.74
	Outcome measure					
	Relative Risk	11	Odds Ratio	18	1.20	0.74
	Disability measure					
	CDM	7	ADL; IADL	8;1	1.31	0.22
	PPM	13	ADL; IADL	8;1	1.35	0.10

Transition	Risk factor	N	Reference group	N	Effect size	p-value
Non-disabled to death	Females	13	Males		0.29	0.00
	Age range of the study					
	Old+oldest old	5	All ages; old	1;4	0.45	0.07
	Oldest old	3	All ages; old	1;4	0.31	0.68
	Outcome measure					
	Relative Risk	8	Odds Ratio	5	0.28	0.77
	Disability measure					
	PPM	7	ADL;IADL;CDM	4;1;1	0.36	0.40
Recovery	Females	15	Males		0.83	0.47
	Age range of the study					
	Old+oldest old	9	old age	3	0.95	0.48
	Oldest old	3	old age	3	0.70	0.14
	Outcome measure					
	Relative Risk	12	Odds Ratio	3	0.81	0.82
	Disability measure					
	PPM	8	ADL;IADL;CDM	5;1;1	0.69	0.27
Disabled to death	Females	20	Males		1.14	0.66
	Age range of the study					
	Oldest old	4	Old;Old+oldest old	3;13	1.43	0.25
	Household type					
	Private	14	Institution; both	5;1	0.64	0.00
	Outcome measure					
	Relative Risk	18	Odds Ratio	2	0.97	0.52
	Disability measure					
	CDM	6	ADL; IADL	7;1	0.73	0.02
	PPM	6	ADL; IADL	7;1	0.91	0.28

Table A 2: Effect sizes estimated by meta-regression using the study characteristics: BMI, sex, age range of the study, outcome metric and disability measure

Transition	Risk factor	N	Reference group	N	Effect size	p-value
Non-disabled to disabled	*BMI*	20				
	Overweight	2	Normal		1.18	0.00
	Obese	7	Normal+overweight		1.20	0.01
	Obese	11	Normal (RG)		1.83	0.00
	Outcome metric					
	Relative Risk	10	Odds Ratio	10	2.02	0.23
	Disability measure					
	CDM	3	ADL;IADL	4;1	2.55	0.03
	PPM	12	ADL;IADL	4;1	1.83	0.98
	Age range of the study					
	Young & middle ages	4	Old + oldest old	16	2.40	0.04
	Sex					
	Females	5	Both	10	1.26	0.03
	Males	5	Both	10	1.16	0.01

RG: Reference group of the studied risk factor = constant of the regression model.

Risk factor sex:

For each of the transitions we estimated one model: 29 effect sizes are included in the model for the transition from non-disabled to disabled, 13 in the model for the transition from non-disabled to death, 15 for the model for recovery and 20 for the transition from disabled to death. In all the models the reference group consists of studies that use odds ratios and define disability in the form of ADL and IADL. The reference group for the age range, however, is different.

Transition from non-disabled to disabled:

Females on average have a 17% higher risk of becoming disabled than males which, however, is not significant at the conventional significance level (p=0.12). If disability is measured in terms of PPM then the risk increases to 35% (p=0.1). Neither the age ranges of the studies, nor the outcome metric have a significant impact on the effect sizes.

Table A 3: Effect sizes estimated by meta-regression using the study characteristics: smoking, sex, age range of the study, outcome metric and disability measure.

Transition	Risk factor	N	Reference group	N	Effect size	p-value
Non-disabled to disabled						
Odds Ratio		12				
	Smoking					
	current	4	Never (RG)		0.71	0.20
	current	6	former		0.55	0.34
	former	2	never		0.53	0.34
	Age Range of the study					
	Old + oldest old	7	All ages	5	1.47	0.05
	Disability measure					
	CDM	7	ADL; IADL	1;1	1.35	0.00
	PPM	3			1.10	0.03
	Sex					
	Females	2	Both	5	0.34	0.02
	Males	2	Both	5	0.63	0.74
Relative Risk		25				
	Smoking					
	current	11	Never (RG)		1.22	0.02
	current	4	former		1.53	0.06
	former	10	never		1.04	0.00
	Age range of the study					
	Old + oldest old	21	Young + middle ages; all ages	3;1	1.14	0.41
	Disability measure					
	CDM	4	ADL	4	0.96	0.19
	PPM	17	ADL	4	1.25	0.63
	Sex					
	Females	8	Both	6	1.35	0.20
	Males	11	Both	6	1.33	0.15

RG: Reference group of the studied risk factor = constant of the regression model.

Transition from non-disabled to death:
The risk of females to die healthy is only 0.29% of the risk of males and highly significant. The mortality advantage of females attenuates with age and is 45% among the "old+oldest old" (p=0.07).

Recovery:
The average effect size for females is 0.83 and indicates a lower chance for females to recover. The sex difference, however, is not significant once corrected for other study characteristics.

Transition from disabled to death:
With an average effect size of 1.14 no significant difference between males and females exists. Females living in private households experience a lower risk than males (effect size: 0.64; p=0.00). If disability is measured in terms of CDM then the effect size is 0.73 (p=0.02) and thus lower than that of males.

Risk factors overweight and obesity:
The number of effect sizes only permits to study the transition from non-disabled to disabled. There 20 effect sizes are reported that distinguish between the risk resulting from (1) overweight versus normal weight, (2) obesity versus normal weight and overweight and (3) obesity versus normal weight. The average effect sizes of obesity versus normal weight is 1.83 and highly significant (p=0.00). The risk of a transition is significantly reduced when measured in terms of overweight versus normal weight (effect size=1.18, p=0.00) and obesity versus normal and overweight (effect size=1.20, p=0.03). Among the young- and middle-aged the average effect size increases to 2.40 (p=0.00), thus revealing a strong age gradient. In studies that look at males only the effect size is 1.16 (p=0.02) and therefore lower than in studies based on both sexes (1.79). This is also true for studies based on females only (effect size=1.26, p=0.03). When disability is measured in terms of CDM the effect size significantly increases to 2.55 (p=0.03).

Risk factor smoking:
All together 37 effect sizes describe the risk of smoking to experience the transition from not disabled to disabled. Since in the course of the meta-regression it turned out that the use of odds ratios or relative risks as outcome metric significantly influences the result we report two separate models.

Twelve studies report effect sizes in terms of odds ratios. There the effect of smoking is only significant based on CDM and PPM measures. Among the “old and oldest+old” current smokers have a significantly increased risk (effect size=1.47, p=0.05) as compared to never smokers.

25 effect sizes are measured in terms of relative risks. The effect size of current versus never smokers is 1.22 (p=0.02). Current versus former smokers (effect size=1.53, p=0.00) have a higher risk, former versus never smokers a lower (effect size=1.04, p=0.00).

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Demand for Long-term Residential Care and Acute Health Care by Older People in the Context of the Ageing Population of Finland

Mike Murphy, Pekka Martikainen

1. Introduction

One of the major concerns relating to population ageing is provision and financing of health and social care services for the older population as their numbers grow. Populations in many industrialised countries have been ageing for considerable periods of time, but this is likely to intensify in the next half century or so. The proportion of people aged 65 and over is likely to increase by about 40% in the EU(25) as a whole and by about 65% and 40% respectively in Finland and the United Kingdom between 2004 and 2025 (Table 1).

Among the older populations, conventionally those aged 65 and over, the numbers of the 'old-old' are tending to increase even more rapidly. The increase in the 80 and over population, although now in line with the growth of the 65 and over population, is likely to grow more rapidly between 2025 and 2050, with the oldest groups such as centenarians having the highest growth rates of all. Growth in the number of elderly people will have major repercussions on the demand for long-term care. Lifetime mortality improvements, together with the numbers of persons in the birth cohort (if migration is ignored) determine the numbers alive at older ages. The larger numbers born in the decades of the 1940s and 1950s as compared with the previous two decades will reinforce the trend towards larger numbers of older people due to mortality improvements.

Between 1971 and 2031, the numbers of people aged 65 and over is expected to more than double in the United Kingdom from 7.4 million to 15.8 million (Office for National Statistics n.d.). Until about the middle of the 20th century, there was relatively little improvement in mortality at older ages in Britain and Finland, especially at ages 80 and over, but rates are now improving rapidly. In Britain, for example, at around 1.5% p.a.: indeed, between 2005 and 2006, mortality rates of older people were improving at annual rates of 4 to 5%. Issues related to the socio-demographic, health and mortality prospects of the old-old as well as likely numbers are becoming of crucial importance in discussions of care needs.

Table 1: Actual and projected populations aged 65 and over & 80 and over, EU(25), Finland and United Kingdom in 2004, 2025 and 2050

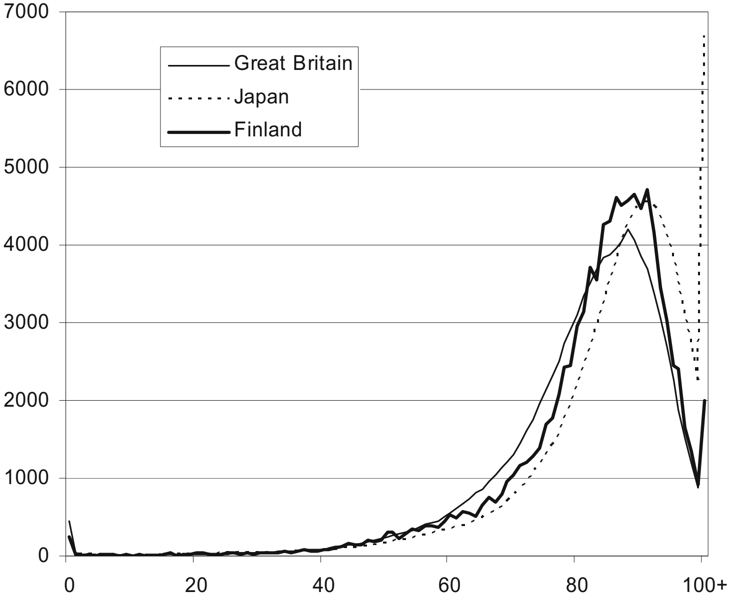
	Year 2004	 2025	 2050
European Union (25 countries) aged 65 and over			
Total	75,283,667	105,899,230	134,540,969
Males	30,788,159	46,254,693	60,191,263
Females	44,495,508	59,644,537	74,349,706
European Union (25 countries) aged 80 and over			
Total	18,215,884	29,745,069	51,140,074
Males	5,814,198	11,130,067	20,589,108
Females	12,401,686	18,615,002	30,550,966
Finland aged 65 and over			
Total	813,195	1,336,022	1,407,425
Males	321,199	595,135	640,088
Females	491,996	740,887	767,337
Finland aged 80 and over			
Total	195,419	326,286	536,920
Males	54,736	120,497	216,326
Females	140,683	205,789	320,594
United Kingdom aged 65 and over			
Total	9,542,770	13,332,386	17,123,350
Males	4,064,439	6,051,783	7,872,758
Females	5,478,331	7,280,603	9,250,592
United Kingdom aged 80 and over			
Total	2,591,601	3,631,898	6,577,002
Males	876,047	1,458,826	2,798,825
Females	1,715,554	2,173,072	3,778,177

Source: Based on abridged life-tables for Great Britain (Office for National Statistics http://www.gad.-gov.uk/Demography%20Data/Life%20Tables/Historic_interim_life_tables.html), Finland (Statistics Finland http://pxweb2.stat.fi/database/StatFin/vrm/kuol/kuol_en.asp), Eurostat 2004.

The effect of mortality regimes on proportions surviving and distribution of deaths is substantial and changes will have major impacts. Figure 1 shows the distribution of deaths that would occur to women if they experienced the mortality rates of Britain, Finland and Japan based on the most recent period life tables for the early part of the 21st century. In Japan, about 7% of women would expect to reach age 100 with current (2006) mortality rates and the modal age of death would be over

90. There would be as many deaths above age 100 as at all ages below 65. In Britain and Finland, about 2% of women could expect to live beyond 100.

Figure 1: Distribution of deaths out of 100,000 births, females, Great Britain 2004 to 2006, Finland 2006 and Japan 2006



Source: Based on abridged life-tables for Great Britain (Office for National Statistics), Finland (Statistics Sweden) and Japan (Ministry of Health, Labour and Welfare).

2. Drivers of Demand for Acute Hospital and Long-term Care

2.1. Proximity to Death

A simple assumption that has been used in many earlier studies is that demand for care would be proportional to the numbers of people in various sex and age groups. Thereby, it is assumed that costs of both acute and long-term care tend to differ between men and women and rise with age.

However, more recently, considerable attention has also been given to the role of a variable that has been of interest for a considerable period of time, namely proximity to death (Scitovsky 1984, 1994, Zweifel et al. 1999, McGrail et al. 2000, Spillman/Lubitz 2000, Wanless 2001 and 2002, Yang et al. 2003, Schulz et al. 2004, Stearns/Norton 2004, Seshamani/Gray 2004, Stearns et al. 2007, Payne et al. 2007). Although the average cost of acute care services rises substantially with age, it is argued that the real reason for this is not to do with age per se, but with the fact that at older ages, more people are close to death and that it is proximity to death rather than age which is the major determinant of health care expenditure. A typical finding suggests that about one third of a person's total lifetime use of acute health care services takes place in the last two years of life (Hoover et al. 2002, Wanless 2002). Such studies usually compare those who die in a particular time window ('decedents') with those of the same age who remain alive through the period ('survivors').

The implications of whether health care needs are affected more by proximity to death rather than by age are substantial in terms of likely additional costs associated with ageing populations. If health costs are largely related to age, then increased longevity will lead to more years spent alive, especially at the older, more expensive ages. On the other hand, if expenditure and health care needs are heavily determined by experiences around the time of death, then expected costs are likely to be less than anticipated for three main reasons. First, pushing back the age of death will also push the health care expenditure further into the future which will therefore make it cheaper (since it is possible to invest the resources which would have been needed in the current year so producing additional resources when they are required in years to come). Secondly, pushing out the age at death will reduce the number of deaths occurring in a given year, much as increasing age at birth pushes births into future years, a phenomenon observed in European countries for about 40 years now and which has had a substantial effect on period fertility rates over that extended period (e.g., Sobotka 2004). A third reason why later age at death is beneficial in cost terms is that in most, but not all, countries, it has been found that health care costs in the last year of life are generally higher for people who die at younger than at older ages. This is probably due to factors such as that aggressive intervention may be considered less worthwhile at older ages or age discrimination (Brockmann 2002). Therefore, the consequence is that the resource implications of ageing populations for the health care system are often interpreted as being less than might otherwise have been assumed.

Proximity to death is a useful analysis variable since it is easy to measure (albeit retrospectively) - at least in those countries where information on earlier circumstances can be linked to mortality data - and reflects health status, a major determinant of health care use: it is suggested that the cost of decedents and survivors with similar medical conditions are not very different (Hogan et al. 2001). However, health status is frequently unavailable, which is one reason why this paper concentrates on more readily-available measures such as sex, age and socio-demographic status. While some studies show the proportion of life spent in poor health increasing (an expansion of morbidity), others suggest the opposite (a compression of morbidity) (see e.g., Hoffmann/Nachtmann, Chapter 9 in this proceedings). Lacks of clear trends make it difficult to predict health status in the future, although, on balance, more experts expect a reduction in the proportion (although not the absolute numbers) of people with poor health, especially the more severe types of poor health such as inability to undertake one or more activities of daily living or instrumental activities of daily living. It might be thought that later age at death would push back the onset of disability, however, even with optimistic assumptions about improvements it is still likely that there will be no change in the proportions of people entering or time spent in nursing homes (Laditka 1998), nor average lifetime health care costs (Lubitz et al. 2003). Thus, while the demand for health care might not increase wholly in line with numbers in the older population (Freedman et al. 2002, Lafortune et al. 2004), health status improvement in the future may tend to reinforce the cost lowering tendencies on acute care of proximity to death noted above.

Much less is known about the relationship of social care costs, including long-term care costs, with age and proximity to death. It is recognised that social care costs, as with acute care costs, rise sharply with age, but it is less clear whether this is related primarily to age or to proximity to death. If the former is the case, the implications for demand for long-term care would be much more substantial then in the latter case (McGrail et al. 2000, Spillman/Lubitz 2000, 2002, Yang et al. 2003). McGrail et al. (2000) pointed out that previous studies of the relationship of age, proximity to death and costs have been restricted to acute medical care, so they included both acute medical care and nursing and social care in a study of British Columbia. They concluded that costs of acute care rise with age, but the proximity to death is a more important factor in determining costs and that these costs of dying in the period before death fall with age. These findings are confirmed in a number of studies from different countries. In contrast, costs of nursing and social care rise with age and proximity to death costs also increase with age at death. While age is less important than proximity to death as a predictor of overall costs, ageing has a relatively larger impact on social and nursing care costs than on acute medical care costs.

A number of other authors (Scitovsky 1984, 1994, Schneider/Guralnik 1990, Schulz et al. 2004) have compared health and nursing home costs, generally coming to the conclusion that although the intensity of care, as indicated by hospital expenditures, declines with age, any savings on hospital costs of very old decedents are offset by nursing home costs. Inclusion of a full accounting of acute and long-term care costs produces a much less optimistic scenario than those studies confined to acute hospital care only. Spillman and Lubitz (2000) estimated total expenditures for acute and long-term care from the age of 65 years until death and in the last two years of life in the United States. They found that total expenditures (in 1996 Dollars) from the age of 65 years until death increase substantially from 31,000 Dollars for persons who die at the age of 65 years to more than 200,000 Dollars for those who die at the age of 90, in part because of steep increases in nursing home expenditures for very old persons. Total spending in the last two years of life also increases with longevity, but a reduction in Medicare expenditures, which largely covers hospital and physician costs, (37,000 Dollars for persons who die at the age of 75 years and 21,000 Dollars for those who die at the age of 95) moderates the effect of the increase in nursing home expenditures (6,000 Dollars for those who die at the age of 75 years and 32,000 Dollars for those who die at the age of 95). They also note that health care spending for women is consistently higher than that for men, even after adjustment for their higher longevity. Overall, they concluded that the effect of population ageing on expenditure for acute care differs from its effect on expenditure for long-term care. Yang, Norton and Stearns (2003) investigated the relative contributions of both age and time to death to health care expenditures for elderly Medicare beneficiaries. They concluded that health care expenditures for older people increase with age primarily because mortality rates increase with age and health care expenditures increase with proximity to death. Time to death is the main reason for higher inpatient care expenditures, whereas ageing is the main reason for higher long-term care expenditure (for which Medicaid was a major source of funding), but, for example, average nursing home expenditure around ages 85 to 90 was about twice as high for those who died within one year as those who survived, a similar ratio as that was found for the Netherlands by Polder, et al. (2006).

In the context of ageing populations the importance of changing health status can be fruitfully elaborated with the example in Table 2. This table shows the projected number of older people and deaths in England and Wales between 2006 and 2051. The number of deaths is expected to remain at present levels for the next quarter century, whereas the population will increase by nearly 50%. If it is argued that deaths rather than population numbers are the key factor, then the relaxed views about health care costs may be justified. However, the much sparser evidence base shows that not only the older the population structure, the larger the long-term care costs, but that the last year of life "surcharge" (i.e., the extra average cost associated with the final year of life as compared with a survivor of the same age) increases with age. While health care costs in the last year of life are frequently found to fall with higher ages at death (Brockmann 2002), so offsetting the extra years of health care experienced by those who die at advanced ages, the surcharge for social care will tend to compound the extra costs associated with later ages at death. However, all these conclusions are based on the assumption that populations that live longer have no better health on average at a given age than those who die earlier. Better understanding of future health status changes is necessary.

Table 2: Population (in 1,000s) and deaths (in 1,000s), People aged 65 and over, England and Wales, 2006, 2011, 2021, 2041 and 2051

	2006	2011	2021	2041	2051
Deaths	4,422	4,150	4,229	5,846	6,312
Population	8,611	9,328	11,449	15,643	16,733

Source: Based on Office for National Statistics (n.d.).

2.2 Other Drivers of Health and Social Care Costs

However, the emphasis on proximity to death as a determinant of health care needs and resources is problematic. Its use as an independent/explanatory variable for earlier health care is an example case of a type of invalid reasoning 'conditioning on the future', and it would be more appropriate to phrase the question not as 'do people who die use more health care resources in the immediately preceding period?', but rather 'does greater use of health care lead to increased chance of death?'. Of course, the answer 'yes' to the latter question emphasises that it is not the health system that leads directly to death (except possibly in cases such as hospital-acquired infections, which typically affect 5 to 10 % of patients in countries such as US, Britain, France, Italy and Switzerland). Proximity to death is not important in its own right but mainly reflects poor health status, which is a major determinant of both health care use and subsequent increased chance of death. If information on proximity to death were available prospectively, it would presumably lead to alternative and better forms of treatment, including hospice care, the choice to die at home and whether to undertake aggressive medical interventions.

Care costs are of course not only determined by sex, age, health/disability status and proximity to death. Previous literature identifies that at least the following additional factors are of major importance: marital status, living arrangements, availability of kin, socioeconomic status and health care technology. So we will briefly review, how some of these might be expected to change in the future before introducing proximity to death as an independent determinant of use of acute and long-term care services.

The combination of improving mortality, reduced sex mortality differentials and the fact that cohorts now entering the retirement phase of life were in the prime marriage ages at the time of the peak marriage boom of the early 1960s (Sardon 2006), leads to a likely increasing proportion of women aged 80 who are married for two decades or so in both Britain and Finland as shown in Table 3 (Kalogirou/Murphy 2006). Also, an increasing proportion of non-married elderly in Finland live as a co-habiting couple.

Table 3: Proportion of married women aged 80, 2000, 2015 and 2030, England & Wales and Finland

	2000	2015	2030
England & Wales	29	40	46
Finland	21	34	38

Source: Authors' calculations based on analyses of Murphy/Kalogirou (2004).

