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Health and Mortality during the transition to retirement in Spain

Analysis of Mortality Differences by Social Position in Spain with the Longitudinal Population Register of Andalusia (BDLPA)

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Abstract

Background: After decades of exceptional mortality improvements paired with low fertility South European societies have to face the challenges of heavy population aging. Especially the prospect of large baby boomer cohorts approaching retirement age raises concerns about the sustainability of social security and pension funds. For the adjustment and reformation of pension systems, it will be essential to address the socioeconomic health gradient and mechanism behind structural inequalities in the retired population. In particular with regard to aspects of social fairness, the quantification of existing inequalities in health and mortality within the retired population can contribute to the anticipation of prospective effects on the population health.

Method: We analyze the impact of several socioeconomic and demographic indicators on mortality during the transition to retirement by applying stratified Cox Proportional Hazard regression models. This analysis is conducted, using the *"Base de Datos Longitudinal de Población de Andalucía"* (BDLPA), a register-based individual level data base which is linked to the Andalusian social security data set NIS for the years 2011 to 2015.

Results: While the results for the male population indicated the existence of a socioeconomic mortality gradient, the analysis could not confirm a similar effect for Andalusian women. Only the group with the lowest household income seemed to be affected.

Conclusion: Although there is no indication for a clear socioeconomic gradient, the analysis of Andalusia's retired population confirmed the increased mortality risk of the group at the bottom of the income distribution.

Introduction

South Europe experiences a rapid change of their population structure. Decades of low birth rates in combination with a historically unique improvement in mortality rates across all ages have led to shrinking and heavily aging populations [**?** **?**]. Despite the remarkable opportunity for millions of people to enjoy longer lives in a better health compared to previous generations [**?** **?**], the growth of average human life lengths entails considerable challenges for social security systems [**?**]. A growing number of welfare or pension recipients is increasing the pressure on the working age population which itself is declining at the same time. The Old-Age Dependency Ratio [1] in Spain and Italy is projected to increase from 0.33 to about 0.5 until 2050 and therewith exceeds values of most North and Central European countries [**?** **?**].

Besides the pressure caused by demographic aging, South European economies were hit extraordinarily hard by the global financial crisis in 2008. Austerity policies in answer to the recession additionally jeopardized the sustainability of social service budget and public pension funds [**?** **?**]. Consequently, policy makers were forced to react and initiated modifications with regard to the access to public pensions following the example of other European countries. In Italy and Spain adjustable conversion factors were implemented in the pension formula which determine future pension sizes and eligibility ages based on life expectancy [**?** **?**]. The extension of the working life in particular promises to be a relative efficient and cost-effective adjustment to the population development and would postpone shortages of pension funds to the future [**?** **?**].

Regarding social fairness, however, it is important to ask if the additional burden which is imposed on the population by prolonging their working lives and cutting their pensions is shared equally. In other words, will such reforms affect particular social groups more negatively than other and increase existing health inequities? Since the average life expectancy was chosen to determine the eligibility to full pension, heterogeneity with regard to survival remains unconsidered. Thus, if structural inequalities with regard to health and survival exist within the society and are related to forms of occupation or other socioeconomic characteristics, raising the eligibility age could manifest and reinforce advantages of social groups over others.

In order to estimate the impact of changes in the eligibility age and pension size on the health and survival, it is necessary to acquire more detailed knowledge about the structural mechanisms which shape the health of the retiring population. Apart from the aspect of fairness, knowledge about structural health differentials by socio-economic and demographic characteristics are essential for the estimation of expenditures for future care need. We aim to fill a part of this void with our analysis of structural mortality differences during and after the transition to retirement. After describing the underlying mechanisms for our examination, we introduce a relatively underused longitudinal data structure provided by our project partner, the Institute for Cartography and Statistics of Andalusia (ICEA). The register-based data infrastructure allowed us to obtain follow-up data for mortality after entry into the public pension system in combination with the Spanish Population and Household census of 2001. We apply stratified Cox proportional hazard models to separately estimate the mortality differentials for women, men and married couples depending on various socioeconomic measures over time.

