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Welfare State and Disability. The Relationship between Stroke and Disability Depends on the Health Care System.

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1. Introduction

The absolute and relative number of older people in industrialized countries has increased in the last couple of decades due to rising life expectancy and low fertility. (Christensen et al., 2009) Thus, issues concerning the health of the older population have attracted considerable attention in recent years. Institutional welfare, pension, and health care systems need to be adapted to cope with the growing number of retirees and the changing demand for medical services associated with this demographic shift. (Schulz et al., 2004) These changes also affect informal care patterns and the total care workload of families. (Haberkern & Szydlik, 2008) The ageing of the population (Christensen et al., 2009) leads to a greater number of older people afflicted with some form of chronic disease or other constraint on leading an independent life, which are the main causes of physical disability. (Puts et al., 2008; Fried, 1999) Therefore, not only developments in morbidity, but also in disability are of interest in assessments of later-life health. From an individual perspective focused on quality of life and overall well-being, as well as from a broader perspective focused on additional pressures on welfare systems, it is desirable to keep the aging population free from disability as long as possible and the need for formal and informal care as low as possible. (Pluijm et al., 2005) Stroke is an important cause of functional disability that is expected to become more prevalent in the coming years. (Ringelstein et al., 2007; Hoeymans et al., 2012, p. 165) In addition, as rates of survival after stroke have increased in recent years, more cases of disability related to stroke can be expected. (Doblhammer et al., 2012; Deeg et al., 2013)

Therefore, we focus on stroke as a driver of older-age disability and assess whether there are country-level differences in its impact on disability in European countries.

The article is organized as follows. First, we give an overview of previous research on population-level health inequalities and their causes, including explanations involving the welfare regime perspective. We then explain why we focus on the comparison of the impact of stroke on disability from a comparative perspective. In chapter 2, we present our data, variables, and methods. In chapter 3 we report our results, which we then discuss in chapter 4.

1.1. State of research: health inequalities

Previous studies investigating aspects of health at older ages, specifically the prevalence of disease and its detrimental impact on physical function from a comparative perspective, have shown signs of inequalities in Europe. These inequalities have been found both in comparisons of population health measures between countries, and in health measures within countries that translate into country-level differences. For instance, Ploubidis et al. (2012) reported a north/south gradient for a measure of later life health in Europe modeled as a latent variable combining a total of nine self-rated and observer-measured health indicators, in which Scandinavian and western European countries (with considerable variation within this group) showed the best population health, while countries in the south exhibited the worst population health. Minicuci et al. (2004) compared the prevalence of disability in daily living activities and found that its prevalence is lower among seniors in the Netherlands than in Spain and Italy. Other studies posited lesser amounts of inequality for some northern or western European countries (Chung & Muntaner, 2007; Eikemo et al., 2008) than elsewhere in Europe (Rostila, 2007). Brennenstuhl et al. (2012) concluded in their literature review of health differences in Europe that the results of studies which either compared population health or tried to link welfare regimes or different measures of socioeconomic inequalities to health outcomes did not provide unambiguous conclusions regarding the relationship of the welfare regime and health outcomes because of the mixed nature of the results. They also noted that the results varied strongly depending on the measure of socioeconomic inequality or health outcome used, and that none of these previous studies focused solely on the disabling impact of a single disease, but rather compared net outcome measures.

A broad body of literature that has tried to explain such mixed results in terms of inequalities in health outcomes is available. Mackenbach (2012) pointed out that, even for western European nations commonly regarded as prosperous and developed in terms of welfare arrangements, socioeconomic stratification as measured by education, occupation, or income systematically translates into morbidity inequalities, regardless of the strength and scope of redistributive schemes, and even independent of the degree of equality of health care access. Eikemo et al. (2008) agreed with this conclusion. Minicuci et al. (2004) argued in a somewhat similar manner, pointing to marked differences in educational status between northern and southern European countries, which translate into differences in occupational and economic status, which are themselves determinants for health outcomes, and which are also related to individual lifestyle, health care utilization, and risk behavior. Avendano et al. (2009) emphasized that, for southern European countries, the association of socioeconomic status and education level with health status is especially strong, leading to less favorable results in the south. He concluded that, because there is less variation in these determinants in northern and western Europe, health inequalities are smaller in these countries than in the southern countries. But as in the rest of Europe, within the northern region, socioeconomic inequalities translate into health inequalities, as Lahelma and Lundberg (2009) have shown.

However, the question remains whether country differences in health are a genuine effect of different welfare regimes, or just the result of different compositions of influential determinants like socioeconomic status in the respective countries. Wendt (2009) observed in summary that most of the studies that have investigated welfare regime effects on health outcomes have attributed only a small part of the health variations between countries to welfare regime effects.

While no clear view on the relationship between welfare regimes and health outcomes has emerged in the literature, the diagnosis of health inequalities within European countries holds over time. Kunst (2005, p. 303) concluded that “socioeconomic inequalities in self-assessed health showed a high degree of stability in European countries.”

Aside from describing health status as a consequence of socioeconomic position, various other explanations of the origins of health outcome differences have been offered. Minicuci et al. (2004), Plujim et al. (2005) and Rostila (2007, p. 235) argued in a similar vein that “[t]here could be crucial cultural differences in the way people of different nationalities and with different languages perceive their own health status and interpret questions about health and well-being.” Thus, varying definitions of what actually constitutes a disability might influence reported levels of disability. Another potential problem which is, unfortunately, hard to assess is a tendency among older people to overreport their degree of physical limitations out of fear of losing the disability benefit payments they need to supplement their pensions. In addition, in countries where intra-familiar support is culturally valued and individually available, there might be a greater willingness to admit to having a disability, whereas in countries with cultural norms of independence and a tendency to underplay disabilities, there might be an underreporting of factual disability prevalence; with each behavior potentially clustered regionally (Minicuci et al., 2004).

1.2. State of research: welfare and health care regime typologies

Most researchers who compare health inequalities across European countries try to determine whether their results can be seen in terms of geographic proximity or the similarities of the relevant institutions. Thus, most directly use or at least refer to welfare regime theory when explaining the different patterns of health across Europe. Welfare regimes are situated at an important intersection between the individual and social spheres, as they regulate and distribute the provision of goods such as wealth, status, social services, and, importantly, health care access and services; based on different paradigms between universal and equal entitlement and the corporatist allocation of individual claims derived from socioeconomic status.

The Esping-Andersen typology, which was first introduced in 1990, is still widely recognized. Esping-Andersen (1990) argued that Europe's welfare regimes can be analytically divided into *three worlds of welfare capitalism*: the liberal, social democratic, and conservative regime types. His view on welfare regime types focused on the degree of the decommodification of labor: that is, the extent to which a regime enables an individual to sustain a certain commonly acceptable standard of living without necessarily relying on the (labor) market, but rather on redistributive transfers from society as a whole. Thus, social stratification, at least from a financial perspective, is influenced by the welfare regime to varying degrees. The liberal welfare state mostly relies on individual market earnings and pension planning, only providing a means-tested basic standard of support. Thus, it is the provision of baseline security and not the reduction of inequality that the liberal state seeks to achieve. The social democratic state, on the other hand, focuses its efforts on providing equity and a just distribution of the resources needed to meet the needs that arise during the life course. In addition to establishing financial redistributive measures, the social democratic state provides a wide range of universally accessible social services, such as education, care for children and older people, and health care services. Between these types, Esping-Andersen placed the conservative welfare regime, which also provides a plethora of social services. But rather than focusing on equal access, conservative welfare states tend to replicate the existing social stratification, by, for example, linking pension levels to wages earned from the previous position in the labor market. Given the importance of the relationship between socioeconomic status and health, it could be argued that, as comparable welfare regimes redistribute resources which influence health status in a similar manner, they should also have comparable health outcomes.

While Esping-Andersen's typology has proven to be very useful as a framework for the study of all kinds of welfare regime effects, it lacks explanatory power concerning two aspects from the perspective of our study. First, the southern European countries are hard to place in the existing original framework (Ferrera, 1996), and second, more importantly, a distinction should be made between the redistributive and social service aspects of welfare regimes and the subset of policies that constitute the health care system. Jensen observed that a distinction between general social services and health care provision is preferable to a direct application of the welfare regime framework for health outcome analyses, because health care expenditures are very similar across European countries, “while expenditure on social care services conforms to the regime typology of Esping-Andersen,” (Jensen, 2008, p. 151) leading him to posit that “health care seems disconnected from the traditional welfare state concepts.” (Ibid., p. 152) Jensen concluded that analyses using classic welfare regime typologies to investigate health differences do not fare well because, in terms of expenditures, there are no distinct “regimes to be found.” (Ibid., p. 156) Other researchers have reached similar conclusions about the applicability of the classic welfare regime framework in comparisons of health outcomes, pointing out that this framework may be a good tool for pinpointing differences in relative deprivation regarding wealth and poverty, but is less useful in understanding health care provision, since there has been a convergence in the levels of overall health expenditure per capita across Europe. (Lahelma & Lundberg, 2009) Of course, this tendency toward harmonization mainly pertains to an aggregate mean of the financial input side, and ignores determinants of individual access and utilization, as well as other finer points of health care system characteristics. Thus, differences in other aspects of the health care system remain that should not be ignored. Several contributions, such as that of Wendt (2009), have noted the shortcomings of classical welfare regime theory in analyzing health outcomes, and have therefore focused on disentangling welfare regime characteristics from health care properties, taking into account the specifics of access regulation. In addition to taking health expenditure per capita (as percentage of gross domestic product or the fraction of out of pocket payments out of total health expenditure) into account, Wendt included measures of inpatient and outpatient health care provision, health care access entitlement, incentives for medical practitioners that might influence their behavior, and different aspects of access regulation and financial obstacles that might prevent direct contact with specialists. (Wendt, 2009) This refined analytical framework can be used to reveal the differences that exist beneath what appears to be a uniform pattern of European health care spending.