Being single, widowed and divorced/separated is associated with higher costs of medical care than being married (Seshamania/Gray 2004) and it is well-recognised that married people are much less likely to live in institutions than others, typically by a factor of 10 at older ages (Murphy 2007) and to that extent, the increase in the proportion of people who are partnered will tend to reduce the demand for long-tem care places. However, Pickard et al. (2000) noted that the latest official marital status projections at that time indicated that more elderly people were likely to receive informal care than previously projected since the number of widows was expected to fall and the number of elderly women with partners to rise, a finding they found unexpected. This change will not only partly shift the burden of care from the institutional to community sector, but from the formal to the informal sector and from the community to the family – redistributing rather than necessarily reducing care.

While considerable attention has been given to social inequalities in health status, mortality and access to health care at younger ages, such disparities also exist even in the period just before death in some cases. However, use of services is influenced by socio-economic status through its effect on health status as well as directly. Liao et al. (1999) using the US National Health Interview Survey (1986 - 1990), with mortality follow-up found that among 10,932 decedents (50 years or older, at baseline interview) educational attainment was inversely associated with long-term limitation of activity, number of chronic conditions and number of bed days and days of short hospital stay during the year preceding the interview. They concluded that decedents with higher socio-economic status experienced lower morbidity and disability and better quality of life even in their last years of life.

Hanratty et al. (2007) used Swedish linked registers to analyse 16,617 deaths among Stockholm County Council residents in 2002 and found that county council expenditure on health care in the last year of life rose with increasing income of the deceased person. Median per capita expenditure increased from 55,417 Swedish Kronor (SEK)[1] in the lowest income group to 94,678 Swedish Kronor in the highest, although expenditure decreased with increasing age over 65 years in all income groups. Higher income was independently associated with greater total public health spend in multivariate analysis, adjusting for age, sex, health-care utilisation and major diagnostic groups suggesting that inequality in public expenditure on health care at the end of life across socio-economic groups exists within Sweden, as well as in countries with less comprehensive welfare systems. However, in Finland, Häkkinen et al. (2008) did not find any strong positive associations between income and expenditure for most non-long term care categories of health care utilisation in the years preceding death, apart from expenditure on prescribed medicines, in which costsharing between the state and the individual is relatively high. They concluded that in the future, health care expenditure might be driven more by changes in the propensity to move into long-term care and medical technology than by age and gender alone, as often claimed.

3. The Policy Background

Health and long-term care provision is a sensitive political area and there are well-recognised pressures to improve services while containing costs. Relatively similar concerns regarding policy responses to these developments have been raised in many of the European countries, including Finland and Britain, as well as international organisations such as the OECD. Below we will briefly describe the policy debate in Britain. In Britain, the relative under-funding of health services was acknowledged by setting up a Review Panel which reported in 2002 (Wanless 2002) and which recommended substantial increases in funding. The importance of meeting the health care needs of older people was a major area of investigation and the Review split its modelling of hospital care between people in their last year of life (decedents) and those not in their last year of life (survivors). The framework was based on the premises that "The costs of acute care are strongly associated with proximity to death, regardless of age at death, i.e., health costs for older people are higher mainly because they are closer to death" but that "Such a split [into survivors and decedents] has not been used for social care. There, as costs increase with proximity to death, they also increase with age" (Wanless 2002: 43). The same Chairman undertook a second study of social care (Wanless et al. 2006) and in the second report he pointed out that "The five years since the [first] Report in 2002 have

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[1] 1.00 Swedish Kronor = 0.099 Euro; 55,417 Swedish Kronor = ca. 5,490 Euro; 94,678 Swedish Kronor = ca. 9,380 Euro (24/09/09).

witnessed unprecedented levels of government investment in the [National Health Service] NHS – there has been average annual real term growth of 7.4 over the five years to 2007/8. Over that period, real spending on the NHS has risen by nearly 50% – a total cash increase of 43.2 billion British Pounds– while the proportion of the United Kingdom's gross domestic product (GDP) devoted to health care spending has grown to 9 - 10%, within striking distance of the European Union average." However, the second report made no recommendations for such a massive effort to be devoted to improving social care, even though a key driver of demand, population ageing, was clearly going to require considerable additional resources. Wittenberg et al. (2004) estimated that long-term care expenditure in the UK would need to rise by over 300% in real terms between 2000 and 2051 to meet demographic pressures and allow for real rises in care costs of 1% per year for social care and 1.5% per year for health care.

4. Aims of the Finnish Case Study Analyses

The aim of our case study is to assess drivers of future demand for both acute health care and long-term social care. In addition to proximity to death, we will concentrate mainly on sex, age and marital status. Kin availability for Britain and Finland has been discussed elsewhere (Murphy et al. 2006) and we regard future developments in technology and health status as more problematic to project than those we concentrate on. While projections of older populations have by no means been accurate in the past, the earlier underestimation of mortality has been substantially corrected for, and although the precise level of mortality improvement will clearly be incorrect, there is clearly a consensus that mortality will continue to improve, whereas there is no consensus that health status of older populations will improve, deteriorate or remain approximately constant. In addition, it is unclear whether the range of technologies will lead to more or less demand for care services. On the other hand, it seems likely, for example, that the mortality differential between men and women will continue to diminish, and there is clear evidence from across Europe that the proportion of older people who are married or divorced will increase, whereas the proportions widowed will decline (Kalogirou/Murphy 2006). Therefore, we regard future predictions of age, sex, marital status and proximity to death as more robust than the other drivers above. Whatever happens to these other drivers, the ones we concentrate on will continue to affect future patterns. Our analysis is based on a standard ceteris paribus assumption – these analyses are based on other factors we do not consider remaining unchanged, but we use a wider set of drivers in our analyses than is usual in this area. In order to investigate some of the issues, we use data from Finland which is one of the few countries that has relevant data.

4.1 Data for Use of Long-term Care (LTC) before Death in Finland.

Few countries have good data on long-term care (and even fewer on joint use of community and hospital facilities): reasons include incompatible record systems, confidentially issues regarding linkage of records and the difficulty of sampling communal establishments. However, some countries have good integrated longitudinal record systems such as Finland based on linkages of relevant registers (Häkkinen et al. 2008).

The data set we use consists of a 40% sample of elderly in Finland aged 65 and over with a baseline at 31.12.1997 followed until the end of 2003. The data set used here includes the sum of all days spent in hospital (overnight hospital stays or day surgery) and long-term care (nursing home care and rehabilitation care) up to six years prior to death between 1998 and 2003 or by the end of the follow up period if alive in various "windows".

These windows are the periods before death (if died before end of 2003) or before the end of follow-up (end of 2003) if alive:

- 0 - 3 months
- 4 - 6 months
- 7 - 9 months
- 10 - 12 months
- 13 - 18 months
- 19 - 24 months
- in the 3rd year (i.e., in year 2001 for survivors at end 2003 or N months earlier if death occurred N months before the end of 2003)
- in the 4th year
- in the 5th year
- in the 6th year

In addition, the data set contains other information:

- Age at baseline
- Sex
- Education 1997
- Social class 1995
- Marital status1997
- Living arrangement 1997
- Date of death of spouse
- Cause of death
- Date of death.

We concentrate on the main differences between groups according to whether they survived through 2003 or died in that year. Most studies are concerned with the costs of health care, often from the perspective of a provider or funder of a particular part of the health care system rather than from the perspective of users of the health care system. We use days spent in hospital and long-term care establishments as the main indicators of use since these are well-defined and have also been used in other studies and so facilitating comparisons. They are indicators of being in the need of more severe care from both the health care and social care sectors. From the viewpoint of the patient, the costs may be unknown and irrelevant. However, bed days are a more meaningful indicator of the health status and care needs of the person concerned (although it should be recognised that a hospital bed day will usually be more expensive from the viewpoint of the health care provider, whose perspectives are not necessarily co-incident with those of the patient, the focus of this study). We concentrate on the situation of those alive at 31.12.2002 who were therefore aged 70 and over at that time and we analyse their use of hospital and long-term care services in the 12-month period of 2003 (if alive at 31.12.2003) or in the 12-month period before death (if died in 2003). The total sample size was 227,812.

4.2 Results

Table 4 shows the average number of days in hospital or long-term care by age. By their late 70s or early 80s, people spend slightly more time on average in long-term care than in hospital care, rising to about twice as many days by age 95 and over. In addition, the increase with age is much steeper; 25 times as much long-term care days for those aged 95 and over as for those aged 70 to 74.

Table 4: Average hospital and long-term care days by age

Age group	Hospital days	LTC days	N	LTC as % total days	Hospital days: Ratio to age group 70 to 74 (=100)	LTC days: Ratio to age group 70 to 74 (=100)
70 to 74	7.2	5.3	84,974	42.3	100	100
75 to 79	13.1	12.6	67,559	49.1	183	240
80 to 84	22.0	28.5	43,030	56.5	307	543
85 to 89	35.9	56.0	22,333	60.9	502	1,066
90 to 94	51.6	90.3	8,343	63.6	722	1,720
95 and over	66.8	131.3	1,573	66.3	933	2,501

Source: Authors' analysis of Finnish register data.

Table 5 shows these data broken down by whether they were survivors or decedents in 2003. The proportion of decedents increases steadily with age, but the absolute numbers peak in the age group 80 to 84, but even so, they account for under 10 % of that population. In total, decedents in 2003 account for about 6 % of those alive at the start of the year, although this proportion will decrease substantially in the future as the average death rate for older people declines as Table 2 shows.

At young ages decedents use about 10 times as many hospital bed days as survivors, a finding similar to studies in other countries, but at these ages, the ratio for use of long-term care beds by decedents compared to survivors is about five to one, again similar to other countries (e.g., Polder et al. 2006). Both of the ratios decline with increasing age, so that in the peak age for number of decedents the ratios are about halved, 5 to 1 and 2.5 to 1, respectively.

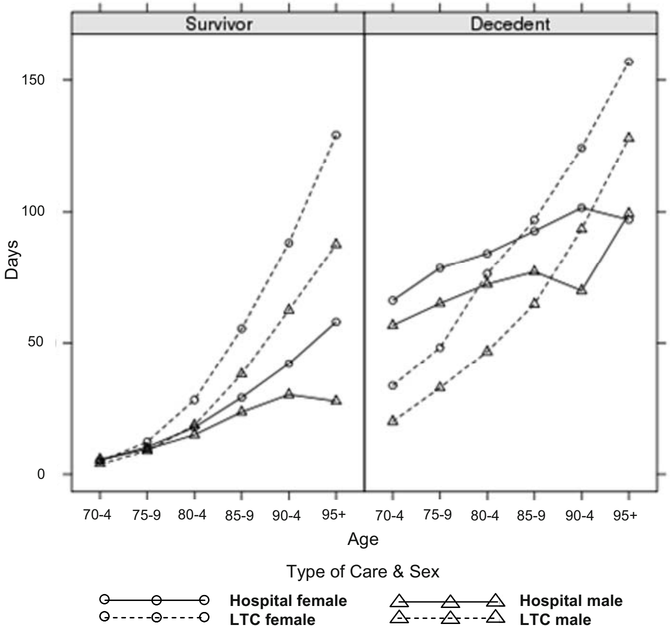
Table 5: Average hospital and long-term care days in previous 12 months by age and survival status

		Average number of days in:				Ratio number of days of those dead to alive (=100) in age group spent in:	
Age group	Survival status	Hospital	LTC	N	LTC days as % total days	Hospital	LTC
70 to 74	Alive	5.7	4.7	82,769	45.1	1054.5	542.1
70 to 74	Dead	60.5	25.5	2,205	29.7		
75 to 79	Alive	10.3	11.3	64,519	52.2	695.4	359.1
75 to 79	Dead	71.7	40.5	3,040	36.1		
80 to 84	Alive	17.2	25.5	39,697	59.8	463.8	254.4
80 to 84	Dead	79.6	64.8	3,333	44.9		
85 to 89	Alive	27.9	51.2	19,343	64.7	315.5	170.3
85 to89	Dead	87.9	87.1	2,990	49.8		
90 to 94	Alive	39.6	82.8	6,492	67.6	236.4	140.9
90 to 94	Dead	93.7	116.7	1,851	55.5		
95 and over	Alive	53.1	122.4	1,088	69.7	183.5	123.7
95 and over	Dead	97.4	151.4	485	60.9		

Source: Authors' analysis of Finnish register data.

In general, women make more use of formal services, both health and social care, although part of this excess is explained by the fact that men are more likely to have a spouse to provide informal care. This is also true in Finland (Figure 2), and the patterns with age are broadly similar (apart from a decline in hospital use among male survivors aged 95 and over which is unlikely to be an artefact of small sample numbers). Overall, women's use of both hospitals and long-term care is about 20% higher than that of men at the same age. Thus, to the extent that the proportion of men among the old population is likely to increase, this will have the effect of reducing the overall average of using care.

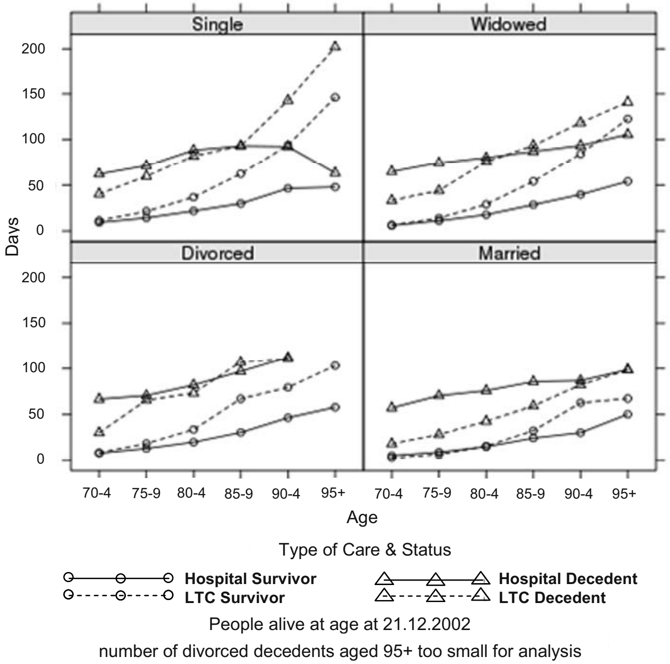
Figure 2: Average days in hospital/LTC, in previous 12 months by sex, age and survival status, Finland



People alive at age at 21.12.2002

Source: Authors' analysis of Finnish register data.

Figure 3: Average number of days in hospital/LTC, in previous 12 months by age, martial status and survival status, Finland



Source: Authors' analysis of Finnish register data.

Turning now to the relationship with marital status, Figure 3 shows the patterns by marital status at 31.12.2002.[2] The most striking point is the much lower use of long-term care facilities by married people, with patterns for the various un-partnered groups being broadly similar. The lower use of such facilities by the married is in line with expectations. The fact that rates among non-married groups are typically about 50% higher than among married people taken in conjunction with the fact

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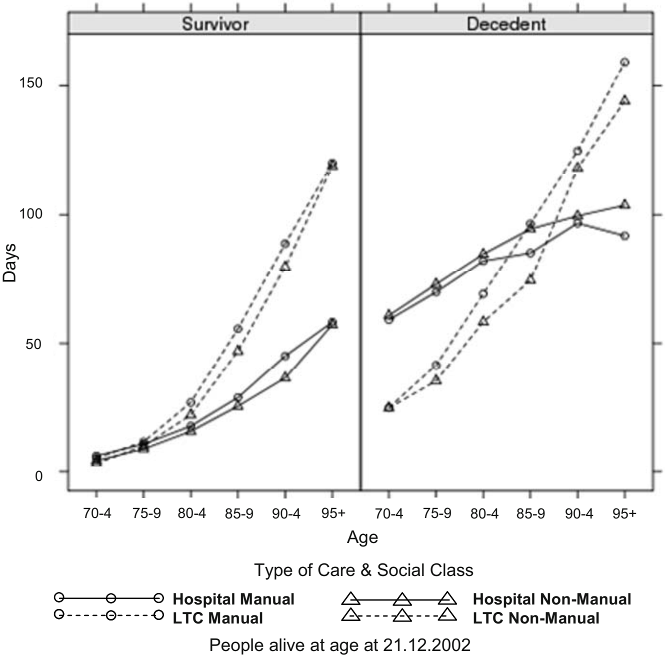
[2] Since only marital status at 31.12.1997 was available, people who were married at that date, but whose spouse died in the intervening period were allocated to the widowed group. This will lead to some minor inaccuracy since re-marriages in the period and divorces cannot be incorporated. However, the number of such events beyond age 65 is very small (Murphy/Kalogirou 2004), so the effect of such misclassification will also be very small. We should note that these data do not identify cohabiting couples, but refer only to de jure marital status.

that a smaller proportion of older people are likely to be non-married in the next quarter century, means that this will tend to reduce the demand for long-term care places to that extent. For hospital use, the differences are generally quite small between marital status groups (the numbers in some groups such as divorced people aged 95 and over are small, so they may be subject to large sampling variability and therefore are not shown).

Figure 4: Average number of days in hospital/LTC in previous 12 months by age, social class and survival status, Finland



Source: Authors' analysis of Finnish register data.

This finding is consistent with other studies which show married people are less likely to use hospital services (Prior/Hayes 2001). Although, when they do so, they were found to receive higher quality treatment in the US (Iwashyna/Christakis 2003), possibly arising from a benefit of marriage: the availability of a partner who monitors health status and advice and seeks care for the spouse is advantageous.

That appears paradoxical, since they often report the best health of all marital status groups.

However, the lower use of hospital services by non-married old-old found in other studies may also be due to the fact that they are much more likely to be in long-term care where some facilities to monitor health status are available and they are able to substitute long-term care for hospital care. Overall, these Finnish data show that single and divorced people tend to spend less time in hospital in the year of death but more time in long-term care – if the total number of days in both sectors is considered, use is much greater for nonmarried than for married groups.

For completeness, we also consider the role of socio-economic factors by showing hospital and long-term care use for manual and non-manual social classes in 2003 (as measured in 1995; we exclude other groups such as farmers and students to simplify presentation). Figure 4 indicates that differences between social classes are small, with rather higher rates of use by non-manual than manual classes, possibly reflecting higher rates of ill-health in lower social classes. Both differentials are small and the social class composition of the population is changing slowly, this factor is unlikely to make a substantial difference for demand for care in the near future.

5. Conclusions

This paper has reviewed the relationship of proximity to death in relation to acute and long-term care. The greater importance of age as a determinant of long-term care use as compared with the relevance of proximity to death for acute care is confirmed. However, the volume of long-term care (as measured by bed days) is greater for the old-old than is the case of acute care, and while socio-economic differentials (as measured by manual/nonmanual status) are relatively small, marital status differentials are substantial and changes in marital status distributions reasonably and easy to predict for the older population in years to come. It would therefore be sensible to include the changing socio-demographic composition of the population, especially marital status, in future projections of both acute and long-term care need.

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Old Age, the Need of Long-term Care and Healthy Life Expectancy

Elke Hoffmann, Juliane Nachtmann

1. Introduction

Because of increased life expectancy, the concept of "old age" refers to a much longer biographical time span today than it did for past generations. Old age is a phase in life that is still increasing in length and which today can last 40 years or longer. Very old age is rapidly becoming a new dimension of ageing, as the growing number of people in Germany aged 105 years or older demonstrates. The number of very old people has almost tripled over the past decade (Maier/Scholz 2007). Moreover, it is remarkable that people aged 80 and above represent the fastest growing population group.[1]

In order to describe demographic developments in the older population and the complexity of the ageing process in more detail, today total lifespan is subdivided into Third and Fourth Ages. But what explains this dichotomy between the 'young old' and the 'old old'?

Transition into retirement is often taken to be the beginning of the Third Age. This group of 60- to 65-year-olds exiting the labour market is "(…) generally well equipped with health, material, social and cultural resources, with very few significant restrictions due to old age and endowed with fresh possibilities for leading to an active, autonomous and accountable life" (Federal Ministry for Family Affairs, Senior Citizens, Women and Youth (BMFSFJ) 2001: 66).

The Fourth Age – by which we mean ages 80 and upwards – is accompanied by a growing risk of being afflicted with multimorbidity, dementia and various forms of dependency. For example, 41% of men and 54% of women aged 85 or older report that they suffer from at least five moderate to severe illnesses (Steinhagen-Thiessen/Borchelt 1999). This accounts for the probability of being dependent on the help and support of others in coping with everyday activities (Hoffmann/Nachtmann 2007). It should be borne in mind, however, that there are con-

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[1] The German Federal Statistical Office anticipates an increase of this age group from 3.8 million today to 10 million in 2050. That is an increase in this group's proportion of the population from just 5% to around 15% (Federal Statistical Office 2006: 43).

siderable variations within the old age population in this regard. The following analysis looks more closely at some of these differences. Sub-chapter 2 provides theoretical background on the question of whether people who live longer remain active, or whether they spend the additional years of life sick and in need of care. In Sub-chapter 3, the German law on care statistics and the data and methods used are presented. The results are described in Sub-chapter 4 and Sub-chapter 5 concludes.

2. Theoretical Background

Good health is a basic requirement for active, independent ageing and can be described as a key asset of quality of life. Given the steady increase in life expectancy, it is interesting to ask whether the additional life years gained are spent in good or bad health.

The analyses of the German Ageing Survey show that current cohorts enter old age with ever improving health and with fewer illnesses than previous generations (Wurm/Tesch-Römer 2006). There are even indications that the health of the very old has improved. In 2002, for example, around 32% of all older women aged 85 and above were living autonomously and without the need of outside help in their own household – an advance of 9% compared to 1991 (Schneekloth/Wahl 2006: 65).