[1] $D = \frac{N_{65+}}{N_{15-64}}$; where N_{65+} is the population 65 years and older, and N_{15-64} the population in working ages

Background

Structural inequalities and health

In spite of the multitude of explanation for the historical mortality decline [**?**], it is hard to imagine that average human life lengths will continue to increase at current rates if improvements of living standards, entitlement to full pension benefits, or access to advanced medical treatments are not shared equally. Although most modern, high income countries provide comprehensive and affordable health care for their citizens, there is evidence for survival differences depending on income, education and occupation type. Numerous researchers point out the existence of a mortality advantage for better educated and wealthier individuals over lower educated and less wealthy ones [**? ? ? ? ? ?**]. Whereas the impact of income on health is probably rather direct in developing country where it determines the access to fresh water and adequate nutrition, it is assumed to work through access to opportunities for social participation in more developed countries [**? ? ?**]. One of the two major hypothesis explaining the impact of income on health is the Absolute Income Hypothesis (AIH). It assumes an indirect relationship between personal income and average health. The Relative Income Hypotheses (RIH) based on Rogers (1979) [**?**], in contrast, relates the average population health level to the income distribution on a society level [**?**].

An economic and education gradient with respect to survival and health needs to be considered for the adjustments of pension reforms on the basis of average life expectancy, especially in times of growing income inequalities in many OECD countries [**? ? ?**]. Increasing the eligibility age and taking away possibilities for early retirement can possibly have very different effects on the longevity of social groups and in return increase the costs through higher care need. Nevertheless, the relationship between socio-economic characteristics is controversial and strongly depends on measurement strategies. The use of cross-sectional information will make it for example hard to distinguish if individual health problems determine the income instead of the other way round. Moreover, aggregated income measures cannot be consistently linked to individual-level health unless the relationship is linear [cf. **?**]. In our contribution, we account for these limitations by applying a unique data infrastructure which allows us to examine the link between individual level pension income and mortality in Andalusia, the second biggest and most populated of the 17 Spanish autonomous communities [**?**].

Since retirement pensions are closely related to the individual life time social security deposits and therewith the working life course trajectories, there are substantial differences in the response to pension measures between men and women. In the context of Spain and Andalusia gender inequality in paid labor as well as other social spheres is historically relatively high and has only recently been addressed at a broad political level [**?**]. With regard to the cohorts under observation, variations and distributions in life time earnings, educational degrees and accumulated pension income through a constant employment are extensive between the male and the female population [**?**]. Moreover, differentials in biological predispositions and risk related behavior have also let to relatively big gender gap in mortality in Spain and other South European countries [**? ? ?**]. Currently the female advantage measured in years of life expectancy at birth is 5.52 years Spain (2014) and 4.73 years in Italy (2012) [2].

[2]Calculations based on data downloaded from the Human Mortality Database, University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). Data downloaded on 26.01.2017 [**?**]

The transition to retirement and its association to ill health

At an individual level, entering retirement is potentially stressful life course event which is associated with a substantial loss of social network resources and can be, dependent on the sociocultural context, perceived as entering a period of cognitive and physical decline [**?**]. Especially during the transition period, various spheres of life such as the daily activities, family relations and financial wellbeing are exposed to substantial changes [**?**]. Given the increasing share of physiological frail individuals in these age groups [**?**] and depending on the financial and family support network, such changes could trigger downward spirals in health and ultimately lead to fatal outcomes.

Regarding the associations between mortality and the transition to retirement, the results are mixed and indicate that we deal with a very dynamic process [**? ? ? ? ?**]. While the meaning of retirement does not only change as social (age) norms evolve, requirements for entering and pension size are as well dependent on the economical and demographic development. Therefore, definitions for retirement are not static and vary along the three major dimensions timing, completeness and voluntariness [**?**]. Furthermore, the decision to retire is highly individual, prone to sudden changes and stimulated by various life course events and push and pull factors. Arguably the biggest obstacle with regard to the association between worsening health and retirement is their endogenous relationship [**?**].