The application of health care system typologies, such as the one provided by Wendt, produces clustering that is generally in line with the classic welfare regions. For example, in his cluster analysis, the western European region encompasses the same countries as in previous welfare frameworks: i.e., the German-speaking countries, Belgium, and France. In the countries in this cluster, there are few to no restrictions in access to specialists, high levels of total health expenditure (most of which are publicly funded), and moderate private copayments. Another cluster includes the northern European countries of

Sweden and Denmark, but also Italy. Relative to countries in the previous cluster, these national health service type countries have lower levels of health expenditure, lower levels of outpatient care, and strict regulations regarding access to doctors. Spain is placed in a third cluster together with Finland and Portugal. The countries in this cluster share low levels of health expenditure and high shares of private copayments, once again combined with dense regulations regarding specialist access and selection. (Ibid.) Thus, the European countries vary greatly, in terms of both their broad welfare regimes and the specific characteristics of their health care systems. These two typologies may be relevant in attempting to explain the ways in which people use the medical services that affect health outcomes, such as disability.

1.3. Why investigate a disability gradient for stroke?

Stroke is in large part a consequence of high blood pressure and atherosclerosis. Over the life course, accumulating deposits in arteries can block the blood flow and oxygen supply of vital organs. If this happens in blood vessels in the brain, a stroke can occur. Another cause is the rupturing of vessels. Because of its etiology, stroke has a sudden onset, and is more likely to occur in individuals who have an unhealthy lifestyle and who are older. If a stroke is not lethal, it leads to varying degrees of disability, depending on the time that elapses between the onset and the initial treatment, and the general level of medical care and recovery measures the individual subsequently receives. (Ringelstein et al., 2007) As the areas of the brain that are most affected by a stroke control the motor and cognitive functions (Fried et al., 1994), patients may face limitations in performing self-care and the higher function tasks of daily living. (Fried, 1999) These drastic consequences make stroke an interesting disease to examine in a study such as this one. Stroke occurs frequently enough to be represented in sufficiently large numbers in the population, and it also leads to severe limitations in activities of daily living in the absence of other constraining diseases.

Given of the general aging trend, and the general expectation that no major change in stroke incidence is likely, most researchers anticipate that stroke will be an increasing problem going forward. All over Europe, mortality caused by stroke and other cerebrovascular diseases is decreasing, not primarily because of lower incidence, but because the chances of surviving and the time of survival after the onset have increased. This means that cerebrovascular conditions, and specifically stroke, will increasingly become major drivers of long-term disability in older age. (Doblhammer et al., 2012) Medical research is currently focused on reducing the disability risk following a stroke by means of innovative treatments, both pharmacological and otherwise. (Hennerici et al., 2013) The findings have so far indicated that new, relatively low-risk clot-busting drug treatments can significantly improve disability and quality-of-life outcomes for one and a half years or longer, if they are administered quickly enough. (The IST-3 coll. group, 2013) The immediate management of the pre-hospital stroke response, which should provide a combination of the most effective treatments administered as quickly as possible, remains an important area of research. There is still considerable room for improvement in this area, and innovations in treatments will be needed. (Fassbender et al., 2013) Thus, despite encouraging results in quick-response management and treatment options, stroke will continue to be a major cause of disability in the future. Therefore, comparative findings regarding the disabling impact of stroke will continue to be useful. (Ringelstein et al., 2007) Focusing on stroke, while still accounting for other health indicators and causes of disability, allows us to assess to what degree European welfare regions differ in terms of the moderating effects between disease and disability. In essence, we narrow our take on welfare regime effects from a broad comparison of, for example, disability prevalence across European countries, to the consequences of a single chronic disease in order to show whether, and to what degree, the outcomes differ.

Moreover, we can analyze to what extent the general variation in disability across Europe depends on the country of residence, all other things being equal.

If we can show that the impact of a chronic disease such as stroke on the ability to perform daily routine tasks varies between European welfare systems as an independent effect not caused simply by the compositional differences of the various populations, we might be able to recommend health care reform policies based on best practice models that can help to create a healthy, disability-free aging European society. By focusing on disability as related to a specific disease such as stroke, it might also be possible to provide more specific insights into the disease-disability relationship, rather than to simply point out gross differences in levels of disability in activities of daily living.

Based on the previous discussion, we develop the following hypotheses:

1) Controlling for relevant determinants, including stroke, as causes of disability, differences in levels of disability in activities of daily living exist across European countries, and the patterns are similar to those of previously developed welfare regime typologies.
2) Given that in the aftermath of stroke, health care utilization is especially frequent, differences in the impact of stroke on disability in activities of daily living are

especially pronounced, and the patterns are similar to those of established welfare regime typologies.

2. Data and methods

2.1. Data

This analysis is based on the Survey of Health, Ageing and Retirement in Europe (SHARE), a multidisciplinary panel study of the life courses, health, and economic situations of Europeans ages 50+. It contains a broad selection of useful information, including details on health, care need, disability, family structure, finances, and demographics. This study primarily uses SHARE's most recent fourth wave, which was collected in 2011/12.[1] The average household response rate was at about 50%, while the average individual response rate was around 44%. (Kneip 2013) Data from individuals ages 60 or older from Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain, Sweden, and Switzerland are used.

Table 1 about here

Out of 24,922 respondents meeting these criteria, 291 nursing home residents were excluded from our analyses, and 31 respondents were excluded due to missing basic information on household composition. Another 800 cases were end-of-life proxy interviews and therefore had to be dropped as well. Of the remaining cases, 119 had missing data on the dependent variable ADL disability, while another 11 cases were removed due to missing information on the depression scale. Finally, in 29 cases the respondent did not answer the questions regarding the consultation of medical practitioners. This left us with a final sample of 23,641 cases from 10 countries.
SHARE's sampling method generally aims for representativeness of the community-dwelling population ages 50 or older and their spouses of any age, in which both partners in each couple speak at least one common language of the respective country. The respondents who were interviewed in nursing homes result from panel follow-up or are located in the few countries where population registers could be used for the sample generation. The numbers and the degree of representativeness of the institutionalized respondents were far from sufficient to allow us to include them in this analysis. (Lynn et al., 2013) Although this is the case in most studies based on survey data, by excluding

[1] SHARE wave 1, conducted in 2004/05, was used for sensitivity analyses; as was wave 2 collected in 2006/07.

people living in institutions such as nursing or retirement homes, the possibility of a healthy elderly bias is introduced, as individual health and care requirements are among the main reasons why people move to a care facility, stroke being a prime example. (Schram et al. 2008) The number of nursing home beds per capita varies considerably among European countries[2], with Spain and Italy providing up to about 500 beds per 100,000 citizens, while Sweden offers about triple that number. This results in shares of up to 10% of the older population living in institutions, especially in the northern and western European countries, while the institutionalization rates are very low in southern Europe. It is also important to note that, as healthy individuals are more likely to participate in a rather lengthy survey than health-impaired individuals or people of high ages, the potential problem of bias goes beyond the population living in retirement homes. We aim to address this problem using a control variable, as described below.

We used variables at the individual level as well as at the country level. For the descriptive results in the following chapter as well as in Table 2, we categorized the regions as follows: northern Europe includes Sweden, Denmark, and the Netherlands; western Europe is comprised of Belgium, France, Austria, Germany, and Switzerland; while Spain and Italy make up the southern European region. Results of chi^2-test for independence between the northern, western and southern regions are shown in the last column of Table 2. First, we describe the variables set at the individual level, beginning with the dependent variable: namely, the health outcome as measured by disability in the activities of daily living (ADL).

Table 2 about here

2.2. <u>Health outcome: ADL disability</u>

Since SHARE focuses on the aging population, it includes a rather extensive questionnaire on self-assessed and physician-diagnosed individual health status, as well as a standardized set of questions concerning the level of difficulty with activities of daily living. The ADL disability indicator is a binary variable based on the following activities: dressing (including putting on shoes and socks), walking across a room, bathing or showering, eating (such as cutting up food), getting in and out of bed, and using the toilet (including getting up or down). For each of these activities, the respondent is asked whether he has any difficulties because of a physical, mental, emotional, or memory problem. Respondents who admit to having limiting and longer-lasting difficulties in at least one of

[2] See WHO European health for all database (HFA-DB) indicator 5100 at http://data.euro.who.int/hfadb/

these activities are classified as ADL disabled.

Although 141 respondents did not answer this set of questions, it was possible in 22 of these cases to determine their ADL status using the item for self-perceived health as a proxy. Respondents who chose the worst possible health rating were classified as ADL disabled, whereas all respondents with a better than the worst self-rating were classified as not disabled in daily activities. The remaining 119 cases with missing information on ADL and self-perceived health were excluded.

Over all of the welfare regions, 12.7% of the sample reported having at least one ADL disability. Broken down by region, the results showed that 9.4% of respondents in the north had an ADL disability, compared with 13.4% in the western region and 15.9% in the southern region.

2.3. Determinants of health

2.3.1. Socio-demographic information

We used a set of socio-demographic variables comprised of individual characteristics and social support indicators as control variables for the multivariate analyses. They included age as a categorical variable (in six age groups: 60-64, 65-69, 70-74, 75-79, 80-84, 85 and older) and binary variables for sex and partnership status (living as single or living with a partner/spouse). Overall, 28.5% reported living as single, although the share was slightly lower in the southern region, where 23.8% of respondents said they lived as single.

Education was used as a categorical variable grouped into low, medium, and high educational attainment based on the International Standard Classification of Education (ISCED-97) and a category for missing information. The lowest category includes individuals who obtained basic education up to eight years without further vocational training, or secondary education only. Respondents with secondary educational degrees (mostly of the kind that serve as a qualification for enrolling in college or university) and who had completed a vocational training course of about three years or more are classified as being at the medium level. The highest category is comprised of all respondents whose qualifications include a higher vocational degree or a college or university degree. If a respondent obtained more than one educational degree, only the highest is considered. Over all of the regions, the lowest category was the most common, with 45.1% of respondents having a low level of education. Meanwhile, 29.3% had a medium level of education and the remaining 23.6% had a high level of education. However, there were differences between the regions. The northern countries had the highest and the southern regions had the lowest shares of respondents with high educational status, of about 30.5%

and 6.7%, respectively. The findings further indicated that 80.7% of the southern subsample fell into the lowest educational category, compared to 40.5% in the northern region and about 33.6% in the western countries.