Generally, however, the literature provides contradictory theoretical positions on this question. Following the work done by Fries (1980, 1989), proponents of the 'compression theory' assume that morbidity declines with increasing life expectancy: i.e., that the interval between the age when a chronic illness first appears and the later date of decease becomes shorter because primary prevention and a healthier life style postpone the onset of chronic morbidity. The 'expansion theory' contradicts this hypothesis, maintaining that overall morbidity is increasing (Gruenberg 1977). Curative medicine is admittedly making progress in dealing with the complications that accompany chronic illnesses, and thus prolongs life. But, according to the expansion theory, the progression of the primary disease cannot be halted. This leads to an expansion of the length of morbidity (Kuhlmey et al. 2007). A third scenario, known as the 'dynamic equilibrium', posits that a shift is occurring in the severity of health limitations from more severe disabilities today, to fewer serious illnesses in the future (Manton 1982).

The theories propagated in this scientific discourse have been somewhat modified over the past few years. New findings have led to a more differentiated view that distinguishes between an 'absolute' and 'relative' compression or expansion of morbidity (Robine et al. 1993). The 'relative compression' approach would, for example, assume that, while the period in life in which poor health is experienced is increasing, the proportion of the total lifespan is decreasing. The reverse situation would be that the number of healthy years is increasing, but is at the same time decreasing as a proportion of total lifespan ('relative expansion').

In Germany, authors such as Dinkel (1999), Klein/Unger (1999, 2002) and Ziegler/Doblhammer-Reiter (2005, 2007) have conducted empirical analyses on the two opposing theories. Because of the use of differing time perspectives, age groups, definitions and measurements for the indicators used in the analyses, a direct comparison of the empirical results is not feasible. Nevertheless, the studies that have been undertaken mainly show a positive picture of the development of healthy life expectancy. International studies that examine the health quality of the additional years of life also confirm to some extent a positive trend. A compression of morbidity over time was, for example, demonstrated in the case of the Austrian population by Doblhammer/Kytir (2001) and by a working group around Kenneth Manton (1998) for the USA. Broad overviews of this research are available in Robine et al. (2003) and in the publications of the international research network REVES (International Network on Health Expectancy and the Disability Process), which endeavours to supply standardised methods and comparable results (Romieu 2007).

3. Long-term Care Statistics in Germany

3.1 Long-term Care Statistics in German Law

The empirical analyses presented here are based on the official long-term care statistics of Germany. The collection of these statistics is regulated in the Long-Term Care Statistics Regulation of 24 November 1999 as national statistics with an obligation of ascertainment.[2] They are linked to the Long-Term Care Insurance Act[3] (SGB XI: Social Code Book XI), which was introduced in two phases in 1995 and 1996, and which determines the social protection of those in need of long-term care. The data collection is a complete survey of all recipients of Long-Term Care Insurance benefits (Federal Statistical Office 2007). The statistics have been maintained at two-yearly intervals since 1999. Currently, they constitute the largest, most detailed and most consecutive set of empirical facts on care in Germany.

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[2] Section 109 Social Code Book XI "(1) For the purposes of the Code, the Federal Government is authorised to request by ordinance issued with the consent of the Bundesrat annual surveys in the form of national statistics of non-institutional and institutional care facilities and home care". The Care Statistics Regulation of 24 November 1999 regulates the actual implementation of the collection of statistics. BGBl I 1999 No. 52: 2282-2283 (Federal Law Gazette).

[3] Act providing for the social protection of persons in need of long-term care – Long-Term Care Insurance Act – of 26 May 1994 (BGBl. I 1994 No. 30: 1014-1015).

The social law definition of dependency (see Pfaff, Chapter 1, Sub-chapter 2.2 in this proceedings) regulates access to social law benefits to compensate for deficits that are mainly physical and to make a distinction between these and other types of social benefits. This definition is quite distinct from the concept of the individual need for help and care used in surveys based on self-rated health and on individual assessments of the ability to cope with health impairments that affect daily life.

Any analysis and interpretation of data from official long-term care statistics must therefore be treated in terms of the following:

- The data are based exclusively on the social law concept of dependency as defined in Social Code Book XI Sections 14 and 15. If the term 'persons in need of care' is used, it is indicated that he or she is a recipient of Long-Term Care Insurance benefits and is assigned to one of the care levels. An amendment to the social law definition currently under discussion as part of the reform of the Long-Term Care Insurance Act would have a significant impact on the prevalence of care need assessed by the official statistics.
- The data reflect both officially recognised dependency and the behaviour of the population in claiming social benefits in accordance with the Long-Term Care Act. The latter pre-supposes a certain degree of knowledge on the part of those concerned and the individual ability and motivation to apply for benefits.
- The actual extent of the need for care and assistance is greater than the official care statistics would suggest. Not all of those affected apply for recognition of a care level and not all applications are approved. The Medical Advisory Service approval rate for recognition of a care level has been 70% in recent years (Federal Ministry of Health (BMG) 2007). The assessment practice of the Medical Advisory Service, which is subject to constantly changing assessment guidelines, also influences the prevalences shown in official long-term care statistics (Federal Ministry of Health and Social Security (BMGS) 2004: 48).

3.2 Data and Method

The following statistical analysis of the characteristics of dependency is based on the official statistics measuring long-term care benefits as defined in Social Code Book XI. Use was made of a Scientific Use File (SUF) with micro data on benefit recipients broken down by single-year age intervals, sex, care level and type of provision supplied for the survey dates 1999, 2001, 2003 and 2005. This was provided by the Research Data Centres of the Federal Statistical Office and the Statistical Offices of the Länder (FDZ).

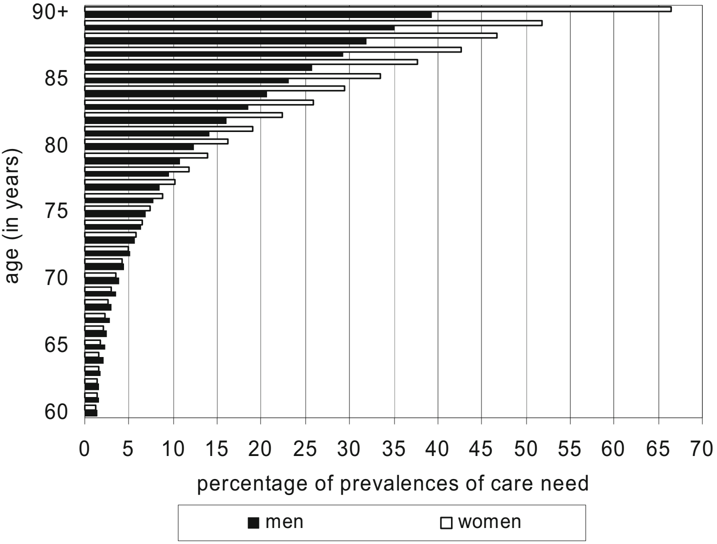
The population at December the 31st of each year recorded by the German Federal Statistical Office was used to calculate the prevalence of care need. The abridged periodical mortality tables for Germany in 1998/2000 and 2004/2006 were the reference point for the analysis of healthy life expectancy.

4. Descriptive Results

4.1 Analysis of the Prevalence of Care Need for Women and Men

In the year 2005, the Federal Statistical Office records 2.13 million people in Germany with a recognised care level. Compared to 1999, this represents an increase of 112,000 people, or 6%. The number of dependent people in relation to population shows that, for the year 1999, the care need prevalence was 2.5%; for 2005, it was about 2.6% (Federal Statistical Office 2007). Despite an increase in the absolute number of dependent people in Germany over a six-year period, their proportion of the total population has altered little. One reason for this is the accelerated ageing of the population (Federal Statistical Office 2008: 18).

Figure 1: Care need prevalences for women and men in 2005



Source: SUF - Long-term care statistics, Research Data Centres of the Federal Statistical Office and the Statistical Offices of the Länder (FDZ).

Although dependence is not limited to the older members of the population, the probability of needing help and support by others increases sharply with age. This can be seen in Figure 1 that shows the percentage of care need prevalences for women and men for single-year age intervals in 2005.

In 2005, four out of five people in need of long-term care were aged 65 or older. Looking at the proportion of dependent individuals in relation to the population of all ages, the five percent mark is first reached by both women and men at the age of 72. This alone demonstrates the importance of long-term care as an issue for those generations in the Third and Fourth Ages. The highest dependency rate is seen in the over-nineties age group, of whom more than 66% of women and more around 40% of men are in need of care (Table 1).

The gender differences here are striking. In 2005, two-thirds of all dependants were women and from the age of 70 onwards, as many as 74% were female. The sharp increase in dependency among women aged 80 to 85 is very noticeable, rising from 16.3% to 33.6%. Finally, one in three women over the age of 85 and at least every second woman aged 89 and over, were affected by dependency. The rate for men, on the other hand, was much lower. The larger prevalence differences between women and men start at the age of 80. Men showed a 10% lower prevalence than women at the age of 85 and, at older ages showed as little as three-quarters of the female prevalence. Meanwhile, younger people exhibited only very small gender differences in care need. In general, women were more affected by dependency than men. But for both sexes, there were only minimal changes in prevalences over time at each age (here shown for 1999 and 2005 in Table 1). Gender seems to remain a dominant structural characteristic of dependency risk.

Table 1: Care need prevalences for women and men in 1999 and 2005

Age	Women		Men	
	1999	2005	1999	2005
60	1.21	1.25	1.43	1.43
65	2.13	1.85	2.55	2.24
70	3.83	3.60	4.13	3.90
75	7.94	7.44	7.31	6.87
80	17.46	16.29	13.5	12.26
85	33.72	33.58	24.15	23.08
90+	65.33	66.51	41.98	39.24

Source: SUF - Long-term care statistics, Research Data Centres of the Federal Statistical Office and the Statistical Offices of the Länder (FDZ).

What is the reason for these gender differences? One explanation for the higher percentage of dependency among women is undoubtedly the fact that women live longer and that the need for care increases with age. A 70-year-old woman will live today for an additional 16 years, while a coeval man will only live for another 13 years (Table 2). Women at age 85 may expect to live an additional six years, while men have only 5.4 years left to live. But the higher life expectancy of women does not by itself explain their higher rate of dependency. The reasons can be found inter alia in the gender-specific health conditions and disease patterns of older people (Naumann Murtagh et al. 2004, Schneider 2002, Verbrugge 1982). Women suffer more often than men from chronic illnesses or multimorbidity. These are not directly fatal but can, nevertheless, place lasting constraints on an autonomous lifestyle and lead to dependency over the longer term (as, for example, in the case of osteoporosis with restricting effects on mobility). In addition, dementia is more likely to occur at higher ages and thus poses a particular risk for women as more women reach these ages. Circulatory diseases are the most frequent illnesses attacking men and are likely to be fatal, and thus remain the most common cause of death.

Data by Pick (2004) on the diagnoses triggering the need for long-term care clearly underline these differences between women and men. For women between 65 and 79 the three main causes of care need are diseases of the circulatory system (19.7% of all diagnoses), mental and behavioural disorders (17.8%) and diseases of the musculoskeletal system and connective tissue (16.3%). The results for men show that diseases of the circulatory system (25.3%), neoplasms (19.6%) and mental and behavioural disorders (15.3%) are the main causes of care need. At age 80 or older, symptoms, signs and abnormal clinical and laboratory findings that are not elsewhere classified as a specific disease were found to trigger the need for care for 24.7% of women and 23.5% of men (Pick et al. 2004).

It is also conceivable that there is a specific female pattern of behaviour when the application for a care level is made. Women are widowed much earlier than men and, hence, have fewer compensatory resources in their private environment to fall back on when the need for care and assistance arises. Dependent men, in contrast, are often looked after by their wives, so they sometimes refrain from applying for care benefits (Federal Statistical Office 2008: 22). Additionally, women also utilise health services more frequently than men (Mehrbach et al. 2006, Wurm/Tesch-Römer 2006, Schneider 2002: 56-61, 113-117).

Table 2: Healthy life expectancy, remaining life expectancy and the healthy life years ratio for German women and men in 1999 and 2005

	1999			2005		
Age	Healthy life expectancy in years	Remaining life expectancy in years	Healthy life years/ Remaining life expectancy %	Healthy life expectancy in years	Remaining life expectancy in years	Healthy life years/ Remaining life expectancy%
			Women			
60	20.56	23.50	87.5	21.01	24.49	85.8
65	16.27	19.25	84.5	16.66	20.18	82.6
70	12.24	15.25	80.3	12.47	16.03	77.8
75	8.54	11.61	73.6	8.60	12.22	70.4
80	5.37	8.47	63.4	5.19	8.87	58.5
85	2.95	5.93	49.7	2.45	6.16	39.8
90+	1.43	4.13	34.6	0.31	4.11	7.50
			Men			
60	17.75	19.25	92.2	18.66	20.58	90.7
65	14.04	15.57	90.2	14.81	16.77	88.3
70	10.74	12.31	87.2	11.23	13.25	84.8
75	8.05	9.73	82.7	8.05	10.15	79.3
80	5.18	6.83	75.8	5.18	7.40	70.0
85	3.43	5.15	66.6	2.87	5.40	53.1
90+	2.33	4.02	58.0	0.55	3.75	14.7

Source: SUF - Long-term care statistics, Research Data Centres of the Federal Statistical Office and the Statistical Offices of the Länder (FDZ).

4.2 Analysis of Healthy Life Expectancy

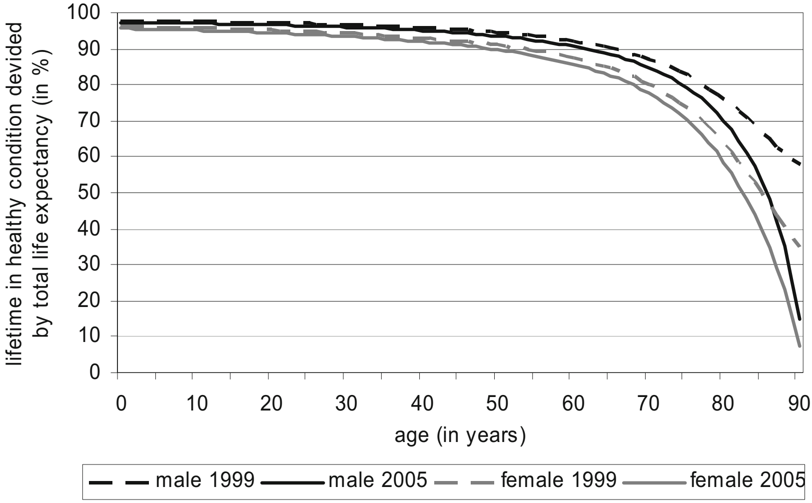
The availability of data on the single-year prevalence of care need made it possible to calculate the number of healthy life years, or years without recourse to benefits from Long-Term Care Insurance. It is, therefore, also possible to calculate the proportion of healthy life years in relation to (total) remaining life expectancy. To calculate the number of healthy life years, the Sullivan method was applied (Robine et al. 2007, Jagger 2006, Heigl 2002, Dinkel 1999, Vita et al. 1998). The calculations were based on the prevalence distribution of dependency according to age and sex in reference to the age-specific death rates of the periodical mortality table.

Gender and Age. In Table 2, the number of healthy life years and the remaining life expectancy of women and men for 1999 and 2005 are presented. What clearly emerges from the results is that women have more healthy years up to around the age of 80 than men in 1999 and in 2005. In 2005, a 60-year-old woman may expect 2.3 more healthy years than a man of the same age, while for 70-year-olds, a difference of 1.2 years is observed. This advantage for women turns into a disadvantage at higher ages, as men have more remaining healthy years than women. The reason for this is, as described above, the higher care prevalence among women at higher ages.

Time. Furthermore, it can be shown that the number of healthy life years increased from 1999 to 2005 for men and women, but only for the age groups below 80. In the subsequent Fourth Age, with its typical higher care prevalence, a trend towards a decrease in healthy years can be noted. The shifts are minimal, however, and are interpreted by the Medical Advisory Service more as delayed effects of the introduction of Long-Term Care Insurance (Wagner/Brucker 2007: 21).

In order to answer the questions raised earlier regarding compression and expansion of morbidity in the case of an ongoing increase in life expectancy, healthy life expectancy calculated on the basis of care prevalence must be seen in reference to total remaining life expectancy. The quotient calculated in Columns 4 and 7 of Table 2 shows the number of healthy life years – i.e., years without need for long-term care – in relation to remaining life expectancy in 1999 and 2005 in the following HLY-ratio (Figure 2).

Figure 2: Healthy life years in reference to total remaining life expectancy (HLY-ratio) in 1999 and 2005



Source: SUF - Long-term care statistics, Research Data Centres of the Federal Statistical Office and the Statistical Offices of the Länder (FDZ).

Gender and Age. At both measurement points, the proportion of years without the need for care in relation to the remaining life expectancy was found to be lower for women than for men. Given the higher care prevalence for women, this seems to be plausible. Additionally, it can be seen that the higher the ages, the lower the HLY-ratio. That means that healthy life years in relation to remaining life expectancy tend to decrease with age.

Table 3: Change in remaining life expectancy and healthy life expectancy between 1999 and 2005, in years

Age	Change in remaining life expectancy 2005-1999	Change in healthy life years 2005 - 1999
	Men	
60	1.33	0.91
65	1.20	0.77
70	0.94	0.49
75	0.42	0
80	0.57	0
85	0.25	-0.56
90+	-0.27	-1.78
	Women	
60	0.99	0.45
65	0.93	0.39
70	0.78	0.23
75	0.61	0.06
80	0.40	-0.18
85	0.23	-0.50
90+	-0,02	-1,12

Source: SUF - Long-term care statistics, Research Data Centres of the Federal Statistical Office and the Statistical Offices of the Länder (FDZ).

Time. The healthy life years increase during the same time interval, but at a slower pace than the remaining life expectancy (while HLY increase only until the ages around 80 and the total remaining life expectancy only to the ages under 90). For example, the remaining life expectancy of 60-year-old women (men) increased by 0.99 (1.33) years, while the healthy life expectancy grew by just 0.45 (0.91) years (Table 3). That is, the greatest positive changes in both parameters were made in the youngest cohorts, while in the age groups of the Fourth Age, losses in both measures have to be recognised. All in all, it can be said that the positive growth in remaining life expectancies during the observation period was more intensive than that of the healthy life expectancies in all age groups. This means, in turn, that the relative proportion of dependent years has grown since 1999. Thus it is apparent that the gain in years, whether healthy or in total, is bigger for men than for women.

Seen in relation to the theory of compression and expansion of morbidity in old age discussed earlier and measured here on the basis of an indicator of officially recognised dependency, the following conclusion is reached: the years spent in good health increased in the period of observation, albeit at a slower rate in relation to longer overall remaining life expectancy. The result is a proportionate increase in lifetime in which the quality of life is restricted. Thus, the classic theory of compression appears to be confirmed. But, as the proportion of healthy life years to remaining life expectancy has decreased, the results indicate that a 'relative expansion' of care need took place in Germany between 1999 and 2005. However, it should be pointed out that more differentiated analyses are required for the age group 90 and over. This group is particularly affected by the risk of dementia and the resultant dependency implications. It remains to be seen to what extent scientific and medical and technical progress can reduce this risk in such as way as to produce measurable positive health effects for people in the Fourth Age.

5. Conclusions

As mentioned in the introduction, in future the number of old people, particularly oldest old people, will increase. Thus, it becomes more and more important to be able to make accurate assessments on the demographic development for these age groups that are based on reliable data.

This is, after all, the information local government bodies will need in planning to meet the demand for institutional and home care services. But at this point a problem occurs: the population data for Germany make it difficult to assess the situation for those aged 90 and older (Jdanov et al. 2005) because it is not possible to calculate differentiated care prevalences for the oldest old. An additional difficulty is that the official care statistic data do not represent 'care biographies' since they can be used for cross sectional analysis only. Medical and care histories of the recipients of benefits, including time spent in and transition to higher care levels, cannot be reconstructed. This information is collected in detail by the Medical Advisory Service when dependency is assessed, but the data are not available to the scientific community. Questions relating to specific care risks remain unanswered for this reason.

In future it will be important to focus even more strongly on questions relating to causes and interdependences of care need. At what age does the interplay between the aftermath of illness, degenerative processes and individual resources offsetting health impairments evolve into an acute need for care? How do disease patterns, subjectively perceived health, and internal and external resources influence the course of care progression (e.g., the length of care, the transition between care levels and institutional vs. home care service provision)? What are the influencing factors that cause health inequality in old age and the differences in quality of life among the elderly?

Seen overall, the results presented here seem to suggest a 'relative expansion of morbidity'. The years spent in good health increase, yet their share in overall years of life is declining. But it should be pointed out that it is not sufficient to restrict the focus to dependency and its prevalence, since they are based on periodical analyses and do not allow us to study cohort aspects. However, findings on 'healthy life expectation' extracted from official care statistics can provide one further piece in the puzzle, enhancing our understanding of the connections between old age, health and care.

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Trends in Individual Trajectories of Health Limitations: A Study based on the German Socio-Economic Panel for the Periods 1984 to 1987 and 1995 to 1998

Gabriele Doblhammer, Uta Ziegler

1. Introduction

Health is a dynamic process and individuals differ in their pathways, experiencing deterioration, but also recovery. Subgroups of the population may have fundamentally different, often non-linear developments of their health, which, in aggregate form, follow the well-known deteriorating trend with age. Changes in health status over time may not only affect the level of health and disability, but may also alter individual pathways. Possible changes in individual pathways are overlooked in the typical studies of compression or expansion of disability based on the prevalence of disability in the context of the Sullivan Method (Sullivan 1971) or the incidence of health transitions in combination with multi-state life tables (e.g., for one of the most recent studies see Cai/Lubitz (2007).