Mortality differentials and social inequalities in South Spain

Although mortality differentials by socioeconomic characteristics seem to be rather moderate in South European countries in comparison to other European regions [**?**], their current demographic, social and economic development entails various potential challenges regarding regional and economic inequality. Studies on the onset of disabilities and age related chronic diseases reveal that these historical gains in average life span are generally spent in good health [**?**]. Although the most recent economy crisis and the related reductions of the health and social service system budget were expected to slow down the remarkable mortality improvements [**? ?**], short-term effects on overall survival even pointed towards a faster reduction of Spanish mortality rates. Whereas some studies found an elevated risks for suicide and mental health issues which correlate with the economic downward trends and increasing unemployment [**? ?**], mortality from most causes decreased after 2008 [**?**]. While Spain's population , the transition to a regime with low fertility and mortality rates was remarkably rapid. 1941, two years after the end of the Spanish civil war, marks the beginning of the exceptional growth period with an increase in average life expectancy at birth for both sexes combined by more than ten years within four years (47.19 years - 57.79 years) [3]. Following a short period of stagnation, a more moderate but long-lasting increase in life expectancy sets on in the 1950, probably related to the economic stabilization through (!!!). Since then, the period life expectancy at birth grew with except of a socio-political re-orientation period after the end of the dictatorship in the early 1970s, and arrived to be the European record for women during the last three consecutive years [**? ?**]. Our analysis is centered around Andalusia, which is the southern most and with about 8.3 million inhabitants (2016) most populated of the 17 Spanish autonomous communities [**?**]. Although the predominantly rural region has experienced economic bottlenecks and strong selective outmigration of young healthy individuals throughout the twentieth century, in recent decades, not only eco-

[3] The series of Spanish life tables was downloaded from the Human Mortality Data Base (access date 01.08.2017) [**?**]

nomic and social indicators approximated the Spanish average but also Andalusian mortality rates. Analyses of small area differences have indicated that currently only a group of municipalities in the south west of the community is exposed to higher mortality rates than the Spanish average [**?**]. While survival disadvantages were historically attributed to strong excess mortality of children and young adults, since the 1960, differences are contributed by the population older than 65 years [**?**]. With its historically rather instable economy, Andalusia was hit extraordinarily hard by the recent financial crisis which led to extreme job loss and a constantly increasing at-risk-of-poverty rate which reached with 35.4% in 2016 far higher levels than the Spanish national average (22.2%) [**?**]. Since it can be assumed that the effects of a recession on mortality and health are somewhat time lagged, it is not surprising to find ambiguous short-term results for this relationship. The only exception is the sharp increase in mental health problems which is for example expressed through the vast increase in suicide attempts since 2008 [**?**].

Methodology & Data

Following an initiative of the Andalusian government in 1996, the Institute of Statistics and Cartography of Andalusia produced a register based longitudinal population dataset, the *Base de Datos Longitudinal de Población de Andalucía* (BDLPA). This relatively recently developed statistical infrastructure allows us to follow up death and out migration for an almost full sample of a synthetic cohort of the Andalusian population in 2001 to currently 2015. Based on the Spanish population and housing census of 2001 a major advantage of the data structure is the possibility to jointly apply it with other administrative population based data basis in Andalusia or Spain [**?**]. For the examination of a possible socioeconomic gradient during and after the transition to retirement, we applied for the pension spell data set of the Spanish National Institute for Social Security (NISS) [**?**] and successfully linked information on the spells of retirement, widowhood and disability pensions for the years between 2011 and 2015 to the individuals in the BDLPA. While we have no detailed information on private pension schemes, the NISS provides data on the about 93% of the population who receive a public pension [**?**]. For the analyzes of health inequalities during the transition to retirement we focus on individuals in three states. Apart from the absorbing state death, which is our variable of interest, we observe everybody who has entered the public pension system between 2011 and 2015. Consequently, individuals in our study population can either still be employed or on the job market or they are retired. We assume that individuals are not able to change their state from retired to working. In order to capture earlier entries to retirement as well as have a reasonable cut of point we decided to observe only persons of age 55 or older at begin of the study in 2011. The legal eligibility age for early retirement was set to 61 by a royal decree in 2002 [**?**]. Since there are occupational groups like workers in the mining industry who have separate benefit systems, we set the entry age to 55. We do not observe the mortality or the pension information for individuals older than 90 to avoid possible biases through missing data and errors. Since the data has been gained through administrative processes, in the transmission and linking process a number incoherences have occurred. We decided to take precautionary measures and exclude the age groups where possible data errors could have a large effect on the outcomes as consequence of small group size.