The financial situation of each respondent is included as a three-fold categorical variable. In cases of missing information, we used the average of the five imputations SHARE provides for each respondent. The total values of financial reserves were split into terciles separately for each country. Thus, we obtained a country-specific measure for each respondent’s financial situation. While by design this variable did not lend itself to descriptive inter-country or inter-regional comparisons, we found that, as expected, respondents in the southern countries had lower financial reserve levels than respondents in the other regions.

Another variable included in the categorical form was the distance to the closest living child, with four possible values. These were no living child, a child who is co-resident in the same household or building, a child living within a distance of between one to five kilometers, and a child living more than five kilometers away. Overall, the most frequent response was a child living between one and five kilometers away. A closer look reveals that cohabitation was common in the southern countries, where 48.9% of respondents reported that at least one of their children was living in their household or building. By contrast, in the northern countries, this was the case for about 20% of respondents. In the northern and western regions, the distance to the closest child was most likely to be greater than five kilometers.

We also included a categorical variable containing information on the area in which the respondent’s place of residence is located within the categories of city, suburbs, or larger town; small town or rural area; and missing information. In total, a majority of respondents were living in small towns or rural areas (53.8%), while 40% were located in cities, towns, or suburban areas. The remaining 6.2% fell into the missing category.

2.3.2. Health situation

We included a zero-one variable for stroke (respondent did not suffer a stroke vs. respondent had one or more strokes, including cases with multiple strokes) and another binary variable that indicated only the cases with multiple strokes. To collect information on stroke as well as on the other chronic diseases, the respondents were asked whether a doctor had told them they had or have the specific condition, and whether they are being treated for or bothered by the condition.[3] Therefore, the data collected only covers specifically diagnosed and/or treated conditions. In the case of stroke, the question referred to stroke or cerebral vascular disease. Among the respondents who had suffered a stroke, 16% received help in answering the questions from another person present. Among the remaining cases, about 4% received help. Overall, 4.7% of respondents had experienced at least one stroke.

The frequency of medical consultations with a general practitioner or specialist (excluding dentists) was included as a binary variable, separating zero to five contacts per year from more than five consultations per year. In total, 59.1% of the sample fell into the former category of up to five medical consultations per year. However, the frequency was found to differ between the northern and southern countries. Just 25.5% of respondents reported having six or more consultations in the northern countries, compared to 45.4% in the western and 52.6% in the southern countries.

Also included were binary variables for diabetes (13.3%), hypertension (40.5%), asthma (1.1%), cataract (11.3%), heart attack (13.8%), and cancer (all kinds, 5.7%) that were analogous to the binary variable for stroke (all values over all regions).

In addition to these chronic diseases, we controlled for the number of symptoms of other, less severe, ailments, like back, knee, hip, or joint pain; heart trouble or chest pain; breathlessness; persistent cough; swollen legs; sleeping problems; (fear of) falling down; dizziness; faints or blackouts; stomach or intestine problems; incontinence; and fatigue. These symptoms were used as a proxy for the remaining overall health situation of the respondent. This information was collected by asking the respondents whether they had been bothered by any of those conditions in the six months prior to the interview. The categorical variable distinguishes between respondents with none of these symptoms (24.3%), those with one to two symptoms (46.8%), and those with three or more of these symptoms (28.8%, overall values). On a regional level, the southern countries appeared more often in the 3+ multi-morbidity category (33.6%) than the western (30.6%) and northern (22.7%) regions.

Finally, we included a binary indicator for depression (indication or no indication) based on the EuroD depression scale, using the cut-point suggested for EuroD of four or more positives on the standard set of 12 EuroD items (respondent was asked whether he/she

[3] The wording of the question is as follows: “Has a doctor ever told you that you had/Do you currently have any of the following conditions?” One of the listed conditions was “stroke or cerebral vascular disease.” In case a respondent needed further clarification, he was told: “By this we mean that a doctor has told you that you have this condition, and that you are either currently being treated for or are bothered by this condition.”

had experienced the following within the last month/recently: sadness or depression, pessimism about the future, suicidal thoughts, a tendency toward guilt, trouble sleeping, a general lack of interest in things, an inability to maintain interest in things, irritability, a lack of appetite, a decline in food intake, a lack of energy in general, an inability to concentrate on entertainment or reading, a general lack of enjoyment, crying). While 25.5% of all of the respondents showed signs of depression, differences were found between the regions, with 17.3% of respondents in the north showing signs of depression, compared to over 25.6% in the west and up to 37.3% in the south.

2.3.3. Country level

To account for the exclusion of the institutionalized population from the SHARE sample, as well as for the tendency of survey data to underrepresent the oldest age groups in general, we compared the composition of the national subsamples from SHARE to national population statistics (Eurostat, reference year 2010). First, the ratio of total population (60+) to sample size (60+) was calculated for each country. Then, the country-wise sample size was multiplied, with this factor split by age groups (60-64, 65-69, 70-74, 75-79, 80+). This allowed us to calculate the percentage of divergence between the 80+ age group of the SHARE sample we used and the total population of people ages 80 and above. This measure should have accounted for the exclusion of institutionalized people, as well as for other sampling losses. This variable was included as a percentage on the country level. We chose to concentrate on the 80+ age group because they are the primary clientele for nursing homes and are most likely to cause the sampling losses in the community-dwelling population due to ill health and other reasons for non-participation. This group might therefore influence our results. The lowest deviations were found in the Danish and Spanish subsamples, where the 80+ age group was underrepresented by about 1.66% and 2.96%, respectively. The greatest difference between the actual population and the sample was found in Italy, where the 80+ age group was underrepresented by about 38%. This contrasting result is quite surprising, given that Spain and Italy have the two lowest institutionalization rates. Up to age 74, the differences are generally rather low, and SHARE even tends to overrepresent the population between the ages of 60 and 69 in particular. The values are shown in Figure 1, which also presents similar calculations for SHARE waves 1 and 2 to illustrate the progress of the SHARE sampling from wave to wave.

Figure 1 about here

This deviation measure varied rather substantially between the SHARE waves, and generally got smaller from waves 1 and 2 to wave 4. It is noteworthy that, especially relative to wave 2, wave 4 achieved much better results in terms of the representativeness of the 80+ age group in all of the countries except Switzerland.

2.4. Methods

All descriptive statistics that are reported at the level of welfare regions—e.g., in Table 2 and the variables chapter—showed weighted results adjusted for national sample sizes. To examine the national-level variation—that is, the effect of differences between welfare regimes at the national level on stroke-related disabilities in activities of daily living—we used binary logistic multilevel regression. In multilevel models, individuals on the first level are grouped into countries on the second level. This allowed us not only to examine the amount of inter-group variation, but also to account for the nested data structure while controlling for the effects of all individual-level covariates on an individual's ADL disability status.

We used random effect models that included (a) a random intercept that allowed us to examine the amount of between-country variation for overall ADL disability and (b) a random slope component for the stroke variable. Therefore, all individual-level coefficients except the coefficient for stroke were found to be fixed effects; i.e., the effect of all of the individual-level variables but stroke were found to be the same for all countries in the sample. The stroke effect was composed of the fixed effect for stroke, which is the same for all countries as well, and the random part, which differs by country and was added to the fixed effect to calculate the country-specific coefficient. This random slope component allowed us to assess whether the effect of stroke on ADL varies depending on the country. In all cases, the country acted as the second level that structures the individual cases into 10 groups. The difference between the de facto population distribution and the sample population of the people ages 80 or older was included as a variable at the country level. All other variables were included on the first (= individual) level. The Stata 11.2 routine xtmelogit was used for all models.

This modeling approach results in the following regression equation for the log-odds that y_{ij} (individual *i* in group *j)* is ADL disabled:

$$\ln \frac{P(y_{ij} = 1)}{1 - P(y_{ij} = 1)} = \hat{a}_0 + u_{1j}x_{1ij} + \hat{a}_{1i}\, x_{1ij} + \hat{a}_2 x_{2j} + u_{0j}$$

$\hat{a}_0$ is the overall intercept or constant that stands for the probability P(y_{ij} = 1) (ADL disability for individual *i* in group *j*) in the case that *x = 0* and *u = 0*; i.e., when all individual- or secondary-level explanatory terms equal zero and the random intercept component equals zero as well, as would be the case for a completely average country. In short, the equation would be reduced to P($y_{ij} = 1) = \hat{a}_0$.

u_{0j} is the random part of the intercept for a given country, j and is added to the overall intercept. Thus, due to the *randomly varying* value of u_{0j}, each country has its specific total intercept value. This is referred to as the group effect or random intercept.

On the individual level, $\hat{a}_{1i}$ is the coefficient of the independent variable *i* and contains the effect of a change of one unit in x_{1i} on the log-odds that y = 1, but under the condition that the group effect u is held constant (adjusted for). Thus, the value of the coefficient is the same across all countries. This is the same as in a standard one-level logistic regression model. This term would be replicated for all individual-level fixed effects in the model. For the sake of conciseness, the equation only contains this term once.

The term $u_{1j}x_{1ij}$ refers to the random slope part of the model that we use for the stroke variable. Here, we add the random term u_{1j} to the independent variable x_{1ij}. u_{1j} is the result of adding up the fixed part of the coefficient, as described above, with the group-specific random part. Thus, as was already described for the random intercept, the resulting coefficient varies depending on the specific group *j*. Since the stroke variable is binary, this term either equals zero (no stroke) or takes the country-specific value shown in Figure 2. Again, the one in the subscript indicates that this term is set on the individual level.