During the last two decades, a series of studies analysed courses of health and disability by exploring individual-level trajectories of functional impairment and disability (Maddox/Clark 1992, Verbrugge/Jette 1994, Li et al. 2000, Liang et al. 2003, Deeg 2005, Nusselder et al. 2006), physical symptoms (Aldwin et al. 2001) and health trajectories (Clipp et al. 1992, Liang et al. 2005, McDonough/Berglund 2003). Liang et al. (2007) combine courses of functional status and subjective health, while Taylor and Lynch (2004) explore trajectories of impairment in relation to depressive symptoms later in life. The concept of individual-life trajectories has, however, not been used so far to study changes in disability and health limitations over time.

Over the past three decades, gains in life expectancy have primarily arisen from reductions of mortality among the old and oldest old (Thatcher et al. 1998). A long series of studies show that this positive development in mortality goes hand in hand with a positive trend in health. Starting with the early 1980s and continuing into the 1990s, the percentage of elderly with limitations in ADL or IADL has been decreasing (Freedman et al. 2002, Manton/Gu et al. 2001). Overall trends in healthy life expectancy and disability-free life expectancy support the theory of dynamic equilibrium (Robine et al. 2003). Over the last several years, various longitudinal studies conducted in the United States, Europe and other developed countries concluded that there was a significant reduction in the rate of functional decline over the last three decades (Cutler 2001, Freedman et al. 2002, Robine et al. 2003). In terms of active life expectancy Crimmins et al. (1989, 1997) and Crimmins et al. (1994), found that, between 1970 and 1980, most additional years gained in life expectancy were disabled years, while most of the increase between 1980 and 1990 came in years free of disability. Researchers estimated that a mortality reduction of approximately 1% per year was accompanied by at least a 2% reduction of disability (Manton/Gu 2001).

However, these trends do not take into account the fact that the terms "morbidity" and "disability" are not interchangeable. The presence of different diseases may have quite different effects on mortality, hospitalisation, disability and functional impairment (Mor 2005, Verbrugge/Patrick 1995). In France and the US, the prevalence of disabling chronic diseases has increased, while the severity of disability has decreased (Crimmins/Saito 2001; Robine et al. 1998), which may be attributed to a weakened link between chronic disease and disability (Freedman/Martin 2000). A study of Swedish oldest old shows increasing health problems between 1992 and 2002 that include self-reported diseases and symptoms, as well as objective tests of physical capacity, lung function, vision and cognition. Surprisingly, no significant differences in the activities of daily living limitations were found (Parker et al. 2005). These findings are supported by Parker et al. (2007), who report improvements in disability measures while there is a simultaneous increase in chronic disease and functional impairments. In their words, "an expansion of other health problems may accompany a compression of disability" (150).

Previous studies for Germany generally show a positive development regarding active life expectancy and, thus, support the compression-of-morbidity hypothesis. Many of these studies are, however, based on cross-sectional analysis rather than on longitudinal data. In cross-sectional analyses, Brückner (1997) explores different health indicators for the years 1986 to 1995 and finds different results. For West Germany, "data seem to match Fries' compression hypothesis most closely" (21). Good self-perceived health is, however, decreasing for all West Germans. Cohort analyses confirm the compression-of-morbidity hypothesis. Dinkel (1999) uses a question about experiencing any sickness in the last four weeks from the West German Microcensus between 1978 and 1995 and finds an increase in active years. A series of studies have been performed with the German Socioeconomic Panel using the question about health limitations that is also the basis of this study. Klein and Unger (2003) cover the time period 1984 to 1998 and conclude that a compression of morbidity has taken place and that there have been increases in absolute and relative disability-free years. Unger (2006) confirms this finding using a general question about health satisfaction. Doblhammer and Ziegler (2006) compare the two cross-sections of the GSOEP in the years 1992 and 2001 separately for West and East Germany. For West Germany, results depend on the age group. Among the young (40 to 59), there is a clear reduction in the ratio of years with more limitations, but only a small reduction if years with some and more limitations are combined. Among the young old (60 to 75), both the ratio of years with some and more limitations is clearly reduced. Among the old (75+), there is an increase among males and stability among females. The authors come to the conclusion that the trend is best described by Manton's hypothesis of the dynamic equilibrium (1982), with a shift towards some limitations in the younger age groups. In a second study, restricted to ages 60+, Ziegler and Doblhammer (2008) explore cohort effects in the incidence of care need using an ADL-type question in the GSOEP for the period 1986 to 2005. They conclude that significant cohort effects exist if moderate and severe care needs are combined, with the younger cohorts having a lower risk of a transition into care need. If only severe care need is investigated, then no cohort effect exists.

Turning from studies of prevalences and incidences to individual health trajectories, the question of "typical" health trajectories arises. Clipp et al. (1992) developed a typology of trajectories of physical health in a long-term perspective. They use two starting points of health, namely, good health and poor health and propose five trajectories: 'constant good health', 'decline at the end of life', 'decline and recovery', 'constant poor health' and 'linear decline'. In this study, we are analysing short-term changes over two three-year time periods and we use a categorical operationalisation of health which allows individuals to state whether they are healthy, have some limitations or have more limitations. Thus, we have three starting points and we expect that, in the short term, recovery without immediate deterioration may be possible. Applying the above typology by Clipp et al. (1992), we expect to find the following trends, given the initial health status at the beginning of the observation period. Healthy individuals may remain (1) healthy, experience (2) temporary spells of deterioration followed by recovery or will have (3) worse health status at the end of the observation period than at the beginning. Similar trajectories, but turned to the positive, should exist for those who start with more limitations. For those who enter the study period with some limitations, more possibilities exist: (1) their health status may remain unchanged, they may experience (2) temporary spells of recovery or (3) they may experience temporary spells of deterioration. In addition, their health may be (4) better or (5) worse at the end of the period than at the beginning.

The objectives of this study are threefold. First, we will identify typical trajectories in the two periods and contrast them with the archetypes defined above. Second, we will explore whether the frequency of individual-level trajectories changed from the 1980s to the 1990s, taking into account changes in the age structure and the socioeconomic structure of the population. Based on the existing literature, we expect an increase in trajectories involving moderate limitations, which results from a decrease of trajectories with more limitations. Third, we compare the trends in health trajectories with trends in risk factors published in earlier studies for Germany. In the US, obesity, blood pressure and smoking have been repeatedly mentioned as the major drivers of recent health trends and we will explore whether this is also true for Germany.

2. Data

We use data from the German Socio-Economic Panel (GSOEP) and restrict our analysis to West Germany. The GSOEP includes a variety of health and disability questions that were asked over different time periods. In the years 1984 to 1987, 1992 and 1995 to 2001, self-perceived health limitation was asked using the question: "disregarding occasional illnesses, is the fulfillment of everyday activities, e.g., in the household, your job, or education, hindered by the state of your health, and to what extent?" The possible answers to this question were "not", "some" and "more". This means that the limitation score used in the following analysis has three discrete levels, ranging from 1 (healthy) to 3 (more limitations).

We chose this variable, because it comes closest to the meaning of health limitations. Sometimes the term disability is used for the health status "measured through activity restriction in daily life", such as "hampered in daily life"', as, for example, defined by Robine and Michel (2004). In the GSOEP, however, the prevalences of answers "some" and "more" are too high to refer to it as disability. Within the paper, we interpret the variable as healthy, some and more limitations.

The variable is used for a long period of time without interruption or changes in the wording, thus we can distinguish between the two periods 1984 to 1987 and 1995 to 1998. Since before 1990 no information for East Germany, then the German Democratic Republic, is available in the GSOEP, we restrict our analysis to West Germany (1995 to 1998) and the Federal Republic of Germany (1984 to 1987). The GSOEP study started in 1984 in West Germany, with 5,921 households in which 12,290 people above age 16 were surveyed. The data consist of seven samples. The original samples that exist since the start of the survey are sample A, "residents in the FRG" and sample B, "foreigners in the FRG". Sample B is too small to analyse it separately and the health of foreigners is too different from the health of Germans to include the sample into the analysis without controlling for it. The "healthy-migrant effect" (Lechner/Mielck 1998) as well as a re-migration effect, especially at higher ages (Jankowitsch et al. 1999), influences the health of this sample. Therefore, this analysis is restricted to sample A.

Two time periods, 1984 to 1987 and 1995 to 1998, are analysed, which means that we can follow health trajectories of individual respondents over two three-year periods. The analysis is restricted to people above age 50, because health problems and death become more important with increasing age. In 1984, 3,699 persons in the GSOEP were aged 50+, with at least one response that provided information about health limitations; in 1995, the number increases to 4,319. In each of the two periods, these respondents are divided into four groups: respondents who survived until the end of the period and who have provided information about their limitation levels for four consecutive years (1984: 2,329 persons; 1995: 3,152 persons). Only this group is used in the identification of trajectories. Meanwhile, 668 (583) persons who were present in 1984 (1995) and who survived to 1987 (1998), but have at least one missing response about their limitation levels, form the second group which is excluded from the analysis of trajectories. The third group consists of those who died (1984 to 1987: 248 persons, 1995 to 1998: 266 persons) and the fourth group of those who were lost to follow-up (1984 to 1987: 454 persons, 1995 to 1998: 318 persons). In the GSOEP, death and attrition can be distinguished and for those remaining in the sample, death information can always be ascribed correctly (Heller/Schnell 2000).

Table 1: Number of trajectories, deaths and attrition

	Period	
	1984-1987	1995-1998
Survivors with full information on limitations	2,329	3,152
Survivors with missing information on limitations (excluded from this study)	668	583
Attrition	454	318
Deaths	248	266
Total	3,699	4,319

3. Method

We decided to use cluster analysis, since our primary aim is to explore the data concerning typical pathways of health, while putting less emphasis on the statistically acceptable inferential framework. A three-step procedure is followed in order to identify similar trajectories of health limitations among individuals. In the first step, we fit to each survivor with four years of valid health status information a linear trend and a second degree polynomial using least squares estimation. This specification allows us to characterise the level and time course of each individual trajectory in three ways: the level and slope based on the linear trend and the concavity/convexity of the trajectory. The latter is the difference between intercept of the linear trend and the second degree polynomial. The level and the concavity /convexity are estimated at the middle of the time period (i.e., 1986 for the first and 1997 for the second period). In the second step, the three aspects are the input variables for a series of cluster analyses that group individuals with similar levels and time courses into separate clusters. We distinguish individuals by the three possible starting points of their trajectories (healthy, some limitations, more limitations) and perform a separate cluster analysis for each of these three groups. In order to assure that each of the three input variables influences the cluster analysis equally, we standardise them using their mean and standard deviation. We use hierarchical agglomerative complete linkage cluster analysis based on Euclidian distances. The number of clusters is decided on the basis of the Dendrogram and the Calinski-Harabasz pseudo-F statistic. We do not include trajectories with stable health information over the three-year period (stable healthy, stable some limitations, stable more limitations) in the cluster analysis. We found this procedure to be the most satisfying because performing one cluster analysis independent of the starting level of health would usually produce clusters that group together two different starting levels with similar shapes, e.g., trajectories that could be characterised as “more limitations, improvement” and “some limitations, improvement”.

4.Results

We identify three clusters of trajectories for individuals who enter the study period healthy, four for those who experience some limitations and three for individuals who start with more limitations. Figure 1 shows the dendrograms of the three cluster analyses and reveals distinct large clusters.

Figure 2 depicts the three most frequent individual trajectories that belong in each cluster. It is important to note that, with the exception of the smallest cluster of only 75 individuals, the shape of the three most important pathways remains unchanged. It is always difficult to decide on names for the different clusters and, after considering several options, we decided to apply the following naming convention. The starting value should be given first and the trend second. For example, trajectories that start healthy and end healthy, but contain one or two consecutive periods of limitations, are named “healthy, spell of limitations”. We also give the proportions of the three major individual trajectories that belong into one cluster. In the case of the homogenous “healthy, spell of limitations” cluster, the first three trajectories account for 89% of all trajectories in the first period and 93% in the second period. The second cluster, “healthy, early deterioration” is constituted by trajectories that start healthy, deteriorate as early as the second year and end with limitations. The most frequent trajectory alone accounts for 47% of all pathways in the first period and 72% in the second period; while the three most frequent trajectories account for 66% and 85%, respectively. The third cluster, "healthy, late deterioration" starts healthy and generally experiences deterioration from the second year on. The two most frequent trajectories make up 72% and 80% of all trajectories. The group is, however, more heterogeneous in itself because the third most frequent trajectory does not really follow a trend, but rather alternates between healthy years and years with some limitations (Period 1: 18%, Period 2: 14%). However, all trajectories in this cluster end with some or more limitations. A similar naming convention is applied to the other clusters.

The homogeneity of the clusters, measured in terms of the three most frequent individual trajectories, is generally very high: it is about 90% in the three clusters that start healthy, between 77% and 90% among clusters that start with some limitations and between 71% and 82% among clusters that start with more limitations. There is one exception, namely the smallest cluster "more limitations, strong improvement". With only 75 observations, this cluster makes up about one percent of all possible pathways. The trajectories are heterogeneous, however, all contain healthy periods. We decided to keep this cluster separate since it shows how rare considerable improvements in health are once individuals start to suffer from more limitations.

In the 1990s, individual health trajectories are more similar than in the decade before: clusters of trajectories that start healthy generally become more homogenous. This trend is particularly strong for the clusters "healthy, spell of limitations" and "healthy, early deterioration". The composition of clusters starting with some limitations remains largely unchanged, while those starting with more limitations become again more homogenous.

Table 2 compares the frequency of the clusters over the two time periods. The most important trend is the statistically significant doubling of the trajectory "some limitations, stable" for both sexes (males, 5.1% to 11.9%, females, 6.6 % to 13.5 %). This doubling is accompanied by a not significant tendency towards the more favourable trajectories. Among those who start healthy, early deterioration decreased, while the trajectories "healthy, late deterioration" and "healthy, spells of deterioration" increase. Among those who start with some limitations, stable trajectories doubled and improving trajectories remained stable, while those including a spell of improvement increase. However, the more negative "some limitations, deteriorating" trajectory also increases. Among males, the group of those who start with more limitations has generally decreased at $p<=0.05$, independently of whether the trajectory follows a stable or improving path. Among females, the "more limitations, stable" trajectory tends to increase, while those experiencing an improvement have decreased ($p<=0.05$).

Figure 1: Dendrograms of the individual trajectories of the survivors of the periods 1984 to 1987 and 1995 to 1998

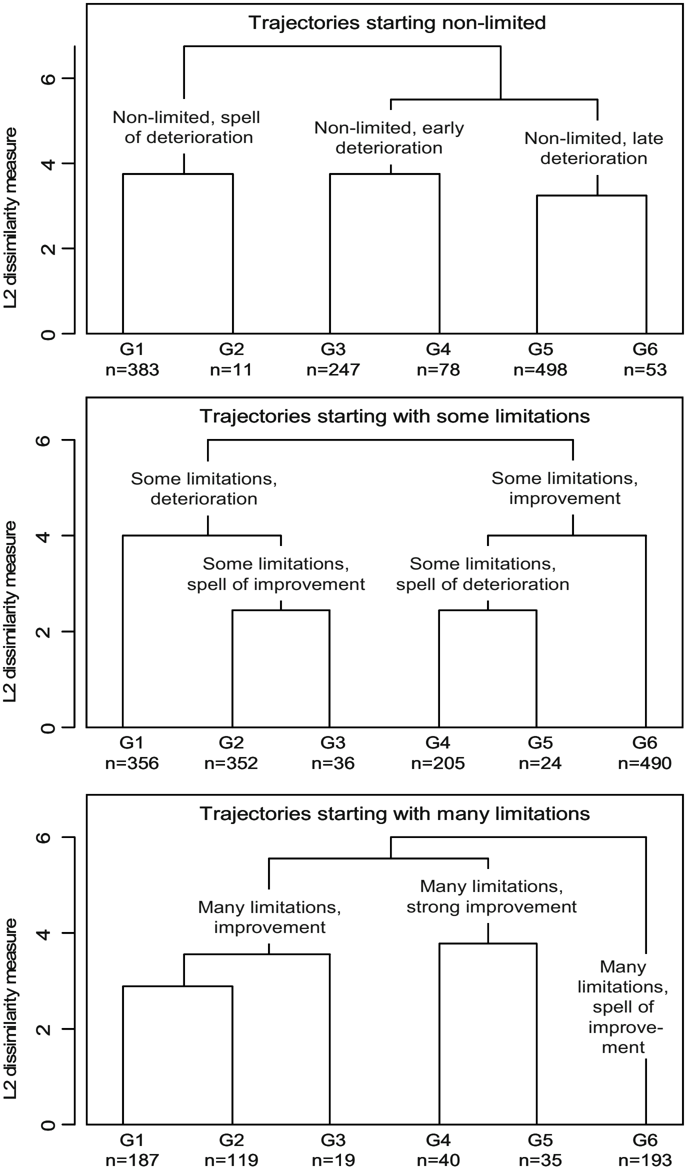


Figure 2: Shapes and frequencies of the three most frequent trajectories in the identified clusters

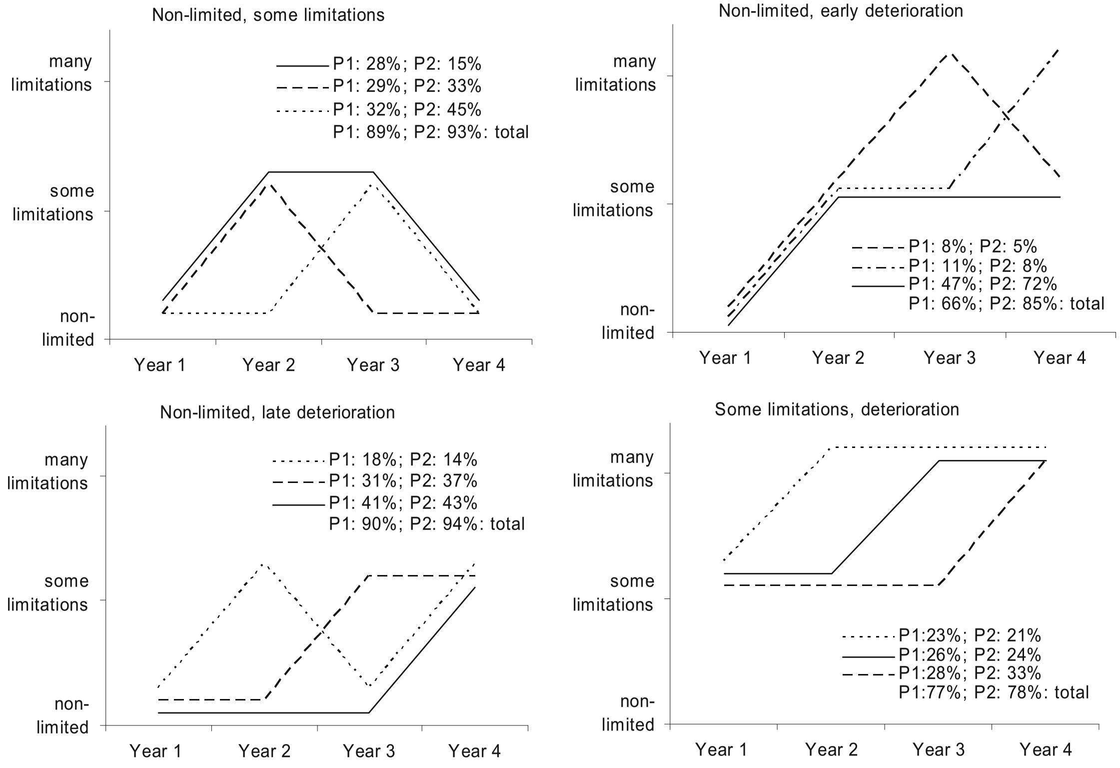
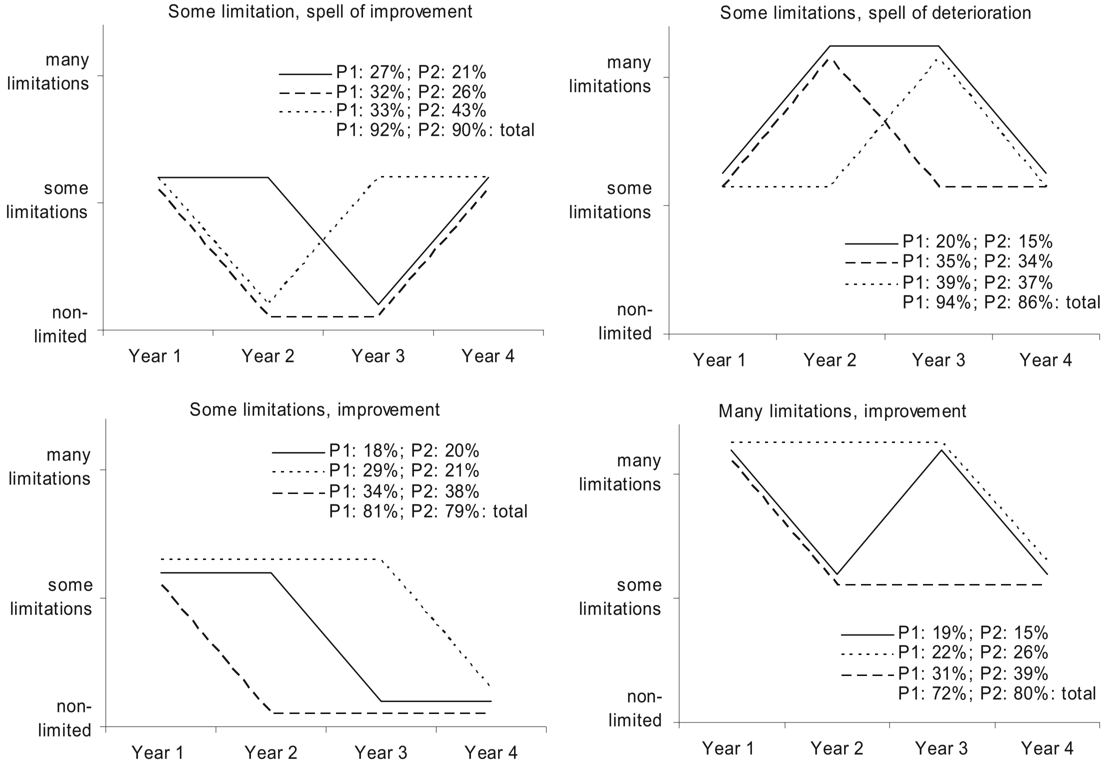


Figure 2: continued



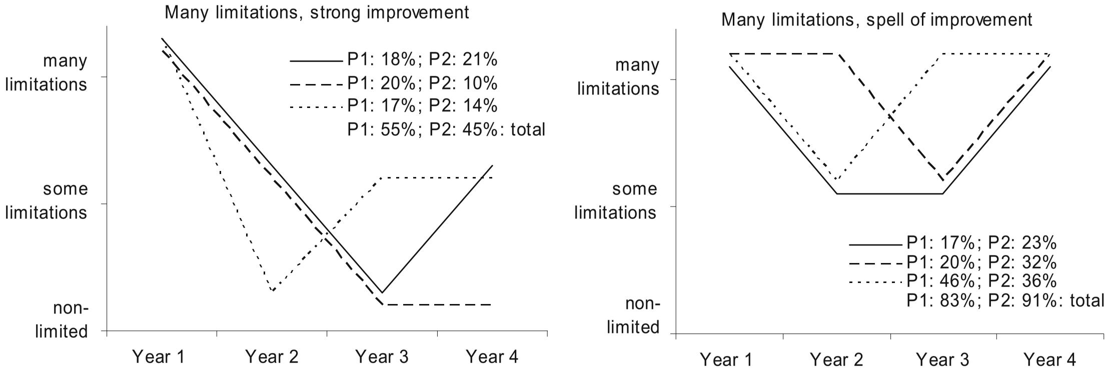
Some limitation, spell of improvement

Some limitations, spell of deterioration

Some limitations, improvement

Many limitations, improvement

Figure 2: continued



P1: Observation Period 1984-1987.
P2: Observation Period 1995-1998.
total: Sum of first three Groups.