From the administrative raw data we generate two distinct data sets to examine socioeconomic differences by individual and household measures. The properties and distributions of important covariates are displayed in

table 1. The data set with individual retirement spells contains information about 641.223 persons who received a public pension between 2011 and 2015 and have resided in Andalusia since 2002. Accounting for gender differences in life course trajectories, earnings, and mortality, we conduct a second analysis applying a subset of the full dataset which contains information on married couples who have received a public retirement pension. Regarding the data structure, the examination of married couples was the only possibility to extract information on the household income for our subsequent analysis of female mortality. With regard to our focus on the impact of socio-economic position on health, the pension as well as the pension household income serves as our main explanatory variable. For easier access we collapse the continuous variables in four categories based on the income distribution of the population at risk.We further refined the socio-economic position of an individual by the highest obtained education degree, the contribution time to social security as proxy for a stable or fragmented working life, the ownership status of the home, and the access to personal motor vehicles. Age, sex and the household size at baseline enter the analysis as demographic variables. The second data set regarding the married couples additional contains information on age differences between the partners as well as the education and pension information of the partner.

Statistical Model

The most often used regression approach to survival data is unarguably the semi-parametric Cox Proportional Hazards Model [**?**]. It is statistically robust and can be obtained for a wide range of data situations without specifying a underlying baseline distribution. The effect of the covariates on the individual hazard in the Cox model enters multiplicative as shown in equation 1 [**?**].

$$h(t_j) = h_0(t) \exp(x_j, \beta) \tag{1}$$

where $h_0(t)$ represents the underlying baseline hazard function at time t and $\exp(x_{j,\beta})$ is the non-negative function of covariates. The model estimates are obtained through the maximization of a partial log likelihood function, a method which was as well developed by David R. Cox [**?**]. He proposed to maximize just the right handed side of the formula with respect to x, setting the derivate equal to zero and solving the unknown parameter [**?**]. The unspecified baseline hazard from the left part of the formula is simply discarded for the further estimations which explain the word partial in the name of the method. The partial likelihood function is treated as an ordinary likelihood function but the maximization process has to be done through a numerical optimization method. The decision to leave the baseline hazard unspecified allows users to avoid assumptions about the survival time distribution [**?**]. Furthermore, it results in a statistically relatively robust model which is easy to apply, very effective in the stratified analysis of nuisance variables and allows for an easy adjustment for time periods when no individual is at risk [**?** **?**]. Given the structure of the data sets we use for the analysis of socioeconomic differences on mortality, we had to allow our model to account for left truncation [**?**]. For everybody who has entered the observation period as a pension recipient, the time under risk before the start date of the study remains unobserved. To account for the different baseline mortality risk and more important the working life trajectories of men and women separate models were estimated for the male and female population.

Results

All conducted models show mixed effects of the pension income on the relative risk of dying. In the analysis containing all individuals who have received a pension between 2011 and 2015, the most categories of the income variable show no statistically significant impact on the hazard (table 1). The exception are the men who receive a public pension between 1000 and 1999 Euro a month. Their risk of dying in comparison to the reference group of men who own more than 2000 Euro monthly is about 6% increased. In the case of the female population, the hazard of dying does not significantly vary by their pension income. The results for education as inequality dimension are more prevalent. The men with a secondary or higher education are highly significant and lower risk of 4.7% of dying compared to their less educated counterparts. The effect for women is with about 8.4% sightly elevated. As a further socioeconomic impact factor for mortality, the ownership status of the house or apartment the persons lives in indicates a mortality advantage of the presumably wealthier individuals. There is also strong evidence that a lack of access to a car and therewith reduced mobility affects the relative risk of dying for both sexes. The effect size is with 1.224 about 12% higher for men than for women compared to individuals who own one or more motor vehicles. Also a protective effect of marriage was prevalent in both populations.