Finally, the term $\hat{a}_2 x_{2j}$ refers to the independent variable part at the second, or group level of the model. This enables us to assess the effect of a group-level control, while still including random effects to capture the effect of unobserved group-level variables. In our model, we rely on a contextual effect when including the control variable for the divergence of the 80+ years population the SHARE sample. The two in the subscript refers to the fact that this explanatory variable is located at the second level; e.g., the percentage of divergence has the same value for all observations in a certain group, as they are all situated in the same country.

Our modeling strategy was as follows. In total, we presented three nested models. Due to their multilevel structure, all models allow us to assess the amount of country-level effects on disability related to stroke and related to all other factors except stroke. The inclusion of country- or welfare-region dummy variables is not necessary to assess country-level effects. Model I included the stroke dummy, age group, and gender. This basic model mainly served as a starting point for quantifying the amount of variation present, and was also used as a comparison for the following models to assess whether and to what extent the observed variation between countries could be attributed to the characteristics that were included in the following models. Model II added information on an individual's education, financial situation, the potential for intra-familiar support, and a basic distinction of the area of residence. Here, our main intention was to assess whether the newly included variables were able to reduce the variation of disability both related and unrelated to stroke. Model III included all medical information, which we believed would contribute a major portion of the variance reduction of disability not related to stroke (later on referred to as overall between-region variation, OBRV). Since all of these variables were fixed effects, a decrease in the OBRV from model II to model III would indicate that the distribution of disability not related to stroke was rooted in the same determinants across all of the European countries we investigated. In other words, a decrease in the OBRV may be expected when the newly included variables are of explanatory power for most or all of the countries in our data for the part of ADL disability not related to stroke. Furthermore, model III included the group-level control for the sample deviation for the 80+ age group, which we included to control for possible issues related to the overrepresentation of older respondents who were not institutionalized and were otherwise healthy. This control was only included in model III because it tapped into the same general dimension as the health status variables.

All of the multilevel logistic regression models were run with ADL disability as the binary outcome variable. All of the models included a random part for the intercept and a random part for the stroke coefficient. Thus, all of the models allowed us to assess whether (1) there were between-country differences in remaining unexplained ADL disability risk, while controlling for cross-regional differences of the stroke effect; and whether (2) there were between-country differences in the specific effect of stroke on ADL disability, while controlling for all of the other causes of ADL disability, as well as for the confounders included in the model.

For each of these models we showed the amount of remaining variation between the countries regarding ADL disability, with the remaining variation indicating differences between the countries, as was posited in the hypotheses. First, we included the overall between-region variation (OBRV), which is the variation of the random intercept, and which can be interpreted as the amount of between-country variation in ADL disability not related to the effect of stroke that is not explained by the other variables in our models. The lower the value, the better suited the individual level variables were to explaining the disability outcome, regardless of the European country in which the case was located. The higher the value, the greater the differences that were found between welfare regimes in ADL disability, despite the inclusion of the covariates. Second, we showed the stroke-related between-region variation (SBRV), which is the amount of variance of the random effect for the stroke coefficient. The SBRV showed whether and to what degree the isolated impact of stroke on ADL disability differed between countries, after controlling for all of the other variables in the respective model. The higher the value, the greater the differences in the strength of the stroke impact on ADL disability between the countries we investigated; while a low value indicated that stroke had the same effect on disability in all of the countries we observed, and could also be included as a fixed rather than a random effect.

As we added covariates to the models, comparing the amount of remaining variation allowed us to assess whether a certain block of variables was able to explain a change in the remaining variation. For instance, if additional health indicators were found to reduce the OBRV of ADL disability, it could be argued that health indicators were important determinants of disability in all of the European countries we observed.

To measure the extent to which an individual's overall odds for ADL disability (including the main effect of stroke) were determined by his country of residence in a way that allowed for a comparison of the strength of the individual covariates, we used the median odds ratio (MOR). This measure is based on the OBRV (Merlo et al., 2006) and allowed us to intuitively quantify the strength of contextual influences in the usual and easily interpretable odds ratio format. However, the MOR only showed the strength of the effect of between-country differences on ADL disability without incorporating the country-specific random part of the stroke effect. To assess if and how the impact of stroke differed between the countries, the direction and strength of each country's random effect of stroke on ADL disability are shown in the discussion of model III.

3. Results

Table 3 about here

The baseline model I that included age, stroke, and gender produced the expected results. Stroke increased disability risk almost fourfold (OR=3.83, p<0.001). Disability risk also significantly increased with age (OR=1.21, p=0.01 for age 65-69, up to OR=8.42, p<0.001 for ages 85+). In this basic model, men had a lower ADL disability risk than women (OR=0.8, p<0.001). The between-region variation for overall ADL disability had a moderate value of 0.12 and a corresponding median odds ratio of 1.39. This indicated that, when controlling for stroke, sex, and age, the OBRV was roughly comparable to the age effect for people ages 65-69 compared to the reference category (60-64). Of special interest was the extent of the SBRV. With a level of 0.16, this variation was higher than the OBRV (0.12). The country-specific direction and the strength of this effect are shown in more detail in the discussion of model III.

In model II, we included variables concerning household composition, education, financial assets, and area of residence. The stroke effect remained nearly unchanged in strength and direction (OR=3.76, p<0.001). Introducing an indicator for the relative household wealth yielded the expected results across all regions: more financial assets were associated with lower ADL disability risk. This finding supports claims that socioeconomic inequalities translate into health outcomes for all of the European welfare regime types. Similarly, when controlling for partnership status and education level, the analysis showed that the presence of a spouse or partner reduced disability risk. Having a higher educational level had the same effect, a result which also supports the claim that socioeconomic resources translate into health status. The partnership variable suggests that having a partner may have a positive influence, as it could indicate the presence of a potential care giver or that more attention is given to having a healthy lifestyle due to tighter social controls. However, introducing a variable containing information on the spatial distance of the closest child indicated that, without controlling for individual health characteristics, which certainly play a role in the demand for intergenerational, intra-familiar care and support arrangements, the results were not significant. It should also be noted that the missing category for the variable indicating the area of residence showed a significant increase for ADL disability risk, whereas no difference between urban and rural areas emerged. Since there was no further information that might help us to identify what led to the missing information, no specific explanation can be offered at this point. Turning to the group level, we can see that both the OBRV and the SBRV remained basically unchanged. This indicates that beyond the basic socio-demographic and socioeconomic characteristics, other, yet unobserved factors that are heterogeneously distributed among European countries affect disability outcomes.

Model III further expanded the model with a block of individual-level health-related variables. These included the number of medical consultations and depression, as well as a list of specific chronic diseases and the number of additional symptoms related to other, less severe ailments. This reduced the effect of stroke on disability, although it still remained an influential predictor of disability (OR=2.25, $p<0.001$).
Not surprisingly, depression was found to be associated with a higher risk of ADL disability, with the causality potentially going both ways; i.e., depression may cause disability, but the need to adapt to disabilities can also put a strain on psychological well-being. The same could be said about the presence of further symptoms in addition to the covered chronic diseases. In particular, individuals who were burdened with a number of other physical limitations saw a big increase in their disability risk. This finding indicates that this variable captured residual aspects of individual health status, justifying its presence in the model alongside the other, more specific medical status variables. Another significant predictor for ADL disability was the number of medical consultations. The more consultations that were reported, the higher the associated ADL disability risk was. Thus, this variable captured the overall medical status from the perspective of demand due to present morbidity. Most of the variables that were already included in the previous model were still significant and exhibited effects in the same direction. Age remained an influential predictor (especially in the older age groups), although the strength of the age and stroke effects was clearly reduced somewhat by the newly introduced medical variables. This indicates the disability-promoting effects of rising morbidity prevalence in older age groups and the possible comorbidities of stroke. The positive effect that the presence of a partner or spouse exhibited on ADL disability remained even after controlling for all of the covariates. Unlike in the previous model, we could see a change in the variable concerning the distance of the closest child. Compared with having the closest child living between one and five kilometers away from the parents' place of residence, the co-residence of at least one child was associated with a higher risk of ADL disability. It is unlikely that the presence of the child actually caused ADL disability; instead, the parent and the child may have been living together because the parent needed the support. After the individual medical status had been accounted for, this effect emerged in the model. It could also be argued that the presence of potential caregivers and the acceptance of their support might lead people to more readily admit their difficulties in performing certain tasks of daily living.

This might be the case especially in southern countries, where co-residence is a far more common pattern than in the other regions in our sample. (Albertini & Kohli, 2013) However, since this effect only appeared after the morbidity indicators were included, the first interpretation seems more likely. Also of interest was gender: controlling for individual health status reversed its effect on ADL status, and indicated that males were subject to higher ADL risk than females. The categorical variable for educational level only showed a significant effect for the highest category, which suggests that some degree of variation in health-sensitive behavior associated with higher education was manifested in the health situation variables. The positive effect of greater affluence on our outcome remained mostly unchanged, with the coefficients getting only a little closer to one, which supports the assumption that the redistributive efforts of European welfare policies did not manage to neutralize the effects of wealth on health outcomes. The controls for other chronic diseases showed that only diabetes and cancer significantly increased the risk of ADL disability, but not as strongly as stroke. The general absence of substantial change between the models indicates that even when we take into consideration individual indicators—such as education, affluence, morbidity, psychological status, or family support—age and living situation are still the most important factors in ADL disability.

Introducing the medical variable block reduced the OBRV to 0.045 (MOR 1.22), while the SBRV remained almost unchanged, dropping by only 0.02 compared to the basic model. This indicates that even when controlling for individual demographic, socioeconomic, and health characteristics, a strong independent effect of country on the consequences of stroke for ADL disability exists. This remaining variation could be attributable to genuine health care system effects.