Table 2: Relative frequencies of the trajectories of health limitations in 1984 to 1987 and 1995 to 1998 by sex

	Males		Females	
	1984-1987	1995-1998	1984-1987	1995-1998
Healthy				
Healthy, stable	15.2	18.5	11.8	12.0
Healthy, spell of deterioration	4.1	5.6	5.0	7.0
Healthy, early deterioration	5.6	3.8	5.5	4.0
Healthy, late deterioration	7.4	8.0	7.9	8.1
Some limitations				
Some limitations, stable	5.1	11.9*	6.6	13.5*
Some limitations, improvement	7.1	7.0	7.0	6.7
Some limitations, spell of improvement	4.6	6.1	4.8	7.1
Some limitations, deterioration	4.3	7.2	5.3	6.8
Some limitations, spell of deterioration	3.5	2.8	3.4	3.4
More limitations				
More limitations, stable	8.9	5.7	6.5	7.9
More limitations, improvement	6.7	3.4*	6.6	3.3*
More limitations, strong improvement	1.9	0.6*	1.2	0.8
More limitations, spell of improvement	3.8	1.9*	4.1	2.3
Deaths	9.3	8.3	7.9	7.9
Attrition	12.6	9.2	16.2	9.3*

1984-1987: Weighted by 1984 survey-weights. 1995-1998: Weighted by 1995 survey-weights.
* Significant difference between the two periods at p=0.05.

Table 3 contains age-specific results and confirms the overall finding. In all age groups, the “some limitations, stable” trajectory is increasing and the increase is statistically significant up to ages 79. The “healthy, stable” trajectory increases between ages 50 and 69, although the rise is not statistically significant. From age 70 onwards, this trajectory even tends to decrease, while the “healthy, spell of deterioration” trajectory increases. Up to age 69, all the trajectories starting with more limitations decrease; at higher ages, trends are statistically not significant and are also not consistent. The significant reduction of attrition occurs in all age groups. In conclusion, we observe a clear positive picture up to age 69, with a trend from more limitations to some limitations and good health. From ages 70 onwards, the only consistent trend is towards the stable trajectory of some limitations.

Table 3: Relative frequencies of the trajectories of health limitations in 1984 to 1987 and 1995 to 1998 by ten-year age groups

	Ages 50-59		Ages 60-69		Ages 70-79		Ages 80+	
Trajectories	1984-1987	1995-1998	1984-1987	1995-1998	1984-1987	1995-1998	1984-1987	1995-1998
Healthy								
Healthy, stable	19.3	22.8	10.6	13.2	9.9	8.5	3.7	1.7
Healthy, spell of deterioration	5.1	6.7	6.3	7.2	3.2	6.2	1.9	3.7
Healthy, early deterioration	6.1	4.0	4.9	4.0	6.2	2.8*	3.7	5.4
Healthy, late deterioration	8.9	10.6	7.4	7.4	7.6	6.4	4.1	4.2
Some limitations								
Some limitations, stable	6.7	12.8***	6.7	15.4***	5.1	12.5**	3.3	6.7
Some limitations, improvement	7.5	8.2	8.2	8.5	6.9	4.0	1.9	2.7
Some limitations, spell of improvement	4.5	4.5	5.4	8.7	5.6	9.3	1.4	4.0
Some limitations, deterioration	3.7	2.8	4.4	3.8	2.6	3.0	1.9	2.8
Some limitations, spell of deterioration	3.1	5.7	4.7	5.9	7.4	10.4	5.9	8.2
More limitations								
More limitations, stable	5.1	5.0	9.6	5.9	6.8	10.0	12.6	11.5
More limitations, improvement	6.8	3.5***	7.3	2.5***	6.6	4.3	4.2	3.4
More limitations, strong improvement	1.2	0.4*	2.3	1.1	1.3	0.9	0.4	0.2
More limitations, spell of improvement	3.7	1.4***	3.6	1.2***	5.2	5.1	2.9	1.5
Deaths	2.8	1.2	4.4	6.1	13.4	9.3	31.8	34.6
Attrition	15.3	10.2***	14.2	9.2	12.3	7.3	20.2	9.3***

1984-1987: Weighted by 1984 survey-weights; 1995-1998: Weighted by 1995 survey-weights.
***:p<=0.01;**:p<=0.05;*:p<=0.1.

In addition to these significant trends and non-significant tendencies, we observe a large and significant drop in panel attrition over the two periods. The question arises whether this drop may have caused the shift towards the "some limitations, stable" trajectory. One possibility is that, in the second period, more respondents with some limitations remained in the sample. In order to answer this question, we identified possible trajectories among those lost to follow-up and explored their effect on the distribution of trajectories among the survivors. Identifying trajectories among cases of attrition is more complicated than among the survivors because these trajectories span over different time periods: some are in the survey only in the first year, others are included two or three years. We decided to use the first and the last observation to distinguish between deteriorating (final health status is worse than the first), improving (final health status is better than the first) and stable trajectories (final health status equals first health status). Respondents with only one observation are categorised according to the level of limitations. The first part of Table 4 gives the frequency of the trajectories among the survivors (based on Table 2), the second part shows the frequency of the trajectories among those lost to follow-up and the third part contains the hypothetical frequency distribution of survivors and attrition together. For the survivors, we combine improving trajectories with trajectories containing a spell of improvement and label the combined group "improving". The same approach is applied to deteriorating trajectories. We used the most conservative approach and assumed that respondents with only one observation would have followed stable pathways and combine them with the stable trajectories of the survivors according to their initial health status. The outcome fully supports our original finding that the main trend between the 1980s and the 1990s is the shift towards the stable health trajectory with some limitations. In the hypothetical distribution of survivors and attrition, a combined 10% follow this trajectory; in the second period, 15%. We therefore conclude that, even under the most conservative assumptions concerning the pathways of those lost to follow-up, this shift cannot be explained by changes in panel attrition.

In order to account for the structural changes in the population by age, education and marital status, we estimate a multinomial logit-model with 15 outcomes (13 trajectories, death and attrition). We indicate the two time periods by a dummy-variable, which takes the value zero for the period 1984 to 1987 and one for the period 1995 to 1998. We present the odds ratios for the period 1995 to 1998 and the estimated probabilities for both periods in Table 5; the reference category is the "healthy, stable" trajectory. The multivariate analysis confirms our previous results: for males, trajectories starting healthy increase from 39.9% to 43.2%; for females, from 37.6% to 39.7%. This increase is accompanied by an increase in trajectories starting with some limitations (males: 1984 to 1987: 24.4%, 1995 to 1998: 34.2%; females: 1984 to 1987: 26.5%, 1995 to 1998: 35.7%) and a reduction of trajectories starting with more limitations (males: 1984 to 1987: 20.3%, 1995 to 1998: 11.3%; females: 1984 to 1987: 15.1%, 1995 to 1998: 10.6%)

Table 4: Possible effect of attrition on the observed frequency distribution

	Proportions of trajectories	
	1984-1987	1995-1998
Trajectories of survivors (based on Table 2)		
Deteriorating*	26	29
Improving**	24	20
Healthy, stable	13	15
Some limitations, stable	6	13
More limitations, stable	7	7
Deaths	9	8
Attrition	15	9
	100	100
Trajectories among attrition based on first and last observation		
Deteriorating***	11	14
Improving****	9	19
Healthy, stable	12	15
Some limitations, stable	10	22
More limitations, stable	8	7
One observation, healthy+	20	11
One observation, some limitations+	17	6
One observation, more limitations+	13	7
	100	100
Identified trajectories among survivors plus trajectories among attrition		
Deteriorating	28	30
Improving	25	21
Healthy, stable++	18	17
Some limitations, stable++	10	15
More limitations, stable++	10	8
Deaths	9	8
Total	100	100

1984-1987: Weighted by 1984 survey-weights. 1995-1998: Weighted by 1995 survey-weights.
*deteriorating plus spell of deterioration.
**improving plus spell of improvement.
*** health status at last observation worse than at the beginning of the observation period.
****health status at last observation better than at the beginning of the observation period.
+ respondent is only observed in the first year.
++ includes respondents that are only observed in the first year.

Table 5: Odds ratios and estimated probabilities of trajectories in 1995 to 1998 as compared to 1984 to 1987

	Males			Females		
Trajectories	Odds Ratio	Estimated Probabilities		Odds Ratio	Estimated Probabilities	
		1984-1987	1995-1998		1984-1987	1995-1998
Healthy						
Healthy, stable (Reference group)		19.8	23.1	1.34	17.0	18.0
Healthy, spell of limitations	1.17	4.7	6.4	0.67	5.2	7.4
Healthy, early deterioration	0.58**	5.7	3.9	1**	5.8	4.1
Healthy, late deterioration	0.89	9.5	9.8		9.5	10.1
Some Limitations						
Some limitations, stable	1.99***	5.1	11.8	1.98	7.8	16.4
Some limitations, improvement	0.81	7.2	6.8	0.94***	9.0	8.9
Some limitations, spell of healthy	1.15	3.8	5.0	1.44	3.4	5.2
Some limitations, deterioration	0.65	3.9	3.0	0.93*	3.2	3.2
Some limitations, spell of deterioration	1.51**	4.3	7.6	1.21	3.1	4.0
More limitations						
More limitations, stable	0.56***	8.4	5.4	1.11	3.8	4.5
More limitations, improvement	0.43***	6.8	3.5	0.48	7.4	3.7
More limitations, strong improvement	0.24***	1.3	0.4	0.71***	0.9	0.7
More limitations, spell of improvement	0.47***	3.7	2.0	0.53**	3.0	1.7
Deaths	0.81	2.1	2.0	0.76	1.7	1.4
Attrition	0.60***	13.3	9.3	0.53***	19.1	10.7
Log Likelihood	-7282.6			-9236.3		

1984-1987: Weighted by 1984 survey-weights; 1995-1998: Weighted by 1995 survey-weights.
***:p<=0.01;**:p<=0.05;*:p<=0.1.

The more detailed trends again mirror our earlier results: within the generally positive picture, we find that it is the "some limitations, stable" trajectory that increases most, with the odds ratio for the second period being highly significant for both sexes (males: OR=1.99, p=01; females: OR=1.98, p=01). Trajectories starting healthy do not increase significantly over time, but the trajectory "healthy, early deterioration" is about halved in the second period (males OR=0.58, p=0.02; females: OR=0.67 p=0.05). Significantly increasing is the trajectory "some limitations, spell of deterioration" for males (OR=1.51, p=0.05) and the "some limitations, spell of healthy" trajectory for females (OR=1.44, p=0.08). This trend is paralleled by a reduction of the least favourable trajectories that start with more limitations. Among males, both the "more limitations, stable" (OR=0.56, p=0.01) trajectory as well as the trajectories that involve an improvement, become significantly less likely over time. Among females, the improving trajectories become less likely, but the "more limitations, stable" trajectory remains unchanged.

Table 6: Trends in the risk factors blood pressure, body mass index and smoking between 1985 and 1998 in West Germany

Year						
	50-59	60-69	70-79	50-59	60-69	70-79
Systolic Blood Pressure (Mean mm Hg)						
1985	140.8	144.3		136	143.4	
1988	140.5	148		138.3	146.4	
1990	141	147.6		138.6	147.9	
1998	142	150	153	142	153	154
Diastolic Blood Pressure (Mean mm Hg)						
1985	87.5	84		83.7	82.5	
1988	86	83.8		84.1	81.4	
1990	86.7	84		85.2	83.2	
1998	89	88	89	86	86	83
Body Mass Index (Mean)						
1985	27.5	26.9		27.3	27.8	
1988	27.4	27.7		27.1	27.9	
1990	27.9	27.6		28	28.3	
1998	28	28	28	27	29	28
Smoking						
Smokers						
1985	36.3	31.1		18.8	13.3	
1988	34.3	35.3		18.6	14.5	
1990	32.6	24.8		18.5	12.3	
1998	31.6	18.4	15.7	20.4	11.5	10.2
Ex-smokers						
1985	42.1	48.8		13.7	13.2	
1988	38.7	47.2		12.9	14.2	
1990	40	59.3		15.9	15.1	
1998	34.5	48.5	60	19.5	11.4	11.5
Never-smokers						
1985	21.6	20.1		67.5	73.5	
1988	27	17.5		68.5	71.3	
1990	27.5	15.9		65.7	72.6	
1998	33.9	33.1	24.3	60	77	78.3

Source: Hoffmeister et al. 1994, Thamm 1999, Junge/Nagel 1999, Bergmann/Mensink 1999.

The age effect in the multinomial model (not shown) is in line with our expectation that, since the "healthy, stable" trajectory is the reference group, the likelihood of all other trajectories as well as the risk of death and attrition increases significantly with age. We find significant educational differentials, particularly for males (not shown). The highly educated have a lower risk of experiencing a trajectory other than the "healthy, stable" than the less-educated. Strong and significant educational differentials exist for male mortality, but not for attrition. For females, only a few differences exist, most notably among deaths. Marital status differentials (not shown) are generally not significant, with the exception of attrition among women: married woman have a lower attrition rate.

5. Discussion

Although a number of studies have previously explored individual health pathways, this is the first study that compares individual health trajectories over two time periods: namely, 1984 to 1987 and 1995 to 1998. We show that individual trends in health become more similar in the 1990s than in the 1980s and that there is a general shift towards better health, with a particularly strong trend towards the stable health trajectories with some limitations. When these trends are examined in more detail, it appears that only individuals aged between 50 and 69 profit from the tendency towards stable healthy trajectories, while the trend towards the stable pathway with some limitations extends to all ages.

Compared to the analysis of prevalence and incidence, individual health trajectories have the advantage that they depict the heterogeneous development of the health status of a population. Commonly, age-specific developments in health are considered as slowly deteriorating pathways. We show that a substantial proportion of the population above age 50 experiences health improvements. In 1984, among those who start with some or more limitations, 24% experience a lasting or temporary improvement within a three-year time period. In 1995, this figure has decreased to 20%. This fact is often neglected in health studies, where only the prevalence or the transition into bad health is examined. The most frequent pathways, which even increase over time, are the stable trajectories (26% in the first period, 35% in the second period). In this group, it is particularly the "some limitations, stable" trajectory that doubles, while comparatively little change occurs in the "healthy, stable" and the "more limitations, stable" trajectories. The second most frequent trajectories are those that involve lasting or temporary deterioration (26% in the first period, 29% in the second period). One conclusion from these trends may be that individuals experience stable health conditions for a longer period in their life, but that, once their health deteriorates, it becomes more difficult to recover.

The trajectories identified in this study resemble the archetypes defined by Clipp et al. (1992). Depending on the starting level of the trajectory (healthy, some limitations, more limitations), we find improving, deteriorating and recovering pathways. Earlier studies on trends in German health (Doblhammer/Ziegler 2006) have already shown that the younger ages (50 to 69) profited more from health improvements than the old (70 to 79) and oldest old (80+). Recent research indicates that US baby boomers currently approaching retirement age are in poorer health than their counterparts 12 years previously. These studies indicate that members of this group have relatively more difficulty with a range of everyday physical tasks, experience more pain, more chronic conditions and more drinking and psychiatric problems (Soldo et al. 2006). In this study, the German baby boomers are not included, because they had not reached age 50 by 1995. However, it is interesting to note that the overall trend towards the stable moderate disability trajectory is also present in the youngest group, aged 50 to 59. Among members of this group, the proportion almost doubles between the two time periods and the increase in this particular trajectory is more important than in the healthy trajectory.

The shift in health trajectories is accompanied by a reduction in panel attrition. Attrition is mostly caused by refusal to further participate or by the loss of people who could not be contacted due to a change of residence. In general, there is only a weak correlation between years of participation and the health status in the GSOEP (Gramlich 2007). Unger (2003) finds a 1.2% higher attrition rate per year of people with health limitations. This cumulates to 6.06% after 15 waves (1984 to 1999). Heller and Schnell (2000) show that those with health limitations have a slightly higher attrition rate in the first two waves of the panel (i.e., 1984 and 1985). In a model for the prediction of attrition, however, they do not find effects of several health variables. This finding is reflected in our study by the fact that the shift towards the "stable, some limitations" trajectory is unaltered if pathways among cases of attrition are identified and considered together with the pathways of the survivors. We therefore can reject the possibility that observed changes in trajectories are solely the result of changes in panel attrition.

A series of underlying causes of the positive health trends have been discussed, with a general consensus that the reasons seem to be multifactorial. First, significant contributions may have come from a promotion of good health habits, which have an extremely large effect on subsequent limitations and disability (Vita et al. 1998; Hubert et al. 2002). There are a series of studies that show that health habits have generally improved over time, with the exception of obesity. Second, medical advances, such as better treatment of "hypertension, diabetes, coronary heart disease, rheumatoid arthritis, total joint replacements; medical preventive measures, such as colon cancer screening, influenza and pneumococcal vaccines and cardiac-dose aspirin" may also have contributed (Cutler 2001). Third, survival after the incidence of cardiovascular disease has improved and disability has declined, through the use of appropriate therapies, including pharmaceuticals such as beta-blockers, aspirin, ace-inhibitors and invasive procedures (Cutler et al. 2006b). Fourth, rising educational levels may have contributed by influencing lifestyle and raising awareness (Bandura 2000). Fifth, some of the improvement may be due to improvement in the built environment, which helps elderly people to function independently even when their physical capacity has not changed (Spillman 2004). Once functional and cognitive limitations have occurred, new assistive technologies integrated into "smart homes" will help people function independently in their own environment for a longer period of time, thus postponing disability. Rising levels of education will improve the ability of the elderly to cope with limitations. Research shows that better-educated people use substantially more assistive technology (Cutler et al. 2006a). Adjusting the trends in trajectories for compositional effects of education, marital status and age structure of the population has only slight effects in this study. However, we find a significant advantage concerning the health trajectories of highly educated males.

Next to the positive developments in the risk factors described above we find negative trends in three major lifestyle factors in West Germany: namely, smoking, obesity (measured as body mass index) and blood pressure (Table 5). Data from earlier studies (Hofmeister et al. 1994, Bergmann/Mensink 1999, Junge/Nagel 1999, Thamm 1999) are only available up to ages 69 for the years 1985, 1988, 1990 and 1998; only in 1998 is information for ages 70 to 79 available. However, because most changes in this study are observed between ages 50 and 69, these studies can provide some important insights. Both systolic and diastolic blood pressure increases and BMI increases with the exception of men aged 50 to 59, who reveal a reversed u-shape trend. The proportion of current smokers clearly decreases among men, with a shift towards never smokers. Although women still smoke less than men, the proportion of current smokers and former smokers increases, particularly among 50 to 59-year-olds.

The impact of obesity is generally discussed as a threat to improvements in health (Lakdawalla et al. 2004, Peeters et al. 2003, Sturm et al.2004, Olshanksy et al. 2005). In the US, despite substantial increases in obesity, the general health profile of the population seems to be better than in the past. The largest contributions came from a reduction in smoking and the better control of blood pressure (Cutler et al. 2007). However, it has been estimated that about a third of the behavioural improvements witnessed over the past three decades might be offset by trends in obesity (Cutler et al. 2007). In Germany, increases in obesity are less dramatic in the age groups analysed in this study, but progress in smoking behaviour has only been accomplished among men and no progress can be observed in terms of blood pressure at all. We conclude that an environment that is developing largely positively contributes to an improvement of health, but that individual risk factors, such as smoking, obesity and high blood pressure, prohibit the full exploitation of the beneficial effects and may lead to a shift towards trajectories with some limitations, rather than towards healthy trajectories.