The Cox proportional hazard model results based on the married population of 2011 where both partners have retired until 2015 and were left truncated are displayed in the table 2. The income variable relates to the pension income of a house with two retired individuals and behaves similarly to the individual income. In the case of the married couples, the group with a household income of less than 1000 Euro per month were estimated to have a highly significant increased risk of dying within the time period under observation. Notable, the hazard differs relatively strong between men and women. While women living in a household with a monthly income of less than 1000 Euro per month are exposed to a 73.5% higher risk of dying compared to their counterparts who live in households with more than 2000 Euro per month, the relative risk of men in the lowest income category to die is almost 4 times higher than for their more wealthy counterparts. Once the education of the partner is considered the highest obtained degree does not seem to influence the hazard extensively. With regard to the retirement timing, in time and late entry to retirement seem to be related to a lower risk of dying. The effect sizes are possibly biased by the endogenous relationship between health problems and early retirement. In the analysis it was accounted for the reception of a disability support pension before entering retirement. Here certain requirements have to be fulfilled, hence a bias cannot be excluded.

Table 1: Cox PH Model - Estimated hazard of dying for pension recipients between 2011-2015

	Dependent variable:	
	Relative mortality risk	
	males	females
1000-1999 Eur/month	1.059** (1.021, 1.097)	1.076 (0.923, 1.229)
500-999 Eur/month	1.035. (0.997, 1.073)	1.036 (0.884, 1.188)
$<$ 500 Eur/month	1.012 (0.960, 1.064)	1.004 (0.849, 1.159)
Secondary/Tertiary Ed.	0.953*** (0.932, 0.973)	0.916*** (0.871, 0.960)
$<$ 20 y. contrib.	1.055** (1.016, 1.093)	1.015 (0.979, 1.051)
$>$ 40 y. contrib.	0.939*** (0.923, 0.955)	1.025 (0.959, 1.091)
in time ret.	0.851*** (0.835, 0.868)	0.834*** (0.789, 0.879)
late ret.	0.800*** (0.764, 0.836)	0.812*** (0.758, 0.866)
birth year (cohort)	1.007* (1.001, 1.012)	1.023*** (1.012, 1.033)
married	0.801*** (0.770, 0.832)	0.902*** (0.857, 0.947)
widowed	0.905*** (0.865, 0.946)	0.979 (0.934, 1.024)
divorced	1.089** (1.026, 1.153)	1.007 (0.894, 1.120)
own house/apt.	0.935*** (0.899, 0.971)	0.910** (0.843, 0.977)
rent	1.116*** (1.068, 1.164)	0.991 (0.902, 1.080)
no vehicles	1.224*** (1.207, 1.241)	1.099*** (1.066, 1.131)
Observations	441,329	199,894
R^2	0.005	0.001
Log Likelihood	−719,892.600	−178,122.400
Wald Test (df = 17)	2,081.840***	239.440***
LR Test (df = 17)	2,014.293***	234.433***
Score (Logrank) Test (df = 17)	2,091.617***	239.909***
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 2: Cox PH Model - Estimated hazard of dying for married pension recipients between 2011-2015