The last model also introduced a control at the group level: the underrepresentation of the 80+ age group in the SHARE sample. In sensitivity analyses using data from wave 1 and wave 2, this control exhibited a significant effect in the expected direction: the higher the underrepresentation of older people in a certain country, the lower the ADL disability risk. For wave 4, the significant effect disappeared, reflecting the better overall representation of older age groups in wave 4 compared to previous waves. A detailed discussion of the representation of individuals in the highest age groups can be found in the variables chapter. Alternatively, we used an indicator containing data on the relative number of nursing home beds, which represents only a portion of the potential sampling bias. The results (not shown) were the same as for the ages 80+ deviation variable. Both variants suggest that, relative to data from previous waves, wave 4 data provide the best

representation of the whole age spectrum in our analysis on ADL disability.
Overall, model III further reduced the between-region variation in the overall levels of ADL disability between countries. A MOR of 1.22 remained, which indicates that for all ADL causes except stroke, a certain degree of variation between national welfare and health care regimes remains. However, the between-region variation for the stroke random effect was unchanged compared to the previous model, which indicates that even when the possible healthy elderly or other angles of bias introduced by different levels of institutionalization, health-related sample exclusion, or non-response were considered, the differences in the effects of stroke on ADL disability continued to be large between the countries in our sample.
Finally, we will look in detail at the random effect of stroke in order to assess whether and how the different welfare regions perform and potentially cluster together.

Figure 2 about here

Figure 2 shows the country-specific random effect of stroke as country-specific odds ratios. Italy and Spain are at the top, with odds ratios of 3.95 and 3.07, respectively, which indicates that stroke had the most severe impact on ADL disability in these two countries. In Italy, the effect of stroke was nearly twice as big as in the western countries. Differences within the western European region were virtually nonexistent. Austria, Germany, France, Switzerland, and Belgium neatly cluster together in a range of between OR=2.31 (Switzerland) and OR=1.72 (Belgium), with only Belgium achieving an odds ratio somewhat lower than that of the other countries. The northern European group was mixed in terms of stroke impact. While Sweden achieved the lowest odds ratio by far, with 1.19; the Netherlands, with OR=2.26, appears to fit better in the western European cluster. Denmark’s result (OR=2.77) was even closer to Spain’s result than to that of any other country in the northern group, a finding which also demands interpretation.

4. Discussion

This is the first study investigating the country-level differences in Europe of the effect of stroke on the development of disability in the activities of daily living. Previous studies concerned with differences between welfare regimes in health outcomes have not looked into the disabling impact of a single disease, but have mostly approached the subject from a population health perspective. (Brennenstuhl et al., 2012) Our study was the first that investigated the disabling impact of stroke from a quantifiable comparative perspective, while controlling for other causes of disability. This study produced two main findings regarding the influence of different welfare regimes on disability in daily living activities.

First, we showed that the impact of stroke on ADL disability differed markedly between the 10 countries mostly along a north/south gradient. Second, based on the almost negligible remaining amount of OBRV in the last model and the alternative model specifications, which included random effects components for determinants in addition to stroke as part of our sensitivity analyses, we noted that the impact of other determinants of disability was much more uniform across Europe and was not comparable to the degree of difference we observed for stroke.

The differences in the impact of stroke on disability mostly corresponded to geographical regions, especially for the western and southern European countries. The western European countries in our study indeed performed distinctly differently from the southern countries and also from Sweden in the north. The southern region consisting of Italy and Spain yielded the worst results for stroke cases, and was found to be distinct from the rest of Europe. The western countries of Belgium, France, Germany, Austria, and Switzerland also formed a distinct regime category, but our results indicated that in terms of stroke impact, this group should definitely include the Netherlands, as it was shown to be more similar to the western countries than to Sweden or Denmark. The results for the northern group were decidedly mixed, however, as Sweden performed best and Denmark was more similar to Italy and Spain than to Sweden or even the western cluster. The western and southern clusters point in the direction of a north/south gradient with the sole exception of Denmark. However, since our data did not include Norway and Finland, with only Sweden at the top spot and Denmark performing more like a southern European country, we conclude that regarding the impact of stroke on disability, distinct geographical clusters of western and southern European countries emerge, with the western group performing better than the southern group.

Regarding health care regime research, we can see that countries with low scores on access restriction measures (that is, a high degree of freedom of choice) (Reibling & Wendt, 2010, p .449) generally had low values in the stroke-specific effect on ADL disability. Countries like Denmark, Spain, and Italy have policies that greatly restrict access to specialists, while the western countries generally have more liberal policies (Wendt, 2009). The only outlier in this regard is Sweden, which also greatly restricts access to doctors. Countries with good results regarding the disabling impact of stroke generally also provide a good measure of outpatient care and low out-of-pocket copayments. (Ibid.) Thus, health care regimes that provide direct specialist access at a relatively low price to the individual were found to have less stroke-related disability than countries with more highly regulated approaches. Indeed, Spain and Italy were the countries with the highest shares of private copayments to total medical expenditure per capita, and they were also the countries with the lowest financial household reserves—a combination that might discriminate in particular against older people with even fewer financial resources than those of working age. With its highly regulated and partly privatized medical sector, which has often been described as a type of late national health service (Ferrera, 1996), this system seems less suited than other European systems to providing adequate recovery and disability-mitigating long-term care for stroke patients.

Overall, the question of whether there was an independent effect of the welfare regime on the disabling effects of stroke could be answered in the affirmative. Additionally, we found that, with the exception of Denmark, the strength of the disabling effect of stroke followed a north/south gradient in which Sweden showed the best outcomes, the western countries ranked in the middle, and southern Europe saw the largest increases in the disability risk for stroke cases.

The fact that Denmark fared badly, especially in relation to Sweden, is of interest as well. This might be explained at least to some degree by consulting a study by Leys et al. on the quality of stroke care provided in European hospitals. Based on primary data from an independently conducted survey among more than 800 European hospitals involved in acute stroke care, they concluded that as of 2005, Danish hospitals were not well equipped or very good at handling the immediate treatment of stroke patients. This suggests that the fast response needed to counteract the lasting consequences of stroke has not been adequately provided in Denmark. Except for Norway, no western, southern, or northern European country scored as low as Denmark regarding stroke care capabilities. (Leys et al., 2007)

The second main finding concerned the between-country inequalities of the ADL disability not linked to stroke. The remaining impact of specific welfare systems in the saturated model III was very low, and was even insignificant for between-country differences. Thus, it could be argued that, even using fixed effects for all other health-related variables in the model, the health care regimes included in this analyses produced similar outcomes in that these individual-level predictors managed to reduce the remaining between-country variance to a very low level. This suggests that the hypothesis of convergence in a broader sense of the output side of European health care subsystems (at least in terms of ADL disability as a health outcome measure) was supported by our findings. This also indicates that differences in population health in Europe are, stroke excluded, largely due to within-country variations in relevant determinants of health, such as socioeconomic resources. Compared to stroke-related ADL disability, this suggests that there is a more indirect effect of the welfare regime through its redistributive measures on determinants of health than a direct effect of health care systems on disability outcomes in the case of stroke patients.

Looking at the fixed effects in the models, we can note that even in model III, the effect of household financial assets remained significant and unchanged in strength. This also supports claims like those made by Mackenbach (2012), who observed that socioeconomic inequalities translate into health outcomes independent of the welfare region. In our model, the fixed effects shown for socioeconomic stratification support this assertion: over all of the countries considered, the risk-reducing effect of relative wealth was shown to persist. The findings for the effect of education were similar: having a high level of education was found to reduce the risk of disability in all 10 countries. Regardless of the specifics of an individual's health status, the availability of support, companionship, or a caregiver was generally positive, although this was not the only causal pathway. It can also be argued that a partner provided more incentives to engage in physical activity, and also acted as a social control on individual risk behavior (Alber, 2005). Socioeconomic stratification translated into ADL disability health outcomes in the same way, regardless of where these inequalities were found. In addition, the distinction between urban and rural areas remained significant as a fixed effect in the final model. Thus, for the ADL disabilities not related to stroke, it mattered little in which country an individual lived. In general, these findings can be interpreted as another sign of convergence in the process aspect of health care systems, not only in terms of input, as measured in total health expenditure; but also in terms of differences in health outcomes between health care systems when certain socio-demographic, economic, and health-related indicators are combined, such as those measured in ADL disability.

Limitations and alternative model specifications

It could of course be argued that some of those fixed effects might have turned out to vary between countries if the model had allowed them to. To account for this possibility, we performed a series of sensitivity analyses with alternative model specifications. Specifically, we tested whether stroke or other independent individual-level variables had the biggest influence on the reduction of the remaining between-region variation. To do this, we allowed the effects of variables other than stroke to vary across countries. The results showed that gender, partnership status, the frequency of consultations with a medical practitioner, the number of other symptoms, all other chronic diseases, and depression did not exhibit as much between-region variation as stroke. In other words, the between-country variation of the random effects of all of those variables was generally much smaller than the variation of the random effect for stroke, often by an order of magnitude. This indicates that these predictors had basically the same effects in direction and strength across all of the countries in our sample, which justifies specifying them as fixed effects. While stroke proved to be a powerful predictor as a fixed effect, it was especially useful when it was allowed to vary between regions, as it was able to explain much more of the remaining between-region variation, and to shed light on how different welfare regions cope with the disabling consequences of this disease. This was not, however, found to be the case when we specified other individual-level predictors as random effects. In other words, for the other chronic diseases or determinants like wealth and education, very small differences between the countries were found to be present. Generally, however, and especially compared to the much bigger between-country difference of the stroke effect, these results support the general statement that the health care regimes within the European welfare systems are moving closer together in terms of the association between certain determinants like chronic diseases and ADL disability, with the exception of the impact of stroke on disability.