This study has two major limitations. First, like many other socioeconomic surveys, the GSOEP is restricted to private households. Although, in theory, respondents are followed into institutions once they are in the panel, the proportion reported living in institutions in the GSOEP is too small (0.17% age 16+ in 1999) when compared to the German figure (0.61% age 15+ (0.70% total) in 1999, Statistical Office Germany 2001). Thus, most of the transitions into institutions are reported as panel attrition. The lack of the institutionalised population affects the frequency distribution of trajectories. Unfavourable trajectories are underreported, either because they result in panel attrition or because they have been excluded already at baseline due to the restriction to private households. The proportion of people in institutions had, however, changed only slightly between the 1980s and the 1990s and had increased from about 27.3% in 1991 (Felderer 1992) to 28.4% in 1999 (Statistical Office Germany, 2001) (both proportions are for West and East Germany). Changes in the frequency distribution should, therefore, be undistorted.

Second, the GSOEP does not distinguish between limitation, disability and morbidity. Thus, we cannot investigate what type of morbidity accompanies the shift towards some limitations. The operationalisation of the health question used in the GSOEP is very broad and most probably includes limitations as well as complaints about chronic conditions and morbidity in a wider sense.

A deeper understanding of the correlation between subjective and objective morbidity and an awareness of to what extent they are connected to functional limitations and disability are important for further research. To achieve this aim, we need longitudinal data sets that contain both various health measures and the development of important risk factors, such as smoking, obesity and blood pressure. Future studies of health trajectories may then explore how these risk factors influence health trajectories and contribute to the heterogeneity in individual health pathways.

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Part III: Care Givers

Perceived Care Giver Burden of Spouses and Children in Flanders: Who's Feeling more Burdened and Why?

Benedicte De Koker

1. Introduction

The ageing of the population, in combination with other societal evolutions such as the increasing labour market participation of women and the shift towards care 'in the community', has led to a growing awareness of the care provided by spouses, relatives, neighbours and friends. It is now widely recognised that informal care constitutes the majority of all care given to elderly people, and that preservation of the informal care capacity is of paramount importance. In accordance with this perspective, scientists as well as policy makers have shown an increasing concern about the well-being of informal carers (Döhner/Kofahl 2005, Kröger 2001, Walker et al. 1995).

Since the 1980's a bulk of studies have been carried out on the outcomes of informal care giving (Walker et al. 1995). From this research it emerged that giving care to a loved person who is ill or disabled may generate a considerable amount of strain and burden (Braithwaite 1992, Walker et al. 1995). Compared to persons not involved in care giving or population norms, informal carers are reporting more depressive symptoms and higher levels of distress and anxiety (Hirst 2003, Marks et al. 2002, Schulz et al. 1995). While results with regard to physical well-being are less univocal (Hirst 2004, Taylor et al. 1995), a number of studies have found that informal carers tend to have a lower immunity, more physical health complaints and even a higher mortality risk (Schulz/Beach 1999, Vitaliano et al. 2003). Moreover, evidence exists that care giving is associated with other negative outcomes, like a higher risk of social isolation (Fast et al. 1999, George/Gwyther 1986) and a less favourable financial situation (Fast et al. 1999, Heitmueller/Inglis 2007).

The concept of "care giver burden" plays an important role in understanding the outcomes of informal care giving. Although various definitions are apparent in the literature (Braithwaite 1992), the concept generally refers to the care givers' perception of the impact care giving has on their lives (Stuckey et al. 1996). Because it is based on a personal perception, it is sometimes also referred to as perceived care burden or subjective care burden. Care giver burden has proved useful in order to understand variation within care giving populations and as a predictor of care-related outcomes such as the (desire for) institutionalisation of the person in need of care (Stuckey et al. 1996, Stull et al. 1994). Moreover, care giver burden has turned out to be a predictor of the general (psychological) well-being of the care giver (Braithwaite 1996, Chappell/Reid 2002, Lawton et al. 1991, Yates et al. 1999).

This article focuses on the perceived care giver burden of spouses and children of severely disabled persons in Flanders, Belgium. As spouses and adult children are the main care givers of elderly persons, studying these groups is highly relevant in view of understanding the societal consequences of ageing. Previous studies that compared both groups of carers have shown a mixed image. While some studies reported a higher burden among spouses (Miller et al. 1991 (for personal burden), Soskolne et al. 2007), others found no differences between both groups (Chumbler et al. 2003, Kang 2006, Raschick/Ingersoll-Dayton 2004, Yates et al. 1999) or reported that children are feeling more burdened (Thiede-Call et al. 1999). These divergent results may be due to the varying definitions and measurements of care giver burden. Furthermore, this may relate to the fact that studies are often based on non-repre-sentative local samples or are confined to spouses and children of memory-impaired persons, which limits the generalisability of the findings (Kang 2006).

This study adds to the literature on family differences in care giving, by examining care giver burden among a broad representative sample of informal carers in Flanders. Research questions we address are the following: (1) Does perceived care giver burden differ between spouses and children? and (2) if yes, can this difference be explained by the fact that spouses and children are confronting different care giving situations?

2. Theory

The impact of informal care giving has been studied from a variety of theoretical perspectives, of which the stress-theoretical framework has been most frequently applied. According to Pearlin et al. (1990) whose conceptual scheme is widely used, four major factors are central to the understanding of the stress process: the background and context of stress, the stressors, the mediators of stress and the outcomes or manifestations of stress. The family relationship between the care giver and care recipient, being one of the contextual elements, is intricately linked to the other components of the stress process (Montgomery/Wiliams 2001, Pearlin et al. 1990). Dependent on whether the care giver is a spouse or child, it is expected that “the kinds and intensities of stressors to which people are exposed, the personal and social resources available to deal with the stressors and the way stress is expressed” may differ (Pearlin et al. 1990: 585).

Although the stress process model of Pearlin et al. (1990) provides many useful insights, this study draws upon the stress-appraisal model of Yates et al. (1999), in order to explain the perceived care giver burden of spouses and children. The stress-appraisal model integrates elements from the stress process model of Pearlin and colleagues (1990) and the appraisal model presented by Lawton et al. (1989, 1991). In the resulting stress-appraisal model, perceived care giver burden, defined as the care giver's perception of being overwhelmed or overloaded by the daily care giving experiences, is exerting a central role. While care giver burden is itself a determinant of psychological well-being, it is also undergoing the impact of three main factors: primary stressors, primary appraisal and resources. Primary stressors relate to the type and amount of the care needs of the care recipient. These primary stressors lead to a primary appraisal of the amount of care that is needed, which is indicated by the intensity of care provided. It is expected that intensity of care giving will be higher as care needs are higher, but also that the amount of care given depends on the appraisal of the informal carer. Not everyone confronted with the same 'objective' care needs, is providing the same amount of care. Primary stressors are having a direct as well as an indirect impact - through primary appraisal - on the secondary appraisal, which according to the authors can be compared to the concept of subjective (or perceived) care giver burden. The secondary appraisal or perceived burden is furthermore being affected by a number of mediating factors or resources that are able to change the effects of the stressors and their appraisal. It is expected that internal resources (availability of emotional support, sense of mastery, quality of the relationship with the care recipient) and external resources (the use of formal care) will reduce the feeling of burden.

Previous research has demonstrated that spouses and children differ from each other with regard to primary stressors and primary appraisal. Spouses are more likely to bear higher levels of impairment of the elder and they are providing more intense care and more personal care than do children (Deimling et al. 1989, Montgomery/Wiliams 2001). According to Montgomery and Wiliams (2001) these patterns are related to the higher obligation of spouses to provide care. Children are generally expected to give priority to their own roles as parent, spouse and worker and they provide care on a more voluntary basis. These different expectations also result in children asking for more external help and thus having more resources to deal with care giving. Given these expected differences between spouses and children, we will account for the intensity of care giving (the primary appraisal) and the internal and external resources in explaining care giver burden. Primary stressors from the model of Yates et al. (1999), however, will not be included, since the respondents are a relatively homogeneous group of carers of severely disabled persons and the dataset contains no detailed information on the type of care needs.

An element that shows important differences between spouses and adult children, but which is not captured in the stress-appraisal model, are the other roles that the care givers are engaged in. In general, as a result of their younger age, children are having more other family- and work-related commitments than spouses. While stress-theories pay relatively little attention to these roles, studies inspired by role theory emphasise the importance of the number and type of roles for care burden and general well being. According to Hong/Seltzer (1995) early role theorists considered involvement in multiple roles to be a cause of psychological distress. The 'scarcity hypothesis' assumes that human resources of time and energy are limited and the take up of several roles will lead to role overload and role conflicts, causing psychological distress (Hong/Seltzer 1995, Mui 1995). The 'role accumulation hypothesis' on the other hand, states that practicing several roles has positive outcomes for psychological well-being and argues that human resources are flexible and can be controlled and constructed according to the commitment to these roles (Marks 1977, in Hong et al. 1995: 387). Studies on the impact of other roles like paid work and parenthood on care giver burden show mixed evidence. Some studies (e.g., Murphy et al. 1997) find that involvement in multiple roles is resulting in a higher burden. Other studies report that these roles are rather functioning as a buffer against the adverse effects of care giving and are a source of integration, social support and self-confidence (Hong/Seltzer et al. 1995, Martire et al. 1997). Still others find no relationship between care giver burden and the other roles of the informal carer (Mui 1995, Thiede-Call et al. 1999). However, because of the different situations of spouses and children at this point, role elements will be included in the analyses to explain variation in care giver burden.

Finally, next to the impact of the family relationship, a number of socio-demographic background variables will be included as well. With respect to gender, studies often find that women are feeling more burdened as a result of care giving than men (Barusch/Spaid 1989, Yee/Schulz 2000). Since the gender balance may be expected to differ between spouses and adult children in the role of carers, with more men being involved in spouse care (Milne/Hatzdimitriadou 2003), this factor should also be considered. Age is a second factor that must be taken into account. Because spouses are themselves often aged, they may be more vulnerable to the negative (health) effects of caring than children. Thirdly, living arrangement should also be controlled for, as previous work has found that care giver burden is higher when the care giver and care recipient are living in the same household (Deimling et al. 1989).

To summarise, we will explore the impact of four types of determinants in order to explain the level of perceived care burden of spouses vs. children. Next to the impact of the above mentioned socio-demographic variables, it will be examined whether variance in care giver burden by family relationship, can be attributed to the intensity of care giving, the internal and external resources informal carers possess and the other roles they are involved in. The intensity of care giving and the resources are elements from the stress-appraisal model of Yates et al. (1999). It is hypothesised that a higher intensity of care giving will result in a higher burden, while the availability of internal and external resources will alleviate burden. Testing for the impact of involvement in multiple roles is inspired by role theory. As the literature shows divergent results, no hypothesis is set on the impact of these roles on perceived care giver burden.

3. Methods

Data

Data used for this investigation stem from a postal survey of informal carers aged between 25 and 79. The survey "Informal care in Flanders" was performed in 2003 by the Population and Family Study Centre, as part of a wider study on care-related issues in Flanders (Jacobs/Lodewijckx 2004). Questionnaires were sent to a representative sample of persons that were registered by the Flemish care insurance scheme as informal carers of a severely disabled person, living at home. In order to be eligible for an allowance, a care recipient has to be afflicted by a long-term and severely reduced ability to care for themselve. Registered carers had to provide help for at least three days a week (alone or together with other informal carers). Since care recipients could have a wide range of types of illness or disability, the sample is representative for a variety of care giving situations, unlike the data in many other studies.

The net response of the survey was reasonably high (68%), which resulted in usable information on 2,735 care givers (Lodewijckx 2004). For this study, a subsample of spouses (N=617) and children caring for a parent or parent-in-law (N=1,324) is used. Spouses and children who did not perform any care tasks during the past year were excluded. In the multivariate analyses, persons with missing information on the dependent variable or one of the determinants are omitted.

The aim of the survey was to gather broad information on the situation of informal carers in Flanders. Because it was a postal survey, the questionnaire was kept concise and questions were formulated as uncomplicated as possible. Related to this, no use was made of extensive measurement instruments and on certain topics, like the situation of the care recipient, little information was gathered.

Measures

The outcome variable perceived care giver burden, is measured by a scale of eight items on the negative impact care giving has on different life domains and the general energy-level. Care givers were asked to report their agreement with each statement using a 5-point scale ranging from strongly disagree (1) to strongly agree (5). The overall scale score is calculated by the mean of the eight items. If information on up to five items was lacking, the overall scale score was calculated on the basis of the items on which information was available. A higher score signifies a higher perceived burden. Cronbach's alpha for the eight items amounts to 0,88 which indicates a high reliability of the scale.

Family relationship, the independent variable of central interest, is measured by a dummy variable, coded 0 if the care giver is the child and 1 if the care giver is the spouse. Since carers could look after more than one person, it was asked to answer the questions thinking about the person to whom most care was provided (except for the questions on hours of care giving and care giving tasks). The family relationship therefore refers to the 'most important' care recipient.

Next to the family relationship, four categories of independent variables are used in this study. Socio-demographic background variables including age and gender (0=male, 1=female) of the care giver as well as living arrangement (0=not living together with care recipient, 1=living together with care recipient) were included. Intensity of care giving is measured by the average hours of care giving per week and duration of care giving (years). A third measure for the intensity of care giving is a dummy variable on whether the care giver is providing "allround care" (0=no, 1=yes). Allround care is a care giving pattern that resulted from a cluster analysis which took into account amount, type and frequency of care giving tasks. Allround carers are providing a broad range of care tasks, encompassing personal care tasks (which other carers generally do not provide) and they are giving care with a high frequency (Heylen/Mortelmans 2006).

Resources can be divided into internal and external resources. Internal resources relate to the educational level of the carer and the quality of the relationship with the care recipient. Educational level is measured by a dummy variable on whether the respondent has obtained a higher educational degree (0=no, 1=yes). Quality of the relationship with the care receiver is measured by the presence of reciprocity in the relationship and the feeling that predominates in care giving. Persons who report getting some kind of reward from the care recipient (this could be a symbolic reward like appreciation or a financial contribution) are compared to those not receiving any reward. As to the feeling that predominates in care giving, love and friendship are compared to moral duty or other feelings.

External resources are measured by the help the spouse or parent is receiving from other informal carers, professional carers and volunteers. Three dummy variables are constructed that measure the presence of help (0=no help, 1=help from relevant category).

Other roles included in the analysis relate to paid work and other responsibilities in the private sphere. As to paid work, persons working full-time and part-time are compared to persons not involved in paid work. The presence of children living in the household (0=no, 1=yes) and the fact of whether one provides care to another person than the spouse or parent (0=no, 1=yes) are measuring the other roles in the private area.

Analyses

In order to answer the research questions, first, a bivariate analysis is carried out, comparing spouses and children on measures of care giver burden and the various independent variables. Secondly, a multivariate hierarchical regression analysis is performed to study the impact of the relationship on perceived care giver burden after controlling for the other determinants. Hierarchically, the family relationship measure and the socio-demographic variables are entered first. In the next three models, intensity of care giving, resources and other roles of the informal carers are added. In the final model the unique impact of the family relationship is tested, net of the impact of these factors.

4. Results

Bivariate Analyses

Table 1 gives a description of the care giver burden and the independent variables for both spouses and children. Results show that spouses feel significantly more burdened than children caring for a parent or parent-in-law. Significant family relationship differences also appear with respect to the background variables, the intensity of care giving, the resources and the other roles the informal carers are engaged in.

With regard to the socio-demographic background variables, results show that children are mostly female, whereas among spouses, proportions of men and women are more equally spread. Not surprisingly, spouses have a higher mean age than children. While almost all spouses are living in the same household as the care recipient, this is the case for about one quarter of the children.

All three measures for the intensity of care giving show significant differences by family relationship. Compared to children, spouses spend longer hours for care giving per week and they have been caring for a longer time. While almost 80% of the spouse carers is providing allround care (which includes the performance of personal care tasks), this holds for 46% of the children.

As far as external resources are concerned, it emerges that spouses are less likely to receive help from other informal carers, formal carers and volunteers. The internal resources show mixed evidence. Not surprisingly given their older age, spouses are less highly educated than children. For both children and spouses, the predominant feeling in care giving is love/friendship, but moral duty is more often reported by children. The second measure for the quality of the care giving relationship, i.e., the presence of reciprocity, reveals no significant difference by family relationship. Both spouses and children are reporting to a high extent that they are getting some kind of reward from the care recipient.

Table 1: Description of the determinants by family relationship

	Spouses N=617	Children N=1324	Total N=1941
Perceived care giver burden (mean, S.D.)***	3.3 (1.1)	2.6 (1.0)	2.8 (1.1)
Socio-demographic backgroundvariables			
Care giver age (mean, S.D.)***	65.8 (11.0)	52.4 (9.7)	56.7 (11.9)
Care giver gender (% female)***	53.6	67.3	63.0
Living arrangement (% living with care recipient)***	97.9	26.6	49.3
Intensity of care giving			
Duration of care giving (years, mean, S.D.)***	9.1 (9.3)	6.7 (6.5)	7.5 (7.6)
Hours of care giving per week (mean, S.D.)***	88.6 (61.0)	30.2 (44.1)	48.2 (56.7)
Allround care (% yes)***	79.4	45.1	56.0
Resources			
Higher educational degree (%yes)***	7.9	20.7	16.7
Reciprocity care relationship (% yes)	85.0	87.2	86.5
Predominant feeling (%)***			
- Love/friendship	74.6	57.7	62.9
- Moral duty	18.6	34.6	29.6
- Other feeling	6.8	7.7	7.4
Help professionals (% yes)***	61.3	80.3	74.3
Help other informal carers (% yes)***	30.4	55.0	47.2
Help volunteers (% yes)*	9.9	13.8	12.5
Roles			
Paid work (%)***			
- No paid work	89.6	56.1	66.7
- Part-time work	3.6	17.3	13.0
- Full-time work	6.8	26.6	20.3
Living with children (% yes)***	21.7	46.6	38.8
Caring for other person (% yes)***	9.6	25.1	20.1

Note: In order to compare means, t-test statistics were used. For the categorical variables, Chi-square statistics were used.

* $p < 0.05$. ** $p < 0.01$. *** $p< 01$.

Source: Informal care in Flanders, Population and Family Study Centre, 2003.

Turning to the other roles of the informal carers, the numbers illustrate large differences by family relationship. Persons looking after their parent are more often having children living in their household and they are more likely to provide informal care to more than one person. Compared to spouses, children are also much more likely to be involved in part-time or full-time work.

Multivariate Analysis

In order to test whether the higher perceived care giver burden of spouses results from differences in the background variables, the intensity of care giving or the resources or roles, a multivariate hierarchical regression analysis is performed. In the first model, only the family relationship (spouse vs. child) is included. As can be seen in Table 2, this variable explains 8% of the variance in care giver burden. After controlling for the socio-demographic background variables (model 2) the effect of the family relationship is reduced, but remains significant. Being female, being older and living together with the care recipient is all related to a higher perceived care giver burden.

Controlling for the intensity of care (model 3), the impact of the relationship decreases to some extent, but remains highly significant. To a certain extent, the elevated burden of spouses can be explained by the fact that they are providing more hours of care and are more often involved in allround care, which are both related to a higher burden. There is a tendency for duration of care giving to be related to a higher care burden, but the effect is not significant at the 0.05 level in this model. After controlling for the intensity of care, the effects of age and living arrangement are no longer significant.

In the fourth model, the internal and external resources are entered. Results reveal that the quality of the relationship with the care recipient is highly relevant in explaining care giver burden. Persons who do not mainly provide care out of love or friendship run a higher risk of overburdening, as well as persons not reporting any reciprocity. Educational level is not significantly related to care giver burden. Turning to the effect of the external resources, it is found that persons receiving help from professionals are feeling more, rather than less, burdened. Help from other informal carers or volunteers does not make a difference for the level of perceived burden. Given the result that love/friendship is more predominant among spouses and external resources are not related to a lower burden, controlling for resources does not contribute to an explanation of the higher perceived burden of spouses.

Table 2: Determinants of the perceived care giver burden (results hierarchical linear regression analysis, standardised regression coefficients, N = 1345)

	Model 1	Model 2	Model 3	Model 4	Model 5
Family relationship (1= spouse)	0.289***	0.132***	0.098**	0.126***	0.132***
Socio-demographic background variables					
Care giver age (years)		0.085**	0.045	0.032	0.026
Care giver gender (1 = female)		0.181***	0.127***	0.138***	0.124***
Living arrangement (1 = living with care recipient)		0.207***	0.010	0.036	0.037
Intensity of care giving					
Duration of care giving (years)			0.046 (*)	0.045(*)	0.051*
Hours of care giving per week			0.203***	0.194***	0.197***
Allround care (1 = yes)			0.221***	0.235***	0.234***
Resources					
Higher educational degree (1=yes)				0.006	0.002
Reciprocity care relationship (1 = yes)				-0.138***	-0.144***
Predominating feeling					
- Love/friendship (= 0. ref.)					
- Moral duty				0.094***	0.098***
- Other feeling				0.094***	0.097***
Help professionals (1 = yes)				0.100***	0.098***
Help other informal carers (1 = yes)				0.011	0.013
Help volunteers (1 = yes)				0.030	0.030
Roles					
Paid work					
- No paid work (= 0. ref.)					
- Part-time work					0.060*
- Full-time work					0.004
Living with children (1 = yes)					-0.071**
Caring for other person (1 = yes)					0.061*
	$R^2 = 0.083$ R^2 change = 0.083	$R^2 = 0.140$ R^2 change = 0.057	$R^2 = 0.217$ R^2 change = 0.077	$R^2 = 0.267$ R^2 change = 0.049	$R^2 = 0.277$ R^2 change = 0.010

(*) $p < 0.07$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; Source: Informal care in Flanders, Population and Family Study Centre, 2003.