	Dependent variable:	
	Relative mortality risk	
	males	females
1000-1499 Eur/month	0.960 (0.888, 1.032)	0.989 (0.839, 1.138)
1500-1999 Eur/month	0.962 (0.877, 1.047)	1.034 (0.863, 1.205)
$<$ 1000 Eur/month	3.998*** (3.914, 4.082)	1.735*** (1.539, 1.931)
high education.	1.014 (0.947, 1.082)	1.172* (1.026, 1.318)
high education (partner)	0.889. (0.820, 0.959)	0.784*** (0.642, 0.925)
$<$ 20 y. contrib.	0.896*** (0.834, 0.959)	0.962 (0.882, 1.043)
$>$ 40 y. contrib.	0.976 (0.933, 1.018)	0.974 (0.744, 1.205)
$<$ 20 y. contrib.(partner)	0.951* (0.907, 0.995)	1.024 (0.835, 1.212)
$>$ 40 y. contrib.(partner)	0.989 (0.926, 1.051)	0.967 (0.893, 1.040)
in time ret.	0.860*** (0.818, 0.902)	0.811*** (0.692, 0.929)
late ret.	0.765*** (0.691, 0.839)	0.734*** (0.596, 0.872)
in time ret.(partner)	0.931 (0.880, 0.982)	0.902** (0.825, 0.978)
late ret.(partner)	0.907 (0.837, 0.976)	0.822* (0.638, 1.007)
birth year (cohort)	1.037*** (1.025, 1.050)	1.068*** (1.042, 1.094)
$>$10 y. older	0.879** (0.778, 0.981)	1.120 (0.707, 1.534)
$>$ 10 y. younger	1.235** (0.972, 1.498)	1.128 (0.815, 1.441)
1-10 y. older	0.937*** (0.885, 0.989)	1.127* (1.009, 1.245)
1-10 y. younger	1.043 (0.979, 1.106)	1.074 (0.984, 1.164)
other regime	1.174** (1.087, 1.261)	1.210* (1.039, 1.380)
rent	1.223** (1.113, 1.334)	1.325** (1.114, 1.536)
no vehicles	1.223*** (1.183, 1.264)	1.175*** (1.097, 1.254)
large household	1.332* (1.129, 1.535)	1.589* (1.200, 1.977)
couple household	0.924*** (0.885, 0.964)	0.969 (0.892, 1.046)
Observations	140,762	70,376
R^2	0.019	0.005
Log Likelihood	−108,407.600	−27,286.960
Wald Test (df = 24)	3,232.330***	329.320***
LR Test (df = 24)	2,640.235***	346.253***
Score (Logrank) Test (df = 24)	2,985.658***	327.089***
Note:		*p<0.1; **p<0.05; ***p<0.01

Conclusion

In the course of the latest reforms in Italy and Spain, governments implemented a conversion factor in the pension formulas to calculate the entitlement age for full pensions [**?** **?**]. These factors are based on the average life expectancy. Thus, they do not account for the above mentioned heterogeneity in the population and raising the entitlement age based on this factor might manifest existing social inequalities. Lower educated individuals will have to work a longer relative part of their lives under less favorable conditions (lower salaries, manual work etc.) whereas higher educated and wealthier individuals will enjoy not only higher incomes but also on average a longer life on a pension [**?** **?**]. Simulations with Spanish data and varying eligibility ages confirm that income inequalities would ”somewhat increase” [**?** , p.149].

Our contribution adds to the discussion by identifying subpopulations under risk. Although there was no indication for a socioeconomic gradient, the pension income can relate to an elevated mortality risk for the lowest socioeconomic groups in the sample population of retired individuals and the ones who entered retirement within the observation period. Since the transition to retirement often goes hand in hand with a substantial loss of income for this group, the entry to retirement age would affect affluent households less than those under financial strain. A further important and often neglected aspect is the possible time lag between a particular income situation and the effect on health [**?** **?**]. While we draw conclusions from the effects of individual level retirement pension size, this payment can be understood as a proxy for the life time earnings and the fragmentation of the labor market history.

The analysis has several limitations which are partly related to the administrative structure of the data. First, there is a time lag between some of the information from the census and the start of the study period which restricted us to choose presumably time independent variables like sex or the highest education degree in late adulthood. Since individuals could only enter the study if they have received a public social security retirement pension between 2011 and 2015, they data were not only heavily left truncated but also selective. Future analysis should be directed to the estimation of the share of people with private pensions and no social security pensions at all. Assuming that these individuals are either the very wealthy and very poor people, we have confidence in the results from the about 93% of the Andalusian pension recipients who were observed for this analysis. A further limitation is our data driven confinement to the occurrence of death as the only possible outcome. The consideration of socioeconomic impact factors can only contribute to the understanding of the full picture about mortality differentials in the elderly population. This work attempts to quantify the mortality effects of existing structural inequalities and possible effects for the increase of pension age. Therefore, we analyze the health of receivers of pension benefits today. Even if there pension sizes are reflections of there individual labor market history, the influence on their risk of dying is mostly indirect. Given the remarkable public health interventions and reduction of mortality in modern European countries, future analysis need to be focused more on the quality of life, wellbeing and the onset of morbidity and disability. Even though health is often measured through mortality, these questions need to answered in the future.

Appendix

Figure 1: Life Expectancy at Birth by Sex - Spain

References