Another potential criticism of our study might be the use of stroke as a central variable. Stroke is somewhat different from the other medical indicators in our model, in that there is a relatively high mortality risk associated with stroke. (Doblhammer et al., 2012) Thus, it might be argued that the observed difference in the stroke effect between countries is actually a difference in stroke-specific (or general) mortality. To assess this claim, another aspect of our sensitivity analyses consisted of including the percentage of mortality underestimation in SHARE as another variable on the group level. If different levels of stroke mortality had a significant influence, we would expect the amount of between-region variation of the stroke random effect to diminish. This was not the case, as it remained at the same value as before.

To further validate our results, we also replicated the models for samples from SHARE waves 1 and 2, with each producing results similar to those of wave 4 in terms of the effects of stroke on disability and the clusters that result from the country-specific coefficient. The most distinctive difference found was the effect of the group-level control for the underrepresentation of individuals ages 80+, which gained in significance and had a marginal impact when using data with a higher percentage of sample deviation. Overall, the reported results on older age disability status, both those related to stroke as well as in general, were supported by data from 2004 to 2011.

Finally, we were unable to include a point made by researchers like Minicuci et al. (2004), who argued that cultural influences—like differences in the definition of what actually constitutes a disability, or differences in tendencies to admit to or even to pretend to have a certain level of disability—contribute to the differences found in the overall shares of disability, or to the relative impact of certain conditions on disability between European regions. Factors such as varying individual definitions of disability or motivations to admit to having a disability are difficult to measure, and cannot be derived from SHARE data.

To expand on that, there certainly exist other factors we could not include or control for that might also play into the differences in stroke-related disability we found within Europe. The fact that countries with similar health care systems can produce different outcomes of stroke-related disability might to some degree be influenced by unobserved heterogeneities that might systematically cluster on the national population level, e.g. certain patterns of physical activity or lifestyle attitudes that influence health. There might also be additional contextual influences we could not control for, e.g. environmental properties like the availability of infrastructure for sports or community activities that can have an impact on health.

As with most empirical studies, a certain amount of unobserved heterogeneity always remains. However, given the magnitude of the stroke-related differences in the impact on disability that we found, it is unlikely that any one of these factors is responsible for all of the differences shown. It is more likely that on the whole, the impact of stroke on disability might have been a little higher in the north and a little lower in the south, but that the regional clustering in terms of the effect of the stroke would remain generally unchanged even when further expanding the model.

Given these findings, we would argue that, if the policy intention is to reduce overall health inequalities in Europe, policy makers should focus on the socioeconomic inequalities that are significant for health outcomes. If, however, the aim is to reduce the problem of stroke-related disability, policy makers could start by focusing on the health care system. In particular, the large increase in the risk of disability associated with stroke in the southern

European countries points to the need for intervention, at both the level of acute treatment and the level of the treatment and care of stroke survivors. By identifying countries in which stroke patients face a relatively low disability risk, we provide a starting point from which the work of adapting good practice examples can begin. An effort to reduce the wide disparities in the impact of stroke on functional disability within Europe could thus help to eliminate a portion of the costly disability burden faced by aging European societies and welfare regimes in the coming decades.

Table 1: Sample size documentation

Coverscreen wave 4	83854
Reduction to wave 4 interviews	-24696
	59158
Reduction to countries in study	-22532
	36626
Missing information (year of birth)	-12
	36614
Reduction to desired age group (60+)	-11692
	24922
Reduction to population not in nursing homes	-291
	24631
Missing information (household structure)	-31
	24600
Removal of shortened end of live proxy interviews (remove deceased cases)	-800
	23800
Missing information for outcome variable ADL disability	-119
	23681
Missing information for independent variable Euro-D depression indicator	-11
	23670
Missing information for independent variable number of contacts with medical practitioner	-29
Final sample size	23641

Table 2: Descriptive overview of included variables (% and 95% CI; chi² test for independence between regions)

	Northern Europe	Western Europe	Southern Europe	All regions	Chi² test statistic p-value
ADL disability					
no	90.6 [89.9 – 91.2]	86,6 [86,0 – 87,2]	84,1 [83,1 – 85,2]	87,3 [86,9 – 87,7]	115,51
yes	9.4 [8.8 – 10.1]	13,4 [12,8 – 14,0]	15,9 [14,8 – 16,9]	12,7 [12,3 – 13,1]	p < 0,0001
Stroke					
no	95.1 [94,6 – 95,6]	95,2 [94,8 – 95,6]	95,7 [95,1 – 96,3]	95,2 [95,0 – 95,5]	2,73
yes	4.9 [4,4 – 5,4]	4,8 [4,4 – 5,2]	4,3 [3,7 – 4,9]	4,7 [4,5 – 5,0]	p = 0,26
Age (categorized)					
60 – 64	27.9 [26,9 – 29,0]	27,0 [26,2 – 27,8]	23,3 [22,2 – 24,6]	26,6 [26,0 – 27,1]	104,40
65 – 69	24.9 [23,9 – 25,9]	22,1 [21,4 – 22,9]	21,4 [20,3 – 22,6]	22,8 [22,3 – 23,4]	p < 0,0001
70 – 74	18.0 [17,1 – 18,9]	20,5 [19,8 – 21,2]	20,5 [19,4 – 21,7]	19,8 [19,2 – 20,3]	
75 – 79	13.0 [12,3 – 13,8]	14,0 [13,4 – 14,7]	17,2 [16,2 – 18,3]	14,4 [13,9 – 14,8]	
80 – 84	9.3 [8,6 – 10,0]	10,0 [9,5 – 10,6]	10,5 [9,6 – 11,3]	9,9 [9,5 – 10,3]	
85 +	6.8 [6,2 – 7,4]	6,3 [5,8 – 6,7]	7,0 [6,3 – 7,7]	6,6 [6,3 – 6,9]	
Gender					
female	53,2 [52,1 – 54,4]	53,9 [53,0 – 54,8]	53,2 [51,8 – 54,6]	53,6 [52,9 – 54,2]	1,16
male	46,8 [45,6 – 48,0]	46,1 [45,2 – 47,0]	46,8 [45,3 – 48,2]	46,4 [45,8 – 47,1]	p = 0,56
Marital status					
single/widowed	27,8 [26,7 – 28,8]	30,9 [30,0 – 31,7]	23,8 [22,6 – 25,0]	28,5 [28,0 – 29,1]	85,02
living with spouse/partner	72,2 [71,2 – 73,3]	69,1 [68,3 – 70,0]	76,2 [75,0 – 77,4]	71,5 [70,9 – 72,0]	p < 0,0001
Living distance of closest child					
no (living) child	7,6 [7,0 – 8,3]	11,9 [11,3 – 12,5]	9,1 [8,3 – 10,0]	10,1 [9,7 – 10,5]	1794,31
same household/building	19,8 [18,9 – 20,7]	23,2 [22,4 – 24,0]	48,9 [47,5 – 50,4]	27,3 [26,8 – 27,9]	p < 0,0001
> 1 to 5 km	36,1 [35,0 – 37,2]	32,1 [31,2 – 32,9]	29,8 [28,5 – 31,1]	32,8 [32,2 – 33,4]	
> 5 km	36,5 [35,3 – 37,6]	32,8 [32,0 – 33,7]	12,1 [11,1 – 13,0]	29,8 [29,2 – 30,3]	
Multiple strokes					
no	99,4 [99,2 – 99,6]	99,8 [99,7 – 99,8]	99,7 [99,6 – 99,9]	99,6 [99,6 – 99,7]	17,21
yes	0,6 [0,4 – 0,8]	0,2 [0,2 – 0,3]	0,3 [0,1 – 0,4]	0,4 [0,3 – 0,4]	p < 0,001
Diseases					
diabetes	11,0 [10,3 – 11,7]	12,7 [12,1 – 13,3]	18,4 [17,3 – 19,5]	13,3 [12,9 – 13,8]	143,29; p < 0,0001
hypertension	38,3 [37,2 – 39,5]	40,0 [39,1 – 40,9]	45,3 [43,8 – 46,7]	40,5 [39,9 – 41,2]	59,22; p < 0,0001
asthma	1,5 [1,2 – 1,8]	1,2 [1,0 – 1,4]	-	1,1 [0,9 – 1,2]	66,46; p < 0,0001
cataract	9,8 [9,1 – 10,5]	12,3 [11,7 – 12,9]	11,1 [10,2 – 12,0]	11,3 [10,9 – 11,7]	26,63; p < 0,0001
heart attack	13,9 [13,1 – 14,7]	13,6 [13,0 – 14,2]	14,3 [13,3 – 15,3]	13,8 [13,4 – 14,3]	1,33; p = 0,52
cancer	4,3 [3,9 – 4,8]	7,0 [6,6 – 7,5]	4,3 [3,7 – 4,9]	5,7 [5,4 – 6,0]	81,15; p < 0,0001
Depression					
no	82,7 [81,8 – 83,6]	74,4 [73,6 – 75,2]	62,7 [61,3 – 64,1]	74,5 [74,0 – 75,1]	598,08
yes	17,3 [16,4 – 18,2]	25,6 [24,8 – 26,4]	37,3 [35,9 – 38,7]	25,5 [24,9 – 26,0]	p < 0,0001
Other symptoms					
no symptoms	29,9 [28,8 – 31,0]	22,3 [21,6 – 23,1]	21,1 [19,9 – 22,2]	24,3 [23,8 – 24,9]	275,08
1-2 symptoms	47,4 [46,2 – 48,5]	47,1 [46,2 – 48,0]	45,3 [43,9 – 46,7]	46,8 [46,2 – 47,5]	p < 0,0001
3 or more symptoms	22,7 [21,7 – 23,7]	30,6 [29,7 – 31,4]	33,6 [32,3 – 35,0]	28,8 [28,2 – 29,4]	
Education					
low	40,5 [39,3 – 41,6]	33,6 [32,8 – 34,5]	80,7 [79,5 – 81,8]	45,1 [44,4 – 45,7]	3440,25
average	26,7 [25,7 – 27,7]	38,6 [37,7 – 39,5]	10,1 [9,2 – 10,9]	29,3 [28,8 – 29,9]	p < 0,0001
high	30,5 [29,4 – 31,5]	26,2 [25,4 – 27,0]	6,7 [6,0 – 7,4]	23,6 [23,0 – 24,1]	
missing	2,4 [2,0 – 2,7]	1,6 [1,3 – 1,8]	2,5 [2,1 – 3,0]	2,0 [1,8 – 2,2]	
Contacts with medical doctor in the past year					
0 to 5 contacts	74,5 [73,5 – 75,5]	54,6 [53,7 – 55,5]	47,4 [45,9 – 48,8]	59,1 [58,5 – 59,7]	1062,88
> 5 contacts	25,5 [24,5 – 26,5]	45,4 [44,5 – 46,3]	52,6 [51,2 – 54,0]	40,9 [40,3 – 41,5]	p < 0,0001
Area of building					
city/suburbs/town	55,5 [54,3 – 56,6]	31,6 [30,7 – 32,4]	37,7 [36,3 – 39,1]	40,0 [39,3 – 40,6]	1088,98
small town/rural	39,2 [38,0 – 40,3]	62,0 [61,1 – 62,9]	55,3 [53,9 – 56,7]	53,8 [53,2 – 54,4]	p < 0,0001
missing information	5,4 [4,8 – 5,9]	6,4 [6,0 – 6,9]	7,0 [6,3 – 7,7]	6,2 [5,9 – 6,5]	