In the fifth, final model, the other roles of the informal carers are included as well. Compared to the other factors, these elements only add little in terms of explained variance in care giver burden. Providing informal care to more than one person and working part-time (instead of having no paid work), are related to a higher burden. Having children in the household on the other hand is associated with a lower perceived burden. In this final model, 28% of the variance in perceived care giver burden is explained by the determinants. Controlled for the socio-demographic factors, intensity of care, resources and roles of the informal carers, family relationship differences persist: compared to children spouses are feeling significantly more burdened as a result of care giving.

5. Discussion and Conclusion

The aim of this paper was to investigate the level of perceived care giver burden of spouses vs. children and to examine to what extent the difference between both groups can be explained by the different care giving situations they are confronting. From the bivariate analyses it emerged that spouses are reporting a higher burden than children. At the same time, the situation of spouses and children as measured by socio-demographic background variables, intensity of care giving, resources and role involvement did vary in many respects. Not surprisingly, children are younger and less likely to live in the same household as the care recipient. In line with other studies (Milne/Hatzdimitriadou 2003), a higher proportion of men was found among spouse-care givers than among children. As said by Milne and Hatzdimitriadou. (2003), this result can be explained by the fact that spouse-care is less liable on gender norms and by the high likelihood of older men to live together with a spouse. Large differences between spouses and children were also apparent with respect to all three measures of intensity of care giving. The average number of hours devoted to care giving is three times higher among spouses than among children, and spouses have been giving care for about three years longer. The fact that children are providing allround care to a much less extent, gives an indication that providing intimate personal care to a parent is less self-evident. As Montgomery and Wiliams (2001) pointed out, the family relationship seems to be a critical element in determining the manner in which care is provided. On general, it emerges that intensity of care giving is very high in this survey. Obviously, this result is related to the nature of the sample. As criteria to be qualified for an allowance of the Flemish Care insurance scheme are stringent, carers in this survey are confronted with very high care needs.

Bivariate analyses did also yield significant differences with regard to the resources the informal carers have at their disposal. The result that spouses receive significantly less help from professionals, other informal carers and volunteers, is in line with other studies (Deimling et al. 1989). The internal resources did show mixed evidence. On the one hand – due to the rising educational level in the past century - spouses were less highly educated than children. On the other hand, as far as quality of the relationship with the care recipient is concerned, results showed that feelings of affection were more often predominant among spouses, while among children moral duty was more likely to be the main motivating feeling. No significant differences were found with regard to the reciprocity perceived in the relationship. The vast majority of both spouses and children did report getting some kind of reward from the care recipient. Finally, as expected, results showed major differences in the extent to which care givers were involved in other roles. Compared to children, spouses were less likely to provide care to more than one person, to be living together with children and to be involved in (part-time or full-time) paid work.

In order to test whether the higher perceived burden of spouses could be attributed to these differences, a multivariate hierarchical regression was carried out. Based on the stress-appraisal-model of Yates et al. (1999), it was hypothesised that a higher intensity of care giving would be related to a higher burden, while the availability of internal and external resources would alleviate the feeling of burden. Given the fact that spouses did provide more intensive care and at the same time had fewer (external) resources to rely on, it could be expected that controlling for these factors would lead to a reduction of the difference between spouses and children.

After controlling for both intensity of care giving and resources, the difference in perceived care giver burden was reduced, but spouses did remain significantly more burdened. Giving more hours of care and providing allround care were strongly related to a higher care giver burden. The third measure of intensity, duration of care giving, did approach statistical significance. The effect of most resources on the other hand did not turn out as expected. Receiving help from professionals was related to a higher instead of a lower burden. Moreover, neither help from other informal carers nor volunteers were significant predictors of perceived care burden. Given these results, controlling for external resources did not lead to a reduction in the impact of the family relationship. Among the internal resources, quality of the relationship with the care receiver appeared to be highly relevant for explaining the level of burden, while the educational level did not exert a significant impact. Being mainly motivated by love or friendship and the presence of reciprocity in the care giving relationship are associated with a lower burden. However, as spouses were more often motivated by love or friendship and no difference was found with regard to reciprocity, these factors were also not able to explain the higher burden of spouses.

In the final model, the other roles of the informal carers were included as well. From the analysis it emerges that the impact of the roles depends on their nature.

Giving informal care to more than one person and being involved in part-time work (as opposed to having no paid work) are related to a higher burden. These results are in line with the scarcity hypothesis which emphasises the adverse effects of involvement in multiple roles (Hong/Seltzer 1995, Mui 1995). In contrast, the result that having children in the household was related to a lower burden provides evidence for the role accumulation hypothesis (Hong/Seltzer 1995). With respect to this result, however, it should be noted that no restriction was set on the age of the children. Given the mean age of the informal carers (66 for spouses and 54 for children), it may be expected children are no longer dependent on care themselves and they may even lend a hand with care giving. Together, role variables added only little to the explanatory power of the model.

Net of the effects of all determinants, spouses were still feeling significantly more burdened than children. While the higher intensity of care giving did to some extent explain their higher burden, resources and other roles were not able to account for this difference. The elevated care giver burden of spouses can be attributed to a number of factors. Firstly, it has been demonstrated that spouses are experiencing a higher social expectation to care. These stronger norms may result in a feeling of having little control over care giving, which makes them more vulnerable to negative outcomes (Kosloski et al. 1997, Montgomery/Wiliams 2001). Secondly, the higher care burden of spouses may relate to the higher salience of the spouse relationship. As the role of a spouse in later life is more central to the self-concept than the role of adult child, the anticipation of the loss of this role may be more detrimental for them (Li et al. 1997, Rossi/Rossi 1990). Li et al. (1997) also point to the fact that spouses are more reliant on each other for the fulfilment of their emotional needs, than children are on their parents. The loss of emotional support from the spouse might also explain the higher burden perceived by spouses.

Apart from the impact of the family relationship, the results provide some interesting insights on the other determinants of care giver burden. Firstly, as found in many other studies, women were feeling more burdened than men, which may be explained by the higher societal expectations towards women, leaving them less options to withdraw from caring (Boeije/van Doorne-Huiskes 2007). Intensity of care giving also proved to be a highly relevant factor in explaining the level of perceived burden. The higher burden of allround carers, who provide a wide range of care tasks including personal care, reveals that the nature of care giving tasks - apart from hours of care giving - does play a role. In the final model, duration was also positively linked to care giver burden. In the literature, this result has been linked to the ‘wear and tear hypothesis’, which posits that as carers are caring for a longer time, their psychological and physical resources get exhausted (Townsend et al. 1989). Another important determinant was the quality of the relationship, measured by the presence of reciprocity in the care relationship and the feeling that predominates in care giving. The relevance of reciprocity for reducing burden has been reported in a number of other studies, often based on an exchange-theoretical framework (Dwyer et al. 1994, Raschick/Ingersoll-Dayton 2004). While it must be acknowledged that care giving may provoke ambivalent feelings, our results showed the distinction between feelings of affection and moral duty to be relevant in understanding care giver burden. Being mainly motivated by love or friendship instead of moral duty or another feeling is resulting in a lower burden. As far as the impact of the external resources is concerned, results revealed that carers receiving formal help, felt more burdened. This result can not be explained by a low quality of help, since further analyses showed the vast majority of care givers to be satisfied with formal help (De Koker 2009). An alternative explanation could be that care giver burden prompts (rather than results from) the use of formal help. Previous studies that considered the impact of care giver burden as a risk factor for the use of formal community services, have found that care givers may exhaust their resources before turning to formal help (Bass/Noelker et al. 1987, Miller/McFall 1991). Moreover, it should be noted that measurement of help had important limitations. No information was available on the kind of support offered, nor the appropriateness of help. Failure to account for these aspects may also explain the lack of a significant relationship between burden and the help of other informal carers and volunteers.

Before concluding, it is necessary to point to a number of other limitations of the study. Firstly, a number of factors that may be relevant in explaining care giver burden have not been included in the analysis. The survey provides no (reliable) information on the type of impairment of the care recipient (primary stressors from the stress-appraisal model of Lawton et al. 1999), nor on the emotional support spouses and children can rely on. It is possible that the higher burden of spouses is related to differences in these factors. However, with regard to the stressors, it should be noted that care recipients comprise a rather homogenous group of very disabled persons. Moreover, Yates et al. (1999) have demonstrated that it is mainly through the intensity of care giving, that these factors affect care giver burden.

A second limitation of the study relates to the age limits of the sample. Given that the sample is confined to persons up to 79 years old, an important group, namely the spouses of the oldest old, is not considered here. It is to be expected that this group will be even more at risk to overburdening and that including this group would expand differences between spouses and children. Thirdly, it should be stressed that only one side of the care giving experience is examined in this paper. As previous studies have shown, providing care to a loved person may also be perceived as a rewarding and meaningful experience. Care giver burden thus should be viewed as only one of the responses to the care giving situation (Lawton et al. 1989, Walker et al. 1995).

Notwithstanding these limitations, this paper contributes to a better understanding of the heterogeneity in the experience of informal care giving. Based on a broad representative sample of informal care givers, our study has documented important differences in the situation of care giving spouses and children. Spouses are feeling more burdened as a result of care giving, partly because of their higher intensity of care giving. Given the strong family differences in care giver burden and its determinants, programs to support informal carers must allow for this variation. Spouse carers deserve special attention since they are most vulnerable and will become an even more important group of care givers in the future. Projections of living arrangements reveal that the proportion of older persons living with a spouse will increase in the next 30 years, mainly due to the higher life expectancies of men and women. In fact, the greatest part of the increase of the disabled persons aged 75+ will consist of married people with children (see Doblhammer/Ziegler, Chapter 3 in this proceedings). As the bulk of care will fall on the shoulders of the spouses and - to a lesser extent - children, policies to support these carers are of main importance.

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Voluntary Care Giving in the Life Course of Women in Eastern and Western Germany

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Introduction

The German pension fund has gathered information on voluntary home care for the elderly since 1992, as the government decided that, from this year on, care giving episodes in the life course should contribute to the old-age pension. The welfare state provision for voluntary care givers was stepped up in 1995 with the establishment of compulsory long-term care insurance. If the person who is in need of long-term care decides to opt for a home care arrangement, he or she has received since 1995 a benefit from care insurance. Cash payments for voluntary care at home, called 'care allowance', have been introduced in order to encourage home care by laypeople. It was the main new feature of the 1995 newly launched compulsory care insurance. The care allowance is paid in three grades, according to the gravity of the case. Home care is supposed to fulfil the wish of most elderly in need of long-term care to stay in their familiar private surroundings and is also less expensive than institutionalised care, thereby putting less financial burden on the social security system. The person who is willing to undertake the care giving is supposed to receive a fair share of this payment and, in addition, receives contributions to the personal pension account. The goal of this social security provision is to compensate for the reduced employment opportunity of care givers. Given the fact that the overwhelming majority of care givers are women, this fits into the pension policy from the 1980s on to provide old-age pension benefits to women for unpaid work in the family.

The newly created social security benefit 'care allowance' nevertheless provoked a debate in social, medical and nursing science. The question was asked whether the care allowance could motivate these family members to undertake care giving who would not have done so without financial compensation. This notional motivation induced by financial support from long-term care insurance gave rise to two concerns, one being that women could give up gainful employment to provide voluntary home care, the other being that lay care by only financially motivated relatives could cause a threat to the health of the elderly in need of care. However, the goal of social care policies is to strengthen voluntary home care. The current reform debate on care insurance in Germany is focussed on further development to ensure financial sustainability while not lowering the benefits so far that many elderly depend on social assistance because of their need of long-term care. Part of the reform is therefore to encourage voluntary home care with more support for the care givers from 2008 on. One main problem for voluntary care giving is meanwhile the ever-increasing age of the elderly in need of care, the result of an increasing life expectancy. The typical family care givers, spouses and daughters or daughters-in-law, are thereby also becoming older when the care work has to be given.

As the pension fund receives contributions for care givers only up to the age of 65, the paper is focussed on care giving in the lifecourse up to the age of 65. We therefore underestimate the true amount of voluntary home care in Germany. Up to the age of 65, the contributions from care insurance to the pension fund can considerably increase the old-age pension of care givers. This is especially true if the nursing case is severe and the care giver is the sole person to undertake home care. This study shows how long the care giving episodes usually last and how many contributions to the pension fund are paid. With a very large sample of longitudinal data from the German population, this gives an indication of the extent of care work undertaken by German women. It shows also to what extent women have been able to increase their pension entitlements.

In the first sub-chapter the social policy framework of long-term care insurance and the conditions under which care giving is recorded in the personal pension fund account is discussed. The second sub-chapter shows the empirical results on care giving episodes in the life courses of women in East and West Germany for older age cohorts, born between 1939 and 1944, and younger age cohorts, born after 1944. The conclusion summarises the analysis with focus on the potential rivalry of gainful employment and care giving in the female life course and on old-age pensions for care givers.

1. Social Security Arrangements for Voluntary Home Care in Germany

The number of people in home or institutional care rose sharply between 1995 and 2003 from about 1 million to a number close to 2 million (Table 1). Part of this increase was caused by the newly launched long-term care insurance, because the newly offered care allowance for voluntary home care made former informal home care settings in the family statistically relevant. The increase was rather gradual because the institutions that are responsible for the medical assessment had to be set up and the population had to make themselves familiar with the new procedures to apply for care allowance. On the other hand, a demographic effect caused an increase in the number of women of a higher age who were not married and in need of care. In the birth cohorts of the 1920s, the German population has had a large surplus of women since the Second World War and in the 1990s these cohorts approached the age in which need of care is very widespread and becoming more and more likely.

1.1 Benefits from the Compulsory Long-term Care Insurance for Voluntary Home Care

Long-term care insurance offers benefits in case of permanent need of help with personal mobility or hygiene. The need of long-term care has to be proven via a medical assessment. Benefits from long-term care insurance are received by persons who need regular help with mobility and hygiene because of long-term impairment of their health. Physical or mental impairment that only leads to problems with housekeeping, e.g., cleaning, cooking etc. does not entitle to benefits from health insurance. Neither does temporary impairment due to recurrent diseases. Need is assessed according to a catalogue of assistance for all kinds of acknowledged disabilities concerning mobility and hygiene. For each impairment a certain, rather short, time span is designated in this catalogue. The assigned time of assistance is therefore rather short and time pressure constitutes a stress factor for most professional care givers.

Payment by long-term care insurance is then assessed according to the gravity of the case. On a three-step scale the need of care is either 'considerable' (Grade 1), 'severe' (Grade 2) or 'extreme' (Grade 3). The benefits of the care insurance are not meant to cover all the costs of institutional or home care, but they cover about half of the expenses of accommodation in a nursing home. Care insurance replaced the financial support given by the welfare state in case of long-term need of care before 1995 and altered the benefits in three respects:

1.) The benefits no longer depend on means testing, but are only linked to the proven need of care (compared to the social assistance scheme)
2.) The benefits are also available for less severe cases of long-term care (compared to the coverage by the health insurance targeting severe, short-term cases)
3.) Voluntary home care, arranged by the patient itself, also entitles to benefits.

Overall, Germans have to spend less out of their own pockets in case of long-term need of care compared with the situation before 1995/96. The introduction of long-term care insurance was a particular gain for pensioners, because the benefits are financed in a pay-as-you-go scheme. They therefore pay rather small contributions over their lifetime for full coverage from this social security scheme.

Voluntary home care has led to an entitlement to cash benefits since 1995 while the accommodation in a nursing home has been supported with benefits in kind since 1996. In the case of care in a nursing home, the patients must pay part of the costs (co-payment). Both kinds of benefits can also be combined, e.g., staying in a day care institution, but staying at home at night and on weekends. The cash benefit has been very popular in the last decade. In 2003, 49% of all persons in need of long-term care chose the care allowance, 27% were living full-time in a nursing home and the rest opted for a combination or special arrangements. Given the fact that the cash benefit (care allowance) for home care is lower than the benefit in kind financing accommodation in nursing homes, this trend to voluntary home care has eased the financial burden on the social security system. However, from 1995 to 2003 there was a trend towards a combination of professional day care and living in the private home (see Table 1). These arrangements tend to be more expensive, but also less stressful for the relatives.

Table 1: Kind of benefits received from the long-term care insurance, yearly average in percent[1]

Year	Care allowance	Combination of different care arrangements	Full time in nursing home	Full time in home for handicapped people	Other care arrangements (e.g., day care)	Total
1995	83.0	7.7	n.a.[2]	n.a.	n.a.	1,066,695
1996	60.4	8.7	22.7	0.4	7.8	1,562,086
1997	56.3	9.1	24.5	2.2	7.9	1,727,414
1998	53.6	9.6	25.2	3.2	8.4	1,794,564
1999	52.0	10.2	25.7	2.9	9.2	1,888,505
2000	50.7	10.3	26.3	3.0	9.7	1,882,125
2001	50.0	10.5	26.7	3.0	9.8	1,925,053
2002	49.6	10.4	27.0	3.1	9.9	1,971,638
2003	49.0	10.3	27.3	3.2	10.2	1,977,296
2004	48.4	10.3	27.7	3.3	10.3	1,983,358
2005	47.9	10.2	27.9	3.3	10.7	2,004,744
2006	47.4	10.1	28.0	3.3	11.2	2,060,214

1 Including several nominations if different kinds of benefits have been received in the year.
2 Benefits for care in nursing homes were not introduced until 1996.
n.a.: not available.
Source: Ministry of Health - Fourth Report on the development of long-term care insurance, 2007.

Every year since 1995, between 800,000 and 1million people received care allowance in Germany. This means that at least so many persons worked as lay care givers in family home care. Most people who rely on a home care arrangement have ‘considerable’ need of care (Grade 1 classification according to the medical assessment). More than half (57%) are classified as Grade 1, a third as Grade 2 and about 10% are Grade 3 cases. Overall it can be noticed that home care addresses less severe cases than professional nursing home care, where 22% of all cases are classified as ‘extreme’ (Grade 3) and only 39% fall in the Grade 1 category of being only ‘considerably’ needy (Table 2).

Table 2: Beneficiaries of long-term care insurance according to the degree of need at the end of the respective year

	Home care			Nursing home			
	Grade I	Grade II	Grade III	Grade I	Grade II	Grade III	
Year	considerable	Severe	extreme	considerable	severe	extreme	Total
1996	43.8	43.7	12.6	29.1	42.3	28.6	1,546,746
1997	47.5	40.6	11.9	34.5	41	24.5	1,660,710
1998	50.3	38.5	11.3	36.7	41.2	22.1	1,738,118
1999	52.2	36.9	10.9	37.4	41.5	21.1	1,826,362
2000	54.1	35.6	10.4	37.6	41.8	20.6	1,822,104
2001	55.3	34.6	10.1	37.9	42	20.1	1,839,602
2002	56.3	33.8	9.9	38.4	41.6	20	1,888,969
2003	57.2	33.1	9.6	38.8	41.4	19.8	1,893,181
2004	57.2	32.9	9.6	39	41.2	19.8	1,925,703
2005	58	32.5	9.5	39.2	40.9	20	1,951,953
2006	58.6	32	9.4	40.3	40.2	19.6	1,968,505

Source: Ministry of Health - Fourth Report on the development of long-term care insurance, 2007.

Table 2 shows the tendency that relatively fewer people are in extreme need of care than at the start of the care insurance in 1995. This positive trend towards less severe need of care is true for home care as well as for care in nursing homes. In home care, the proportion of people with Grade 3 classification has declined from 15% to 9.6%. Nevertheless, a closer look shows that the overall number of people with a classification for need of long-term care according to the conditions of care insurance has increased, whereas the number of cases with the highest Grade 3 classification has remained steady. Most of the increase is due to cases with Grade 1 classification, many of them in home care. Cases of home care have increased in the last 10 years from 1,051,418 to 1,279,907 by about 20%. However, the number of people living in nursing care homes has increased even more.

The political goal behind the creation of care insurance and the establishment of the care allowance in particular was the strengthening of family home care. To avoid the higher cost of professional care in a nursing home was not the only aim, but also the perceived wish of most elderly people in need of care to stay in their familiar surroundings (Klemmer-Preis 2007: 144). Whether the creation of care insurance has attained the goal of strengthening home care is rather difficult to determine, because the accordant number of people in home care before the launch of care allowance will remain unknown. But care allowance has proved to be rather popular also in combination with other care giving arrangements like professional day care.

In 2008 some improvements of the care insurance came into effect. As the benefits have not been increased in the last decade, coverage has decreased in value due to inflation. On the other hand, the contributions are already not sufficient to cover the costs. Therefore, until 2012 the contributions and respectively the benefits will increase (from the 1st of July 2008 on) by 7% to 15%. On the other hand, the government will try to further strengthen home care over accommodation in a nursing home. One point of the reform was to generate the possibility of 'care-leave' for employees who have to care for relatives for a limited period.[1] Another aim was the extension of day care offered on a more flexible basis in order to relieve the relatives at home. Special attention is thereby given to care for persons suffering from dementia.

1.2 Care Giving in the Personal Pension Record

Until 1991 voluntary care giving played no role in the calculation of the pension. From 1992 on the pension fund recorded care giving episodes because they were considered a period 'under consideration' and could under certain further conditions lead to higher pension benefits in the end. In this way, the 'consideration period' opened the opportunity for care givers to pay contributions to the pension fund out of the own pocket (Reinhardt 2007). Care giving was recorded if a medical assessment had determined that long-term care was needed and the estimated need of help had reached ten hours at least. However, care giving periods were not recorded for the past before 1992. Since the introduction of the care insurance, contributions were paid from the care insurance to the pension fund. Contributions are

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[1] The law grants from the year 2008 on a right on a period of six months of 'care leave'. Employers have to accept this leave if they have more than 15 employees.

far more favourable for the care givers than 'periods of consideration'. One aspect of the contributions is that voluntary care givers are now considered to be compulsorily insured like people in gainful employment. Periods of compulsory insurance are also linked to many favourable legal conditions like the possibility of early retirement or receipt of a disability pension. It depends on the overall biographies of the care givers whether they can take advantage of these more favourable legal conditions. The most important immediate advantage of the new regulation is that credit points are accredited by the pension fund without contributions out of the individual's own means.