Table 3: Odds of ADL disability. Individual and group level variables. Odds ratios and 95% CI from multilevel logistic regression.

<u>**Odds of ADL disability**</u>	Model I (no social context, no medical, stroke random effect)			Model II (no medical, stroke random effect)			Model III (all ind., stroke random effect, deviation 80+)		
Covariates									
Individual level	OR	p	95 % CI	OR	p	95 % CI	OR	p	95 % CI
Stroke [ref: no stroke]	**3,83**	0,000	2,87 - 5,12	**3,76**	0,000	2,84 - 4,98	**2,25**	0,000	1,70 - 2,99
Age group [ref: 60 – 64] 65 - 69	**1,21**	0,010	1,05 - 1,40	**1,21**	0,012	1,04 - 1,40	1,11	0,200	0,95 - 1,29
70 - 74	**1,78**	0,000	1,55 - 2,04	**1,73**	0,000	1,51 - 2,00	**1,47**	0,000	1,27 - 1,70
75 - 79	**2,55**	0,000	2,22 - 2,93	**2,36**	0,000	2,04 - 2,72	**1,86**	0,000	1,60 - 2,16
80 - 84	**4,82**	0,000	4,19 - 5,53	**4,33**	0,000	3,75 - 5,00	**3,18**	0,000	2,73 - 3,72
85 +	**8,42**	0,000	7,28 - 9,76	**7,07**	0,000	6,05 - 8,26	**5,16**	0,000	4,37 - 6,10
Gender [ref: female] male	**0,8**	0,000	0,74 - 0,87	**0,91**	0,032	0,83 - 0,99	**1,25**	0,000	1,13 - 1,37
Partnership [ref: single/widowed] living with partner				**0,83**	0,000	0,76 - 0,91	**0,88**	0,014	0,80 - 0,98
Distance to closest child [ref: > 1 to 5 km] no (living) child				1,09	0,206	0,95 - 1,26	1,09	0,272	0,94 - 1,26
same household/building				1,09	0,122	0,98 - 1,21	**1,15**	0,016	1,03 - 1,28
> 5 km				0,95	0,324	0,85 - 1,05	0,96	0,435	0,85 - 1,07
Educational level [ref: low] average				**0,84**	0,002	0,75 - 0,94	0,92	0,151	0,82 - 1,03
high				**0,64**	0,000	0,56 - 0,73	**0,72**	0,000	0,63 - 0,82
missing information				0,9	0,500	0,66 - 1,23	0,87	0,426	0,63 - 1,22
Financial reserves [ref: low] average				**0,69**	0,000	0,63 - 0,76	**0,78**	0,000	0,70 - 0,86
high				**0,56**	0,000	0,50 - 0,62	**0,66**	0,000	0,59 - 0,74
Area of residence [ref: City/suburbs/town] small town/rural				1,03	0,449	0,94 - 1,13	1,08	0,113	0,98 - 1,19
missing information				**1,43**	0,000	1,20 - 1,71	**1,45**	0,000	1,20 - 1,76
Multiple strokes [ref: no]							**2,13**	0,012	1,18 - 3,85
Diseases [ref: disease no present]									
Diabetes							**1,43**	0,000	1,28 - 1,60
Hypertension							0,95	0,283	0,87 - 1,04
Asthma							1,14	0,428	0,83 - 1,55
Cataract							1,04	0,463	0,93 - 1,17
Heart attack							1,05	0,375	0,94 - 1,17
Cancer							**1,17**	0,047	1,00 - 1,37
Other symptoms [ref: no symptoms] 1 – 2 symptoms							**3,38**	0,000	2,73 - 4,18
3 or more symptoms							**9,72**	0,000	7,85 - 12,05
Contacts with medical doctor [ref: 0 – 5 contacts] > 5 contacts							**1,49**	0,000	1,35 - 1,63
Depression [ref: no depression]							**2,24**	0,000	2,05 - 2,46
Group level									
Deviation age 80+ p. %-point							1	0,646	0,99 - 1,01
	N = 23641			N = 23641			N = 23641		
Overall between region variation (OBRV)	0,12			0,11			0,045		
Median Odds Ratio (MOR)	1,39			1,37			1,22		
Stroke between region variation (SBRV)	0,16			0,15			0,14		
Log likelihood	-8208			-8064,45			-7006,04		
Significance (likelihood ratio test)	0,0000			0,0000			0,0000		

Fig. 1: SHARE sample deviation from official population statistics, age 80 plus for waves 1, 2 and 4 (source: own calculations)

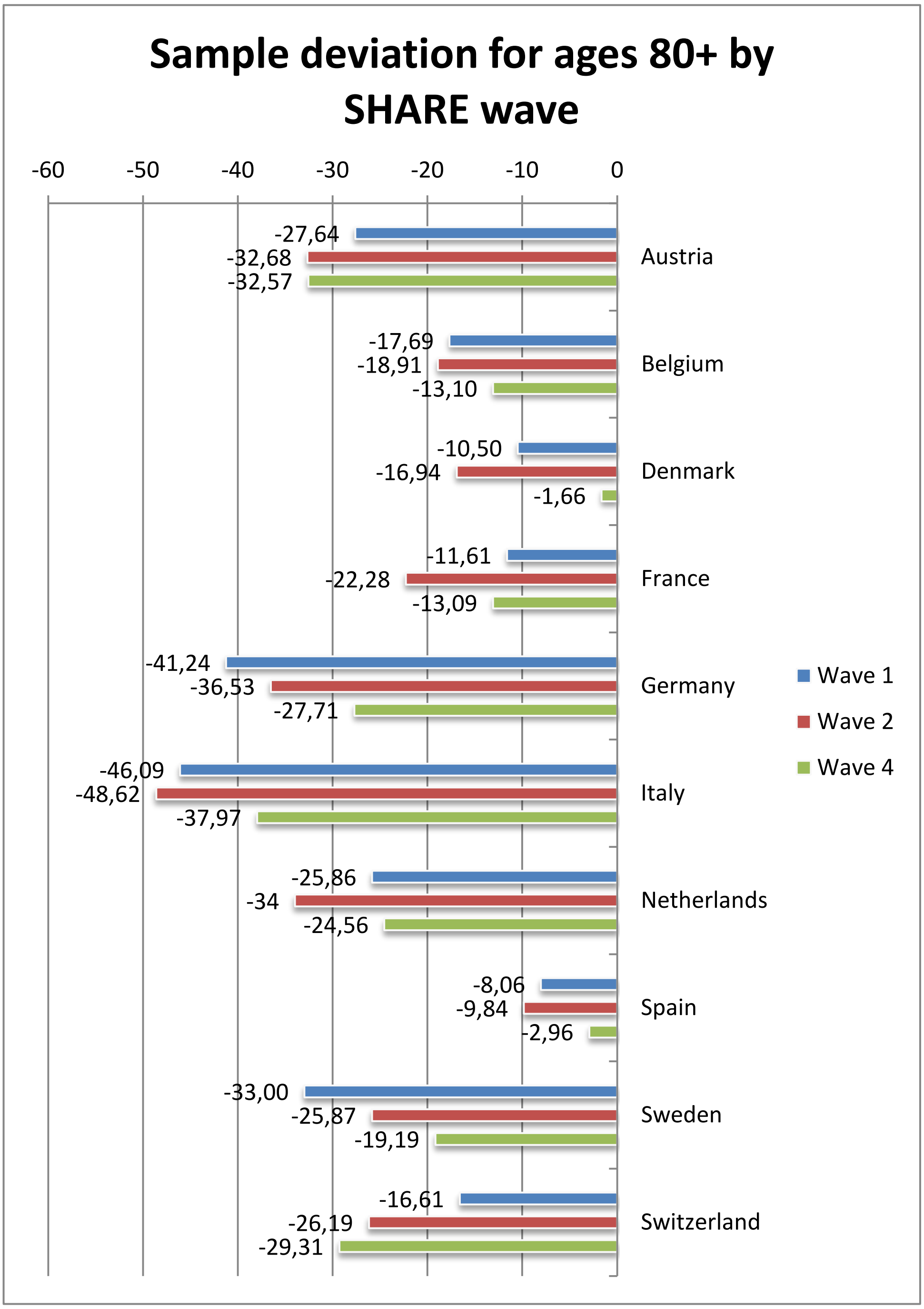
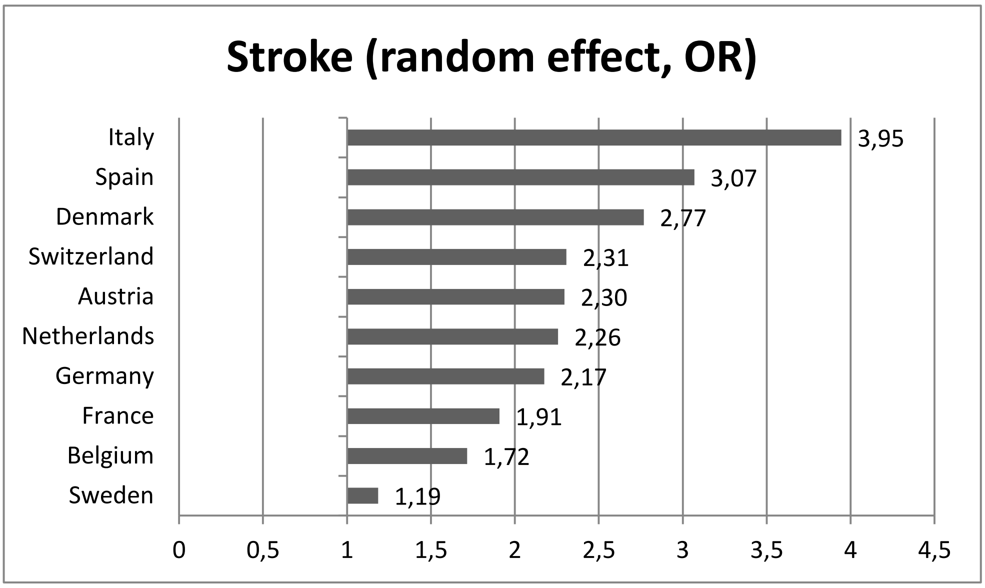