The backbone of the calculations in the German pension insurance is the contribution made to the personal pension record. The contributions are measured against the average national income. Contributions that come from an average income lead to one credit point in the pension record. In the end all credit points are multiplied with the so called 'pension value'. The result of this calculation is the monthly pension paid. According to this mathematical procedure, 45 credit points in West Germany lead currently (July 2009) to a monthly pension of 1,224 Euros.

Contributions are paid by the care insurance if the person in need of care has a recognised degree of care need. The person in need can nominate one or more laypersons willing to under take the care giving. The medical assessment verifies the home as an adequate setting and the layperson is then due to receive counselling and training for the task of care giving. The care giver must be available for care giving for at least 15 hours a week or she or he is refused as not being sufficiently available. This means that more people can contribute to the care giving in the family, but not all are officially recognised care givers, because their care might be limited to evenings and weekends. A person who works for 30 or more hours elsewhere does not receive contributions by the pension record.

The care allowance is then linked to the degree of need and the acknowledged timetable of care. The care allowance is considerably lower than the salary of a professional care nurse. However, the amount of contributions paid for lay care givers is rather high and reaches the amount of contributions paid out of a nurse's salary.[2] The contribution also varies according to the assessed hours of care needed (see Table 3).

The last two columns show that the assessment bases of the pension contributions are far more generous than the care allowance as cash benefit. Because the contributions are calculated in relation to the average income in East and West

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[2] Contributions to the German pension fund are paid half by the employees, half by the employer. Both together pay 19.9% of the gross salary as contributions to the pension fund, e.g., 500 Euros contribution for 2,000 Euros salary.

Germany, the Eastern German assessment bases are lower.[3] The highest contributions, those for persons caring 28 hours a week for a person with extreme need of care, equal 80% of the average income in the respective regions. This is a rather high value for women, because hardly any women reach an average income in Germany even working full-time[4].

Table 3: Assessment bases for the pension contributions in 2007

Grade of Need	Approved need of care (Hours per week)	Care allowance (cash benefit)	Contribution assessment bases (economic equivalent of the contribution) Euro	
			West	East
Grade I considerable	14	205 Euro	653 Euro	560 Euro
Grade II severe	14	401 Euro	871 Euro	747 Euro
	21		1,307 Euro	1,120 Euro
Grade III extreme	14	665 Euro	980 Euro	840 Euro
	21		1,470 Euro	1,260 Euro
	28		1,960 Euro	1,680 Euro

Source: §37 Paragraph 1 Social Code XI (Social Care Insurance) and own calculation on the basis of § 166 Paragraph 2 Social Code VI (Social Pension Insurance).

The contribution assessment bases for care giving are equal in rank and value to contributions made on the basis of gainful employment. The rather high contribution assessment basis can theoretically lead to significant acquired rights to future pension benefits. A year of 28 hours a week of care for a person with 'extreme' need of care leads to a pension right equal to 21 Euros monthly pension in West Germany (East Germany: 18 Euros). 45 years of care giving would then lead to an old age pension of 946 Euros, again a very high value for female pensioners. The average old age pension in 2007 was 434 Euros in West and 660 Euros in East

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[3] The contribution assessment basis is treated as a fictive care givers' income. As a reference for the assessment basis serves the average income of a German employee. In 2007 the average income in West Germany was fixed at 2,450 Euros per month (29,400 Euros per year), the average income in East Germany is assumed to be 2,100 Euros per month (25,200 Euros per year). According to the care levels and hours worked as care givers, determined percentage points of the reference income define the assessment bases for the pension contribution, as they are defined in Table 3.

[4] A full time working care nurse can earn 2,375 Euros per month in the highest income class for her profession (E 7 for qualified nurses, highest class of experience, class 6) according to the wage agreement of the public service. A less qualified assistant care nurse has a maximum of 1,995 Euros monthly wage according to the same wage agreement. Both might earn more because of shift allowances.

Germany. However, it is very unlikely that a care giver is engaged in home care for such a long time and less than 10% of all home care cases are ranked in the Grade 3 need of care. Most home care concerns Grade 1 cases with 'considerable' need of care. In these cases, a year of care leads to a pension right of 7 Euros monthly pension (West), respectively 6.20 Euros (East).

2. Data from the German Pension Fund

For the analysis we use process-produced longitudinal statistical data drawn from the pensions fund records. The data sets are based on the real pensions fund records, in which information on gainful employment is collected as well as notifications on periods of illness or unemployment. Childbirth is also part of the life course in the pension fund record, because for every child born a contribution is paid by the state to the individual pension account. The data offered for empirical analysis are a sample drawn from the original records, leaving out information that could lead to personal identification like the social security number, name and address and the employer's name and address. The longitudinal data sets offer information on every month from the age of 14 on as far as the pension fund knows anything about the activity of the person in the sample.

2.1 Longitudinal Data from the German Pension Fund

For the empirical analysis of the older age cohorts we use the 20% sample of newly granted pensions from 2004, the special levy 'Completed insured life courses' (VVL 2004). The selection of data of one year of newly granted pensions enables us to compare different life courses ending in the social status of becoming a pensioner in the same year in East and West Germany.

At retirement, the pension fund has gathered all information on the life course as far as the activities, contributions and legal entitlements are relevant for the pension benefit. Care giving episodes are one aspect, which leads to higher pension benefits and is therefore registered in the pension record. The moment of retirement is the point of time in life at which people hand over all necessary proofs to the pensions fund in order to receive the highest possible pension. From the statistical point of view, it is therefore the point in time when the information about the life course is most accurate. The sample drawn from all newly granted pensions is with 20% quite large, so that all social strata and many different types of life courses are represented in numbers large enough to enable empirical research on many different questions. Only pensions based on own contributions are selected for this sample.[5] These are old age and disability pensions.

For the 20% sample selected for the longitudinal data set 'completed insured life courses' all pension funds send the information on the completed biography from school time up to the moment of retirement to the data centre of the pension fund (Stegmann 2007). The scientific use file for social research combines the longitudinal life course information with the result of the pension calculation as a cross-sectional part of the data set. The cross-sectional part includes further demographic information. This means that demographic variables mirror the social situation at retirement moment. However, the socio-demographic position might in some cases have changed over the lifetime, e.g., immigrants with foreign nationality might be naturalised at retirement and also the marital status might have changed over the lifetime. The longitudinal information is presented on a monthly basis. For each month the data shows if the person was gainfully employed or had a different social situation like unemployment, care giving, sickness or no information at all. Childcare is assumed to be the main occupation if the birth of a child is registered and no gainful employment has taken place afterwards.[6] Employment has priority status in the data and all other social situations are second in rank. A lack of information means that a person is in none of the other social status situations. Such a gap in information can stand for self-employment without social insurance obligation, unemployment without being entitled to benefits from the Federal Employment Agency, but in most female biographies it signifies a period of housekeeping.[7] If voluntary care giving occurs as the only occupation, this shows up in the data as the prime social situation of the person. The prime social situation in the data would be 'employed', if the person combines gainful employment with care giving. However, in such cases the information about care giving is not lost, but preserved in a second longitudinal variable. This second variable shows for every month of the biography if a person is care giving while also being employed.

The other analysed data set presents a 1% sample of all actively insured persons of a specific year. The data are called 'Sample of the insured populations records'. Here, we have used the 2005 sample. The longitudinal information is presented in the same format as in the 'completed insured life courses' data. The social situations are recoded from the original mainframe data into the same social situa-

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[5] This excludes widows and widowers pensions.

[6] The birth of a child is registered in the pension record of one of the parents. This is in most cases the mother, because there is an income tap that hinders higher earners to profit from the child benefit. The child benefit in the German pension fund accounts for children born before 1992 1 credit point, for children born after 1992 the contribution is 3 credit points.

[7] This fact can be proven with the data from the AVID 1996 project, where process-produced data were combined with survey data.

tions as in the 'Completed insured life courses'. We therefore also know for the younger population before retirement age if they are engaged in care giving.

One difference between the two data sets appears due to legal regulations. Persons, older than 65 years, can no longer receive contributions for care giving, even if they are still engaged in care giving, because they have reached the legal retirement age. Also pensioners do not receive contributions for care giving. For people who retired in 2004, we can therefore finally conclude how many credit points they gained by care giving. This conclusion is not yet possible for younger insured persons who are still in the course of earning credit points in their pension record. The period of care giving might also not be completed at present (right censoring of the data). We therefore evaluated the gain for old-age security only for those who are already retired.

2.2 Information on Care Giving in the Pension Records

The longitudinal data of the pension fund provide information on the length of care giving activities and the credit points earned in the pension record for this activity. Beyond this basic life course information, there are, however, severe restrictions concerning the possible research questions that can be answered with pension record data. Firstly, there is a time limitation that hinders the comparison of different age cohorts. As the registration of care giving only started in 1992 and the de facto inclusion of voluntary home care only since 1995, the older cohorts had no chance or had it only later in their 50s to earn credit points for care giving later in their life. The age limitation of 65 years as the maximum age for earning credit points for care giving sets another limitation to the analysis. It is known from other research that care giving is not limited to the age younger than 65 (Schneekloth et.al. 2005: 77). The other limitations concern the content of the data. If we know the amount of credit points earned for care giving, we still know very little about the severity of the case the care giver is providing help for. Several different settings can lead to the same amount of credit points. As Table 3 has shown, the degree of need as well as the amount of hours worked has an influence on the credit points. If we consider that the care giving can also be shared with another person or a day care institution, we have to admit that we know very little about the case behind the care giver's biography.

3 Empirical Results

3.1 Socio-demographic Profile of the Care Givers

There are so few men with care giving episodes in their pension record that we have excluded them from the analysis and focus on women only. Only 1% of all men in the West and 2% of all men in the East have care giving episodes in their pension fund record. This does not presume that men do not give care at all, but that they seldom fulfil the conditions of the care insurance mentioned above: not being an old-age pensioner and not working more than 30 hours elsewhere. However, up to today care giving is a female domain either as spouse or as daughter (Schneekloth et. al. 2005).

For 14 % of all women in West Germany and for 10% of all East Germans we find care giving episodes in their life course. For the following analysis we compare women with and without care giving episodes in their pension record. We find marked differences between those groups concerning their life course between home work, employment and unemployment. Women with no care giving episodes in their life course are childless to a higher percentage and have fewer children on average (Table 4).

Table 4: Percentage of women by number of children, with and without care giving episodes

	First time female pensioners 2004 (old age pension)	
	With care giving episodes in the insured biography	With no care giving episodes in the insured biography
Number of children		
None	6%	11%
One child	21%	23%
Two children	39%	37%
Three children	20%	18%
Four and more children	14%	11%

Source: 'Completed insured life courses' 2004 (VVL 2004), only women with residence in Germany, own calculations.

The pension fund assumes a certain period after the birth of a child as caring for a child, if no socially insured employment occurs. The time in the pension fund record for every child is 12 months for children until 1991 and 36 months since 1992. If several children are born in this period, e.g., twins, the period is prolonged until the mother has received the accurate number of months of registered child care. If a woman starts working before the fixed period is up, the prime social situation is employment and not childcare. Because of these special regulations and recodes in the data, we can not assume that the childcaring period as prime social situation could be simply calculated by the number of children multiplied by the fixed number of months designated by the law.

3.2 Length of Care Giving Episodes in the Life Course

Table 5 shows how many months the two groups on average were either employed or unemployed on one hand or childraising or care giving on the other hand. Women who have care giving episodes in their life course have on average 176 months (14 years) of employment registered in their pension record. This means that they worked around 6 years less than their non-care giving counterparts, who have 250 months of employment in their records. The longer episodes of bringing up children are a logical consequence of the higher number of children, shown in Table 4, in the records of women with care giving episodes. No difference can be found concerning the periods of marginal employment, registered in the pension insurance records since 1999. However, the working biographies of women with care giving episodes are by far sketchier. This shows the number of months (247) for which no status whatsoever is registered in the records.

Table 5: Length of particular episodes in the insurance record of women by number of children in months- First granted pensions in 2004

	First time female pensioners 2004 (old age pension)	
	Without care giving episodes in the insured biography	With care giving episodes in the insured biography
Social situation: Months in each state on average		
No information in the record	216	247
Employment	250	176
Childcare	97	117
Unemployment	15	19
Marginal part-timers (since 1999)	5	5

Source: ‘Completed insured life courses’ 2004 (VVL 2004), only women with residence in Germany, own calculations.

3.3 Positioning of Care Giving Episodes in the Life Course

In 2004 mainly the age cohorts 1939 and 1944 retired. This selection of age cohorts in the longitudinal data 'completed insured life course' is due to the retirement age in German retirement law. At age 60 women retired who had worked at least ten years over the age of 40. Women retired five years later who did not fulfil this requirement and had therefore to wait until they reached the 'normal' retirement age of 65.

We distinguish for the following analysis two types of female biographies: those who have more than a year of care giving in their life course and those who engaged less than 12 months in caring. We find on average over three years of engagements in voluntary care giving, if the women have any care episodes at all. The average length of care giving differs very little between West German and East German biographies. West German women have on average 40 months of care giving in their life courses, East German women have cared for about 36 months. This means that, if women decided to engage in voluntary caring, they started a longer lasting episode in their life of several years.

The following figures show the placement of care giving in the female life courses. We distinguish the different kinds of socio-economic activities. The first is being gainfully employed, the second is childcare and the third is care giving. The figures show the average rate of engagement in one of the three activities at a given age. A rate of 50% means, that 1 in 2 persons engaged in a given month in the particular activity. A rate of 100% is rather unlikely at any given time, because always some persons are either in a training period, unemployed or working as self-employed and are, therefore, not insured in the pension insurance scheme.

Figure 1 shows the life course of women, who did not engage in care giving. They engaged either in paid work or in childcare.

Gainful employment is overall the dominant socio-economic activity in the life course of this group of women (continuous line). They start to work rather at around age 18. The rate of employed women reaches a peak around age 20 with a little below 60% of all women of this group being employed. The engagement in childcare (represented by the dotted line) starts around age 22 and reaches its peak at the age of 28 to 30. Childcare is no longer the dominant activity around age 37 and looses its importance around the age of 45. The women in this group show typically a 'three staged' life course with childcare placed in the middle age surrounded by socially insured employment.

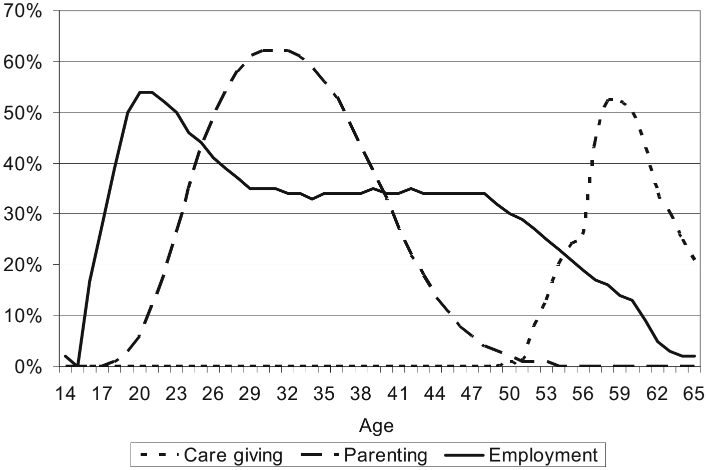
Figure 2 shows the life courses of women, who engage in care giving one year or more in their life course. However, we have to bear in mind the institutional conditions for the recording of care giving in the pension fund's records. Until 1992 there was no recording of care giving at all, because care giving was not recognised from the pension fund. Between 1992 and 1995, there was very little incentive to have the care giving registered in the personal account, because women had to pay the contributions out of their own pockets. Therefore, we will find episodes of care giving only after the creation of the compulsory care insurance in 1995. This means, that women of the age cohort 1939 and 1944 were already in their 50's when the care insurance was installed and offered support in case of voluntary care giving.

Figure 1: Life course pattern of women without care giving episodes in their social insurance records

Source: 'Completed insured life courses' 2004 (VVL 2004), only women with residence in Germany, own calculations.

The rate of women in gainful employment is in the beginning of the life course similar to those of women who were not care givers (compare Figure 1). At the age of 20 around 55% of all women of this group were employed. Around age 22 the parenting activity takes of and employment is simultaneously on the retreat. Childcare is far more dominant in Figure 2 compared to Figure 1. This impression is due to the fact that employment does not rise again after years of childcare, as we have seen it in Figure 1. This decreasing participation in the labour market around age 40 is the characteristic of these life courses. Care giving then appears as the dominant socio-economic activity at around the age of 53 and still increases until it reaches a rate over 50% at the age of 60. A peak of care giving at around this age is rather plausible, because the most common care givers are adult daughters and stepdaughters and their mothers or mothers-in-law. This means, that there is on average an age difference of 20 to 25 years between the care giver and the person in need of care. Over age 80 increases the need of care considerably creating a need of care when the childrens' generation is in their 50s. The care givers' old-age pensions are on average rather low, far below the average of their birth cohort (Stegmann/Mika 2007). Care giving amounts on average (median) to about one credit point, which is equivalent to about 25 Euros monthly pension and 7% of their pension overall.

Figure 2: Life course pattern of women with at least a year of care giving in their social insurance records

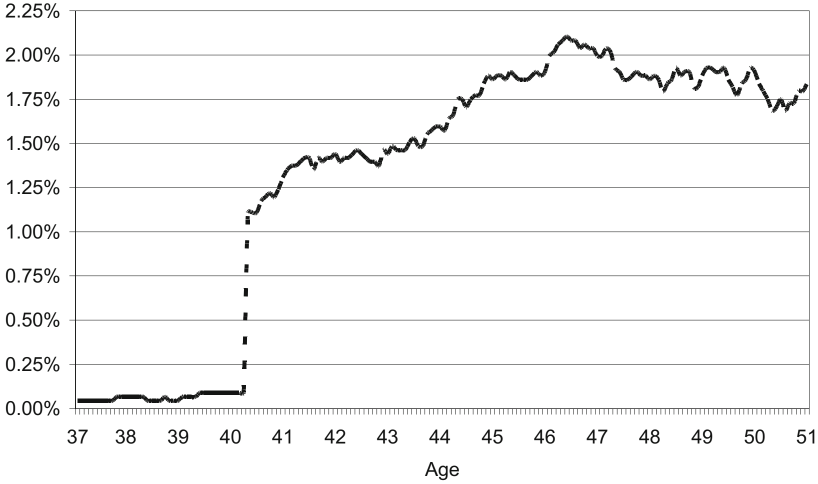


Source: 'Completed insured life-courses'2004 (VVL 2004), only women with residence in Germany, own calculations.

However, to check for the institutional effects of the creation of the care insurance in 1995, we compare the older birth cohorts with the younger birth cohort of 1955. For this purpose we analyse the 'sample of the insured populations records' from 2005. In this year the birth cohort of 1955 reached the age of 40. Figure 3 shows to what extent women at around this age or younger were willing to engage in care giving.

The overall amount of care giving in the birth cohort 1955 is rather low. The rate surpasses 2% at one moment around the age of 46, only to sink below this rate shortly thereafter. However, the older cohort engage also only to about 6% at any given time in care giving. This is due to the fact that the group of women who engage in care giving was rather small also in the older birth cohort (14% in the West and 10% in the East). The younger cohorts' activity is thus equivalent to a third of the older cohort's careactivity and could possibly still increase around age 55 and over when their parents reach higher ages.

Figure 3: Rate of care giving in the birth cohort 1955



4. Summary

Care giving as the main socio-economic activity is a predominantly female phenomenon. We analysed care giving in the life course with a very large sample of all persons who have a record at the German pension fund. One result is that we found even less male care givers than other studies which are based on survey data. 14% of women in West Germany and 10% of women in East Germany have care giving episodes recorded by the pension fund, but only 1% of West German men and 2% of East German men engage in care giving.

The pension fund records those - and only those - cases in which an official procedure has confirmed an at least 'considerable' need of care exceeding the need of help with domestic work. Since 1995 all cases in which an official need of care has been confirmed and care giving is the main activity trigger a notification of the pension fund for care givers below retirement age. The pension fund stops to record care giving, when the care giver retires. We can therefore conclude that the data include all care givers below the age of 65 which care or cared for about half of the day or more.

The average length of care giving until retirement was three years in the age cohort 1939 and 1944. Even though a person could theoretically accumulate rather higher pension credits while caring for a person in 'extreme need of care' (Grade 3 according to the compulsory care insurance), the average credit points from care giving are rather moderate with about 25 Euros monthly pension. The reason is that the most common persons in care need are in Grade 1 ('considerable') need of care.

Concerning the life course pattern of women engaging in voluntary care giving, we find more family-oriented activities in their life course and less employment. Care givers have more children and are only at the ages around 20 predominantly employed. They start to retreat from the labour market after the birth of the first child. Compared to women without care giving episodes, the care givers do not return in the labour market after the childcaring period. We can therefore conclude that the compulsory care insurance gives a premium for an already chosen life style of strong family orientation. The care insurance and its cash benefits do not seem to be a strong incentive to give up working, but to search acknowledgment for an already undertaken activity.

The younger birth cohort of 1955 is not yet as engaged in care giving as the older cohort. We find in 2005 only a third of the older cohort's engagement. However, it is still too early for final conclusions, because the main age of care giving is reached at about 55, when the parent's generation reaches higher ages and starts being in need of help. Because we lack reliable data on care giving before 1995, we do not know to what extent the older cohort was engaged in caring around the same age. We will have to do further research, when the birth cohort 1955 reaches their prime age for care giving.

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