Fig. 2: Total odds ratio for stroke by country, based on random effect component



Sources

Alber, J. (2005): Wer ist das schwache Geschlecht? Zur Sterblichkeit von Männern und Frauen innerhalb und außerhalb der Ehe. In: *Leviathan* 33 (1), pp. 3–39.

Albertini, M.; Kohli, M. (2013): The Generational Contract in the Family: An Analysis of Transfer Regimes in Europe. In: *European Sociological Review* 29 (4), pp. 828–840.

Avendano, M.; Jurges, H.; Mackenbach, J. P. (2009): Educational level and changes in health across Europe: longitudinal results from SHARE. In: *Journal of European Social Policy* 19 (4), pp. 301–316.

Brennenstuhl, S.; Quesnel-Vallee, A.; McDonough, P. (2012): Welfare regimes, population health and health inequalities: a research synthesis. In: *Journal of Epidemiology & Community Health* 66 (5),pp. 397–409.

Christensen, K.; Doblhammer, G.; Rau, R.; Vaupel, J. W. (2009): Ageing populations: the challenges ahead. In: *The Lancet* 374 (9696), pp. 1196–1208.

Chung, H.; Muntaner, C. (2007): Welfare state matters: A typological multilevel analysis of wealthy countries. In: *Health Policy* 80 (2), pp. 328–339.

Deeg, D. J. H.; van Vliet, M. J. G.; Kardaun, J. W. P. F.; Huisman, M. (2013): Understanding the Mortality Decline at Older Ages. Improved Life Course or Improved Present Period? In: *Annual Review of Gerontology and Geriatrics* 33, pp. 261–291.

Doblhammer, G.; Kreft, D.; Dethloff, A. (2012): Gewonnene Lebensjahre. In: *Bundesgesundheitsbl.* 55 (4), pp. 448–458.

Eikemo, T. A.; Bambra, C.; Judge, K.; Ringdal, K. (2008): Welfare state regimes and differences in self-perceived health in Europe: A multilevel analysis. In: *Social Science & Medicine* 66 (11), pp. 2281–2295.

Esping-Andersen, G. (1990): The Three Worlds of Welfare Capitalism. Cambridge, Princeton University Press.

Fassbender, K.; Balucani, C.; Walter, S.; Levine, Steven R.; Haass, A.; Grotta, J. (2013): Streamlining of prehospital stroke management: the golden hour. In: *The Lancet Neurology* 12 (6), pp. 585–596.

Ferrera, M. (1996): The 'Southern Model' of Welfare in Social Europe. In: *Journal of European Social Policy* 6 (1), pp. 17–37.

Fried, L. (1999): Association of Comorbidity with Disability in Older Women. The Women's Health and Aging Study. In: *Journal of Clinical Epidemiology* 52 (1), pp. 27–37.

Fried, L.; Ettinger, W. H.; Lind, B.; Newman, A. B.; Gardin, J. (1994): Physical disability in older adults: A physiological approach. In: *Journal of Clinical Epidemiology* 47 (7), pp. 747–760.

Haberkern, K.; Szydlik, M. (2008): Pflege der Eltern – Ein europäischer Vergleich. In: *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 60 (1), pp. 82–105.

Hennerici, M. G.; Kern, R.; Szabo, K. (2013): Non-pharmacological strategies for the treatment of acute ischaemic stroke. In: *The Lancet Neurology* 12 (6), pp. 572–584.

Hoeymans, N.; Wong, A.; van Gool, C. H.; Deeg, D. J. H.; Nusselder, W. J.; de Klerk, M. M. Y.; van Boxtel, M. P. J.; Picavet, S. J. (2012): The Disabling Effect of Diseases: A Study on Trends in Diseases, Activity Limitations, and Their Interrelationships. In: *American Journal of Public Health* 102 (1), pp. 163–170.

Jensen, C. (2008): Worlds of welfare services and transfers. In: *Journal of European Social Policy* 18 (2), pp. 151–162.

Kneip, T. (2013): Survey Participation in the Fourth Wave of SHARE. In: L. Abduladze (Ed.): SHARE Wave 4. Innovations & Methodology, pp. 140–155.

Kunst, A. E. (2005): Trends in socioeconomic inequalities in self-assessed health in 10 European countries. In: *International Journal of Epidemiology* 34 (2), pp. 295–305.

Lahelma, E.; Lundberg, O. (2009): Health inequalities in European welfare states. In: *The European Journal of Public Health* 19 (5), pp. 445–446.

Leys, D.; Ringelstein, E. B.; Kaste, M.; Hacke, W. (2007): Facilities Available in European Hospitals Treating Stroke Patients. In: *Stroke* 38 (11), pp. 2985–2991.

Lynn, P.; De Luca, G.; Ganninger, M. (2013): Sample design in SHARE wave 4. In: L. Abduladze (Ed.): SHARE Wave 4. Innovations & Methodology, pp. 74–123.

Mackenbach, J. P. (2012): The persistence of health inequalities in modern welfare states: The explanation of a paradox. In: *Social Science & Medicine* 75 (4), pp. 761–769.

Merlo, J.; Chaix, B.; Ohlsson, H.; Beckman, A.; Johnell, K.; Hjerpe, P. et al. (2006): A brief conceptual tutorial of multilevel analysis in social epidemiology: using measures of clustering in multilevel logistic regression to investigate contextual phenomena. In: *Journal of Epidemiology & Community Health* 60 (4), pp. 290–297.

Minicuci, N.; Noale, M.; Pluijm, S. M. F.; Zunzunegui, M. V.; Blumstein, T.; Deeg, D. J. H. et al. (2004): Disability-free life expectancy: a cross-national comparison of six longitudinal studies on aging. The CLESA project. In: *European Journal of Ageing* 1 (1), pp. 37–44.

Ploubidis, G. B.; Dale, C.; Grundy, E. (2012): Later life health in Europe: how important are country level influences? In: *European Journal of Ageing* 9 (1), pp. 5–13.

Pluijm, S.M.F; Bardage, C.; Nikula, S.; Blumstein, T.; Jylhä, M.; Minicuci, N. et al. (2005): A harmonized measure of activities of daily living was a reliable and valid instrument for comparing disability in older people across countries. In: *Journal of Clinical Epidemiology* 58 (10), pp. 1015–1023.

Puts, M. T. E.; Deeg, D. J. H.; Hoeymans, N.; Nusselder, W. J.; Schellevis, F. G. (2008): Changes in the prevalence of chronic disease and the association with disability in the older Dutch population between 1987 and 2001. In: *Age and Ageing* 37 (2), pp. 187–193.

Reibling, N.; Wendt, C. (2010): Bildungsniveau und Zugang zu Gesundheitsleistungen. In: *Das Gesundheitswesen* 72 (08/09), pp. 447–454.

Ringelstein, E. B.; Kaste, M.; Hacke, W.; Leys, D. (2007): Stroke Care in Europe – The Role of Stroke Units. In: *European Neurological Review*, pp. 24–26.

Rostila, M. (2007): Social capital and health in European welfare regimes: a multilevel approach. In: *Journal of European Social Policy* 17 (3), pp. 223–239.

Schram, M. T.; Frijters, D.; van de Lisdonk, E. H.; Ploemacher, J.; de Craen, A. J. M.; de Waal, M. W. M.; van Rooij, F. J.; Heeringa, J.; Hofman, A.; Deeg, D. J. H.; Schellevis, F. G. (2008): Setting and registry characteristics affect the prevalence and nature of multimorbidity in the elderly. In: *Journal of Clinical Epidemiology* 61, pp. 1104–1112.

Schulz, E.; Leidl, R.; König, H.-H. (2004): The impact of ageing on hospital care and long-term care—the example of Germany. In: *Health Policy* 67 (1), pp. 57–74.

The IST-3 collaborative group (2013): Effect of thrombolysis with alteplase within 6 h of acute ischaemic stroke on long-term outcomes (the third International Stroke Trial [IST-3]):

18-month follow-up of a randomised controlled trial. In: *The Lancet Neurology* 12 (8), pp. 768–776.

Wendt, C. (2009): Mapping European healthcare systems: a comparative analysis of financing, service provision and access to healthcare. In: *Journal of European Social Policy* 19 (5), pp. 432–445.